

**UTRGV**



**CSP 23-02 UTRGV- Edinburg CISD**

**Collegiate High School**

**Edinburg, TX**

**ARCHITECTS - PLANNERS**

**Gomez Mendez Saenz, Inc.**

**CONSULTANTS**

**Melden & Hunt Inc.  
Chanin Engineering  
Ethos Engineering  
SSP Design**



**GMS ARCHITECTS**

**David Monreal, AIA**

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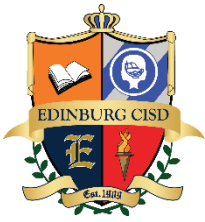
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# EDINBURG CISD

## PURCHASING DEPARTMENT

411 N. 8<sup>th</sup> Ave., Edinburg, TX 78541  
(956) 289-2311, (956) 38-7687

DOMINGA "MINGA" VELA, President  
CARMEN GONZÁLEZ, Vice President  
OSCAR SALINAS, Secretary  
LUIS ALAMIA, Member  
MIGUEL "MIKE" FARIAS, Member  
LETICIA "LETTY" GARCIA, Member  
XAVIER SALINAS, Member

*Dr. Mario H. Salinas, Superintendent*

## Contractor Request for COMPETITIVE SEALED PROPOSALS

NO: 23-02

TITLE: UTRGV - EDINBURG CISD  
COLLEGIATE HIGH SCHOOL

This Proposal includes the following forms:

- Intent to Bid
- Vendor Check List
- Invitation for Competitive Sealed Proposals
- Instructions to Bidders
- Proposal Form
- Original Proposal Form
- Request for Competitive Sealed Proposals
- Agreement (Stipulated Sum)
- Performance Bond and Labor and Material Payment Bond
- Ranking/Selection Criteria
- Form A
- Standard Terms & Conditions
- Construction Agreement
- Felony Conviction Notification
- Conflict of Interest Questionnaire
- Certification of Interested Parties – Form 1295 Example
- Deviation Form
- Wage Rate
- Authorization for W-9/Direct Deposit
- Tax Exempt Organization
- Reference Check Questionnaire
- Special Conditions

### CLOSING TIME/DATE:

Closing Time: 3:00 P.M.  
Closing Date: October 3, 2022

### BUYER:

**ClauDina Longoria, Senior Buyer**  
Phone: 956-289-2311, Ext.2135  
Fax: 956-383-7687  
Email: [d.longoria@ecisd.us](mailto:d.longoria@ecisd.us)

### DELIVER BIDS TO:

Edinburg CISD  
Office of the Purchasing Coordinator  
411 North 8<sup>th</sup> Ave, 2<sup>nd</sup> Floor  
Edinburg, TX 78541

Purchasing Director

9/12/22

Date

DATE WEBBED: September 12, 2022

\*Do not deliver Bids/CSPs/RFPs/RFQs to other ECISD locations. All Bids/CSPs/RFPs/RFQs must be delivered to the delivery address above on or before the Bids/CSPs/RFP/RFQs closing time/date. Purchasing will not be responsible for late submittals as per Board Policy CH (LOCAL).

## Vendor Certification

The undersigned, by his/her signature, represents the he/she is authorized to bind the bidder to fully comply with the terms and conditions on this proposal, including all forms and attachments included herein, for the amount(s) shown on the accompanying proposal form(s), if accepted within sixty (60) calendar days after proposal opening. **Note: Bidder is strongly encouraged to read the entire Solicitation prior to submitting. Failure to provide the above information in its entirety may be grounds for disqualification of response.**

Firm Name: \_\_\_\_\_

Telephone 1-800-\_\_\_\_\_

Address: \_\_\_\_\_

Or: \_\_\_\_\_

City: \_\_\_\_\_

Fax: \_\_\_\_\_

State: \_\_\_\_\_ Zip: \_\_\_\_\_

Web Address: \_\_\_\_\_

Email: \_\_\_\_\_

\_\_\_\_\_  
(Signature of Person Authorized to Sign Proposal)

Date: \_\_\_\_\_

Printed Name: \_\_\_\_\_

Title: \_\_\_\_\_

(Please print or type name above)

I can deliver in \_\_\_\_\_ days. Early Payment Discount \_\_\_\_\_ % if Paid in \_\_\_\_\_ Days, Net 30

## INTENT TO BID

Fax, this **page only**, if solicitation was not faxed or e-mailed directly to your company. All other solicitation documents must be enclosed in a sealed envelope and mailed to the Purchasing Department.

This page is required if solicitation was downloaded without receiving an invitation by the District. Please complete and fax to 956-383-7687 immediately in order to be added to the vendor list and receive addendums or updates regarding this solicitation. It is the intent of the Purchasing Department to ensure that all interested vendors receive addendums or updates, but it will be the vendor's responsibility to check the Purchasing site periodically. If there are addendums posted on the site and your company has not been notified by fax or e-mail, it will be the vendor's responsibility to download from Purchasing site and make sure to include with their packet.

The Edinburg CISD Purchasing solicitations and addendums are available on line at [www.ecisd.us](http://www.ecisd.us).

**NAME:** \_\_\_\_\_

**TITLE:** \_\_\_\_\_

**ORGANIZATION:** \_\_\_\_\_

**STREET ADDRESS:** \_\_\_\_\_

**STREET ADDRESS 2:** \_\_\_\_\_

**CITY:** \_\_\_\_\_

**STATE:** \_\_\_\_\_

**ZIP CODE:** \_\_\_\_\_

**WORK PHONE:** \_\_\_\_\_

**FAX:** \_\_\_\_\_

**E-MAIL:** \_\_\_\_\_

**WEB SITE:** \_\_\_\_\_

## VENDOR CHECK LIST

- |   |     |     |     |    |
|---|-----|-----|-----|----|
| 1. Original Proposal/Addendum Form                                | ___ | Yes | ___ | No |
| 2. Performance Bond   | ___ | Yes | ___ | No |
| 3. Form A   | ___ | Yes | ___ | No |
| 4. Signed Standard Terms & Conditions                             | ___ | Yes | ___ | No |
| 5. Signed Felony Conviction Notification                          | ___ | Yes | ___ | No |
| 6. Signed Conflict of Interest Questionnaire                      | ___ | Yes | ___ | No |
| 7. Signed Certification of Interested Parties (Form 1295)         | ___ | Yes | ___ | No |
| 8. Deviation Form   | ___ | Yes | ___ | No |
| 9. Completed & submitted W9/Authorization for Direct Deposit Form | ___ | Yes | ___ | No |
| 10. Completed & signed Vendor Check List                          | ___ | Yes | ___ | No |

I have read all the specifications and general proposal requirements and do hereby certify that all items submitted meet all specifications, conditions, and instructions of said solicitation, and will follow District policy DBD (Local). The signature below confirms that your company will enter into a binding contract with Edinburg CISD for item(s) awarded to your company.

\_\_\_\_\_  
Company Name

\_\_\_\_\_  
Print/Type Signature Name

\_\_\_\_\_  
Authorized Signature

\_\_\_\_\_  
Date

\_\_\_\_\_  
Official Title

**INVITATION FOR COMPETITIVE SEALED PROPOSALS**

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**GENERAL**

**1.1 PROJECT DESCRIPTION**

- A. CSP 23-02, UTRGV – EDINBURG CISD COLLEGIATE HIGH SCHOOL

**1.2 INSTRUCTIONS TO OFFERORS**

- A. Refer to Proposal Instructions

**1.3 PRE-PROPOSAL CONFERENCE**

- A. The purpose of the Pre-Proposal Conference is to answer any questions that any offers may have and an on-site visit.
- B. Date and Time: **Wednesday, September 21, 2022 @ 11:00 a.m.**
- C. Location: ECISD Facilities Department  
1305 E. Schunior  
Edinburg, TX 78541

**1.4 OPENING OF PROPOSALS**

- A. Place
  - 1. Competitive Sealed Proposals will be received at the office of:  
Edinburg CISD – Purchasing Department  
Attn: Amaro Tijerina, Purchasing Director  
411 North 8th Avenue  
Edinburg, Texas 78541
- B. Date: **Monday, October 3, 2022**
- C. Hour: **3:00 P.M.**

**1.5 REJECTION**

- A. The Owner reserves the right to reject any or all Proposals, and to waive any irregularities or formalities.



## INSTRUCTIONS TO BIDDERS

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### 1.1 SECURITY BOND

- A. Security bond in the amount of five (5%) of the Proposal must accompany each Proposal. Security bond shall be issued by an insurance company authorized to provide bonds on work in the State of Texas and shall be payable to the Owner.

### 1.2 DOCUMENTS

- A. Qualified offerors may obtain electronic files of Drawings and Project Manuals from: Gomez Mendez Saenz, Inc., 1150 Paredes Line Road, Brownsville, TX 78521, 956-546-0110.
- B. Subcontractors may obtain electronic files of Drawings and Project Manuals from: Gomez Mendez Saenz, Inc., 1150 Paredes Line Road, Brownsville, TX 78521, 956-546-0110.
- C. No deposit will be required for a set of Drawings and Project Manuals issued. Partial sets will not be issued.
- D. Complete sets of Construction Documents shall be used in preparing proposals; neither the Owner nor the Project Architect assumes any responsibility for errors or misinterpretations resulting from the use of incomplete sets of Construction Documents.
- E. The Owner or Project Architect in making copies of the Construction Documents available on the above terms, does so only for the purpose of obtaining proposals on the work and does not confer a license or grant for any other use.
- F. Complete sets of Drawings and Project Manuals are on file at the following locations and subcontractors may examine them there:

-Gomez Mendez Saenz, Inc. will provide electronic copies upon request. Contact David Monreal - [dmonreal@gmsarchitects.com](mailto:dmonreal@gmsarchitects.com) or 956-546-0110.

-Edinburg CISD Purchasing Department will upload to the Purchasing site under the Purchasing Vendor CSP/RFP/RFQ Calendar.

-A.G.C. PLAN ROOMS, (McAllen, Harlingen, Brownsville)

-DODGE REPORTS (Online)

### 1.3 EXAMINATION

- A. Offerors shall carefully examine the Construction Documents and the construction site to familiarize themselves with existing local conditions under which the Work is to be performed.
- B. Extra payments will not be authorized for work that could have been foreseen by careful examination of the site. Submission of a proposal shall constitute acceptance, by the offeror, of existing site conditions as a part of the requirements for this work.
- C. Offerors shall carefully examine the Construction Documents to verify that they agree with the Table of Contents in the Project Manual, the Index of Drawings Sheet on the Drawings, and the Cover Page of all Addenda. Offerors shall be responsible for obtaining any pages or sheets which have been inadvertently left out during the printing process.
  - 1. All entities providing proposals on any portion of the work contained in the Construction Documents shall ascertain the completeness of the set of documents.

2. The Construction Documents may be printed by an independent vendor and, although the documents are reviewed for completeness, missing or misplaced sheets in the drawing set and the Specifications have been discovered.
3. Each entity receiving a set of Construction Documents shall check the indexes against the sheets or pages contained in the sets.
4. Should pages or sheets be found to be misplaced or missing, immediately notify the Project Architect who will give direction as to placement or provide the sheets or pages that are missing.
5. Failure to notify the Project Architect means the offeror is providing a proposal based on a complete set of Construction Documents.

#### **1.4 INTERPRETATION OF CONSTRUCTION DOCUMENTS**

- A. Offerors shall promptly notify the Architect/Engineer of any ambiguity, inconsistency, or error which they may discover upon examination of the Construction Documents or of the site and local conditions. Do not dimension the drawings. Any dimensions, questions, should be directed to the Architect/Engineer.
- B. Submit all questions regarding clarification or interpretation of Construction Documents to GMS Architects, David Monreal, AIA – [dmonreal@gmsarchitects.com](mailto:dmonreal@gmsarchitects.com) and Edinburg CISD Facilities Director, Victor Gonzalez – [victor.gonzalez3@ecisd.us](mailto:victor.gonzalez3@ecisd.us).
- C. Submit all questions in writing. In the interest of time, requests may be made by telephone, but they must be confirmed in writing the same day. Replies to questions will be issued to all Offerors in the form of an Addenda. General contractor and subcontractors shall submit questions in writing seventy-two (72) hours prior to opening of proposals.
- D. Make requests for interpretations as early as possible so as to allow adequate time to prepare and issue Addenda.
- E. All Offerors shall check with the Project Architect within seventy-two (72) hours prior to Opening of proposals to secure all Addenda. The Project Architect will not be responsible for oral clarification.

#### **1.5 BASIS OF PROPOSALS**

- A. Proposals shall be on a lump sum basis for each and or combined proposal packages and shall include all costs for these projects as described and indicated by the Construction Documents. Basis for proposals shall be on brands, materials, processes, products, persons or organizations, etc.
- B. Proposals shall include all unit price costs and all Alternate costs as indicated by the Construction Documents and Proposal Form.

#### **1.6 PROPOSALS**

- A. Proposals shall be made on unaltered Proposal Forms provided. No oral, telephone or personal Proposals will be considered. All blank spaces shall be properly filled in by typewriter or manually in ink.
- B. Where so indicated by the makeup of the Proposal Form, sums shall be expressed in both words and figures, and in case of discrepancy between the two, the written amount shall govern.
- C. Any alteration or erasure to information entered in the blank spaces must be initialed by the signer of the proposal.
- D. Original typed sheets shall be submitted, signed in longhand below the typed name of the person authorized to bind the offeror to a Contract.

- E. Wherever the offeror is a corporation, Proposal must be signed with the legal name of the corporation followed by the name of the State of Incorporation and the legal signature of a person authorized to bind the corporation to a contract.
- F. Failure to submit a proposal on the form requested, or the inclusion of conditions, limitations or previsions, distorting the intent of the Construction Documents, will render the Proposal irregular and subject to rejection.

### **1.7 SUBMITTALS**

- A. Submit proposal, Security Bond and other required data in an opaque, sealed envelope. Submit proposal at the time and place shown in the Notice for Competitive Sealed Proposals.
- B. Envelopes shall be addressed to the Owner and identified with the Project Name and the name and address of the offeror.
- C. If the Proposal sent by mail, the sealed envelope shall be enclosed in a separate mailing envelope with the notation "PROPOSAL ENCLOSED" on the face thereof. No envelopes shall be opened until the date and time proposals are to be received.
- D. The District is requesting one (1) original, two (2) copies and one (1) digital copy on a USB drive.

### **1.8 MODIFICATION OR WITHDRAWAL OF PROPOSAL**

- A. A Proposal may not be withdrawn or cancelled by the offeror for a period of sixty (60) days following the time and date designated for the receipt of proposals.
- B. Prior to the time and date designated for receipt of Proposals, Proposals submitted early may be modified or withdrawn only by notice to the party receiving Proposals at the place and prior to the time designated for receipt of Proposals.
- C. Modification of Proposals shall be in writing over the signature of the offeror or be by telegram; if by telegram, written confirmation over the signature of offeror must have been mailed and postmarked on or before the date and time set for receipt of Proposals; it shall be so worded as not to reveal the amount of the original Proposal.
- D. Withdrawn Proposal may be resubmitted up to the time designated for the receipt of Proposals provided that they are then fully in conformance with these Proposal Instructions.
- E. Security bond shall be in an amount sufficient for the Proposal as modified or resubmitted.

### **1.9 CONSIDERATION OF PROPOSAL**

- A. Properly identified Proposals received on time will be considered.
- B. The Owner shall have the right to reject any or all Proposal and in particular to reject a Proposal not accompanied by any required security bond or data required by the Contract Documents or a Proposal in any way incomplete or irregular.
- C. The Owner shall have the right to waive any formality or irregularity in any proposal received.
- D. If the Owner accepts any Alternates, he shall have the right to accept them in any order or combination.
- E. It is the intent of the Owner to award a contract to the offeror submitting the proposal providing the "best value" to the Owner provided the Proposal has been submitted in accordance with the requirements of the Contract Documents, selection criteria and adopted by the Owner.

**1.10 LOCATION AND ACCESS TO PREMISES**

- A. The project site location: Refer to Site Plan on drawings.
  
- B. The offeror shall have access to the premises for the purpose of acquainting himself with the conditions, delivering equipment, and performing the work necessary to fulfill the contract. Offeror shall cooperate with the other contractors who may concurrently be working on the premises, integrating his work with that of others, all to the best interest of the total work and its orderly completion. The offeror must schedule with the Project Architect/ Owner's representative an agreed upon date and time to access premises as may be required. Currently, this site is open and accessible by foot.

**1.11 STATE SALES TAX**

- A. The Owner will furnish the Contractor proof or Certificate of Exemption upon award of contract.

**PROPOSAL FORM**

**PROPOSAL NO. 23-02, UTRGV- EDINBURG CISD COLLEGIATE HIGH SCHOOL**

**EDINBURG, TEXAS**

MR. AMARO TIJERINA  
DIRECTOR OF PURCHASING  
EDINBURG CISD  
411 N. 8<sup>TH</sup> AVENUE  
EDINBURG, TEXAS 78541

The undersigned, as bidder(s), declares that the only person or parties interested in this proposal as principals are those named herein, that this proposal is made without collusion with any other person, firm or corporation; that he has carefully examined the Form of Contract, Notice to Bidders, General Conditions, Special Provisions, Measurement and Basis of Payment, specifications and the plans thereon referred to, and has carefully examined the locations, and conditions and classes of materials of the proposed work; and agrees that he will provide all the necessary labor, machinery, tools, and apparatus, and other items incidental to construction, and will do all the work and furnish all the materials called for in the contract and specifications in the manner prescribed therein and according to the requirements of the Architect/Engineer as therein set forth.

It is understood that the following quantities of work to be done at unit prices are approximate only and are intended principally to serve as guide in evaluating proposals.

It is further agreed that the quantities of work to be done at unit price and materials to be furnished, may be increased or diminished as may be considered necessary, in the opinion of the Engineer, to complete the work fully as planned and contemplated, and that all quantities of the work, whether increased or decreased, are to be performed at the unit prices set forth below except as provided for in the specifications.

It is further agreed that lump sum prices may be increased to cover additional work ordered by the Engineer, but not shown on the plans or required by the specifications, in accordance with the provisions of the General Conditions. Similarly, they may be decreased to cover deletion of work so ordered.

The 5% proposal security accompanying this proposal shall be returned to the bidder, unless in case of the acceptance of the proposal the bidder shall fail to execute a contract and file a performance bond and payment bond within the ten (10) days after its acceptance, in which case the proposal security shall become the property of the OWNER, and shall be considered as payment for damages due to delay and other inconveniences suffered by the Owner on account of such failure of the bidder, it is understood that the Owner reserves the right to reject any or all proposals.

**ORIGINAL PROPOSAL FORM MUST BE SUBMITTED ALONG WITH THE PROPOSAL AND CONTRACT DOCUMENTS BOOKLET**

BIDDERS BOND in the amount of \$ \_\_\_\_\_, (5%) of the greatest amount proposal in compliance with the INSTRUCTION TO BIDDERS.

The above Cashier’s Check or Bidder’s Bond is to become the property of the OWNER, in the event the construction contract (when offered by the Owner) and bonds are not executed within the time set forth.

Item No.	Item Description	Total
1.		
2.		
3.		
4.		

GRAND TOTAL PROPOSAL IMPROVEMENTS: (Items 1-4):        \$ \_\_\_\_\_

The undersigned agrees, unless hereinafter stated otherwise to furnish all materials as shown and specified in the Plans and Specifications. Please attach supplemental spreadsheet detailing equipment, materials, demolition, labor, etc.

Bidder hereby agrees to commence work under this contract within 10 days after “NOTICE TO PROCEED” is issued, and to complete all the work in the Contract within \_\_\_\_\_ **Calendar Days**.

The undersigned bidder acknowledges the receipt of the following addenda:

ADDENDUM NO.	DATE	BY
ADDENDUM NO. 1		
ADDENDUM NO. 2		
ADDENDUM NO. 3		
ADDENDUM NO. 4		

Date: \_\_\_\_\_

By: \_\_\_\_\_  
(Signature)

\_\_\_\_\_  
(Type or Print Name)

\_\_\_\_\_  
(Title)

\_\_\_\_\_  
(Company)

\_\_\_\_\_  
(Address)

\_\_\_\_\_  
(City, State, Zip)

\_\_\_\_\_  
(Phone Number)

\_\_\_\_\_  
(Fax Number)

(Seal – if Bidder is a Corporation)

**REQUEST FOR COMPETITIVE SEALED PROPOSALS**

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PROJECT: **23-02, UTRGV-EDINBURG CISD COLLEGIATE HIGH SCHOOL**

OWNER: Edinburg Consolidated Independent School District  
411 North 8<sup>th</sup> Avenue  
Edinburg, TX 78541

ARCHITECT/ENGINEER: GMS Architects

CSP DEADLINE: Monday, October 3, 2022 @ 3:00 P.M.

INVITATION: Your firm is invited to submit Competitive Sealed Proposals to the Owner, at the Owner's address indicated above, for the work described above, on or before the RFCSP deadline indicated above.

PRE-PROPOSAL CONFERENCE: A Pre-Proposal Conference will be conducted at the ECISD Facilities Department, 1305 E. Schunior, Edinburg, TX. All contractors proposing to submit competitive sealed proposals on this project are strongly encouraged to attend.

INSPECTION OF SITE: The site is also accessible for inspection after the pre-proposal meeting. Proposers are encouraged to visit the site and assess existing conditions.

PROPOSAL DOCUMENTS: Copies of the Proposal Documents, including Drawings and Project Manual (Proposal Requirements & Contract Forms, General Conditions of the Contract for Construction, Specifications) may be obtained, from the District Architect/Engineer's office. Copies of the proposal Documents are on file at the Architect/Engineer's office, Builder's Exchange of Texas, and at the local Associated General Contractors (AGC) and Dodge Plan Rooms.

PROPOSAL SECURITY: Proposers will be required to provide Proposal Security in the form of a Bid Bond in the amount of 5 percent of the largest possible total proposal, including consideration of alternates, with each proposal. A Bid Bond shall be issued by a Surety acceptable to the Owner and meeting the requirements of General Conditions of the Contract for Construction. Bid Bonds shall be prepared on forms meeting all the requirements of applicable States of Texas statutes. Bid Bonds shall be issued on forms acceptable to the Owner and shall include, as a minimum standard, the information, requirements and standard illustrated by AIA Document A310, latest revised edition available. Failure to provide the Bid Bond with the proposal will constitute a non-responsive proposal and the proposal will not be considered.

PERFORMANCE AND LABOR AND MATERIAL PAYMENT BONDS: The successful offeror will be required to provide 100% Performance and Labor and Materials Payment Bonds in strict conformance with all the requirements of the Contract Documents. Failure to do so will result in cancellation of the contract award and forfeiture of the Bid Bond security as liquidated damages.

Proposal withdrawal: Proposals will be required to be submitted under a condition of irrevocability for a period of 60 days after submission. No proposal may be withdrawn for a period of 60 days.

OWNER'S RIGHT OF REJECTION: The owner reserves the right to accept or reject any or all offers (competitive sealed proposals).



**AGREEMENT (STIPULATED SUM)**

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GENERAL

1.1 AGREEMENT FORM

- A. The “Standard Form of Agreement Between Owner and Contractor where the Basis of Payment is a Stipulated Sum, AIA Document A101, 2017 Electronic Format Edition, will be the form used as a Contract for this Project.
- B. General Condition AIA – A201 will be used in this project.
- C. Modification may be made to the above Agreement & General Conditions A201 form or an Owner provided agreement and general conditions may be utilized. Either of which will be provided to contractor for review upon award of project, for the final execution of the contract.

**PERFORMANCE BOND AND LABOR AND MATERIAL PAYMENT BOND**

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GENERAL

RELATED DOCUMENTS: PERFORMANCE BOND AND LABOR AND MATERIAL PAYMENT BOND:

The Contractor shall, prior to the execution of the Contract, furnish bonds covering the faithful performance of the Contract and the payment of all obligations arising thereunder in the amount of 100% of the Contract Price covering 100% performance and 100% payment, and with such sureties secured through the contractor's usual sources as may be agreeable to the parties.

The Contractor shall deliver the required bonds to the Owner not later than the date of execution of the Contract, or if the work is commenced prior thereto in response to a letter of intent, the Contractor shall, prior to commencement of the Work, submit evidence satisfactory to the Owner that such bonds will be furnished.

The Contractor shall require the Attorney-In-Fact who executes the required bonds on behalf of the surety to affix hereto a certificate and current copy of his Power of Attorney.

Any Payment and Performance Bond furnished pursuant to the provisions of Art. 5160, Vernon's Texas Civil Statutes, connected with this project, shall be furnished by a corporate surety or corporate or corporate sureties in accordance with Article 7.19-1, Vernon's Texas Insurance Code, that has stated capital and surplus (as reported by it to the Texas Insurance Commission in its most recent report) that is in excess of ten times the stated amount of the Payment Bond or the Performance Bond. Provided however, that if any Payment Bond or any Performance Bond is in an amount in excess to ten percent (10%) of the surety company's capital and surplus (as reported to the Texas Insurance Commission in its most recent report), as a condition to accepting the bond, the Owner must receive written certification and information, satisfactory in form and substance to the Owner, that the surety company has reinsured the portion of the risk that exceeds ten percent (10%) of the surety company's capital and surplus, with one or more reinsurers who are duly authorized, accredited or trustee to do business in the State of Texas. For the purpose of this requirement, any amount reinsured by any reinsurer may not exceed ten percent (10%) of the reinsurer's capital and surplus (as reported to the Texas Insurance Commission by the reinsurer in its most recent report). In the event there is one or more reinsurer, the surety company must provide all necessary information and certification related to the current financial condition of the surety company and any and all reinsurers required by the Owner, together with copies of all reinsurance contracts with the surety company, before any such Payment Bond and Performance Bond is eligible to be considered acceptable by the Owner.

**ALL CONTRACTORS SHALL SUBMIT THE NAME, ADDRESS AND TELEPHONE NUMBER OF THE CORPORATED SURETIES PROVIDING THE PAYMENT BOND AND PERFORMANCE BOND AND THE LOCAL AGENT.**

**RANKING/SELECTION CRITERIA**

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The selection of offeror will be based on the following: Ranking/Selection Criteria. The District retains the right to apply the selection criteria as allowed in **Educational Code 44.031 section (B)**.

**The following support information must be submitted in sealed envelope with proposal and labeled (tabs) as followed:**

**TAB 1: Proposal Price: 30 Points Max**

- 1.1 Base Proposal (Proposal Form).

**TAB 2: Qualifications/Experience: 25 Points Max**

- 2.1 Number of years in business.
- 2.2 List last five (5) similar projects, client, and construction cost.
- 2.3 Contractor/Vendor qualifications

**TAB 3: Past Performance: 15 Points Max**

- 3.1 Describe history of change order of projects submitted.
- 3.2 Were the projects completed within budget and on schedule.
- 3.3 References

**TAB 4: Contractor Management/Personnel: 15 Points Max**

- 4.1 Provide resume of proposed project manager, project superintendent.
- 4.2 Provide proposed project team structure.
- 4.3 Requests for Proposal completeness.

**TAB 5: Sub-Contractors List: 15 Points Max**

- 5.1 List proposed Subcontractors.

**TAB 6: Insurance Policies**

- 6.1 Provide a copy of the following insurance policies: Professional Liability Insurance, General Liability, Workers Compensation and Automobile Insurance Policies. (All Insurance coverage must be carried and kept current through the entire construction effort.)

**TAB 7: Required Forms**

- FORM A** – Fully completed and signed
- STANDARD TERMS & CONDITIONS** – Fully completed and signed
- FELON CONVICTION FORM** – Fully completed and signed
- CONFLICT OF INTEREST QUESTIONNAIRE** – Fully completed and signed
- CERTIFICATION OF INTERESTED PARTIES (FORM 1295)** – Follow instructions indicated on page 28. Form to be filled out online, printed and submitted with your proposal.
- DEVIATION FORM** – Fully completed and signed
- ECISD AUTHORIZATION FOR W-9/DIRECT DEPOSIT** – Fully completed and signed
- REFERENCE CHECK QUESTIONNAIRE** – Submit for 3 current clients

# FORM A

## Edinburg Consolidated Independent School District

### 1. GENERAL INFORMATION

DATE: \_\_\_\_\_

FIRM NAME: \_\_\_\_\_

ADDRESS: \_\_\_\_\_

CITY: \_\_\_\_\_

### 2. CONTACT PERSON:

(Limited to two person per firm/application)

NAME: \_\_\_\_\_

TITLE: \_\_\_\_\_

TELEPHONE: \_\_\_\_\_

INTERNET ADDRESS: \_\_\_\_\_

NAME: \_\_\_\_\_

TITLE: \_\_\_\_\_

TELEPHONE: \_\_\_\_\_

INTERNET ADDRESS: \_\_\_\_\_

### 3. TYPE OF ORGANIZATION:

a. \_\_\_\_\_ Sole proprietorship (individual)

b. \_\_\_\_\_ Partnership

c. \_\_\_\_\_ Professional Corporation

d. \_\_\_\_\_ Corporation

e. \_\_\_\_\_ Joint venture

f. \_\_\_\_\_ Other \_\_\_\_\_

**4. FIRM BACKGROUND AND STAFF**

Year present firm established \_\_\_\_\_

Name of parent company, if any \_\_\_\_\_

Address \_\_\_\_\_

Year parent firm established \_\_\_\_\_

Former company name(s), if any, and year(s) established or other name through which business is conducted

Name \_\_\_\_\_ Year \_\_\_\_\_

\_\_\_\_\_ Year \_\_\_\_\_

\_\_\_\_\_ Year \_\_\_\_\_

Number of employees in firm \_\_\_\_\_

Total employees in firm (all office locations) \_\_\_\_\_

**5. EXPERIENCE PROFILE**

PROFILE OF FIRM'S PROJECT EXPERIENCE FOR LAST FIVE YEARS IN SIMILAR CONSTRUCTION EFFORTS

List the total number of projects for the last five years.

	<b>Project Type</b>	<b>New Construction</b>	<b>Renovation/Addition</b>
A.	High Schools		
B.	Middle Schools		
C.	Elementary Schools		
D.	Athletic Facilities/Stadium Parking Lots		

**6. CURRENT CLIENTS AND PROJECTS**

Please list three of your current clients whose projects reflect the scope of your present workload.

A. Project \_\_\_\_\_

Client \_\_\_\_\_

Contact person/title \_\_\_\_\_

Phone number \_\_\_\_\_

Services provided \_\_\_\_\_

B. Project \_\_\_\_\_  
Client \_\_\_\_\_  
Contact person/title \_\_\_\_\_  
Phone number \_\_\_\_\_  
Services provided \_\_\_\_\_

C. Project \_\_\_\_\_  
Client \_\_\_\_\_  
Contact person/title \_\_\_\_\_  
Phone number \_\_\_\_\_  
Services provided \_\_\_\_\_

**7. APPLICATION SIGNATURE**

The information provided on this application I believe to be true and representative of the firm for which it is submitted

\_\_\_\_\_  
Signature of firm's contact person

\_\_\_\_\_  
Date

**STANDARD TERMS & CONDITIONS**

(REVISED SEPTEMBER 2022)

**PLEASE READ THE FOLLOWING CAREFULLY, AND RETURN THE SIGNATURE PAGE WITH YOUR BID OR PROPOSAL.**

The following terms and conditions are requirements that are binding upon the vendor awarded the proposal and they communicate the Edinburg School District's expectations in regard to the bidder's performance in connection with the district's purchase.

1. **Seller of Package Goods:** Seller will package goods in accordance with good commercial practice. Each shipping container shall be clearly and permanently packed as follows:
  - a. Seller's name and address;
  - b. Consignee's name, address and purchase order or purchase release number and the supply agreement number if applicable;
  - c. Container number and total number of containers, e.g. box 1 of 4 boxes; and the number of the container bearing the packing slip.
  - d. Seller shall bear cost of packaging unless otherwise provided.
  - e. Goods shall be suitably packed to secure lowest transportation costs and to conform to requirements of common carriers and any applicable specifications.
  - f. Buyer's count or weight shall be final and conclusive on shipments not accompanied by packing lists.
2. **Shipment under Reservation Prohibited:** Seller is not authorized to ship the goods under reservation and no tender of a bill of lading will operate as a tender of goods.
3. **Title and Risk of Loss:** The title and risk of loss of the goods shall not pass to Buyer until Buyer actually receives and takes possession of the goods at the point or points of delivery.
4. **Delivery Terms and Transportation Charges:** F.O.B. Destination Freight Prepaid unless terms are specified otherwise in proposal:
5. **No Placement of Defective Tender:** Every tender or delivery of goods must fully comply with all provisions of this contract as to time of delivery, quality and the like. If a tender is made which does not fully conform, this shall constitute a breach and Seller shall not have the right to substitute a conforming tender provided, where the time for performance has not yet expired, the Seller may reasonably notify Buyer of his intention to cure and may then make a conforming tender within the contract time but not afterward.
6. **Place of Delivery:** The place of delivery shall be that set forth on the purchase order. Any change thereto shall be effected by modification as provided for in Clause 20, "Modifications," hereof. The terms of this agreement are "no arrival, no sale."
7. **Invoices:** Seller shall submit separate invoices, in duplicate, on each purchase order after each delivery. Invoices shall indicate the purchase order number, shall be itemized and transportation charges, if any, shall be listed separately. A copy of the bill of lading, and the freight weight bill when applicable, should be attached to the invoice. Mail to:

**Edinburg Consolidated Independent School District  
Attn.: Accounts Payable Department  
Drawer 990  
Edinburg, Texas 78540-0990**
8. **Payments:** The payment shall not be due until the above instruments are submitted after delivery. Suppliers should keep the Accounts Payable Department advised of any changes in your remittance addresses.
9. **Taxes:** Do not include Federal Excise, State or City Sales Tax. School District shall furnish tax exemption certificate, if required.
10. **Gratuities:** The Buyer may, by written notice to the Seller, cancel this contract without liability to Seller if it is determined by Buyer that gratuities, in the form of entertainment, gifts, or otherwise, were offered or given by the Seller, or any agent, or representative of the Seller, to any officer or employee of the School District with a view toward securing a contract or securing favorable treatment with respect to the awarding or amending or the making of any determinations with respect to the performing of such a contract. In the event this contract is canceled by Buyer pursuant to this provision, Buyer shall be entitled, in addition to any other rights and remedies, to recover or withhold the amount of the cost incurred by Seller in providing such gratuities.
11. **Special Tools and Test Equipment:** If the price stated on the face hereof includes the cost of any special tooling or special test equipment fabricated or required by Seller for the purpose of filling this order, such special tooling equipment and any process sheets related thereto shall become the property of the Buyer and to the extent feasible shall be identified by the Seller as such.
12. **Warranty Price:** The price to be paid by the Buyer shall be that contained in Seller's proposal which Seller warrants to be no higher than Seller's current prices on orders by others for products of the kind and specification covered by this agreement for similar quantities under similar or like conditions and methods of purchase. In the event Seller breaches this warranty, the prices of the items shall be reduced to the Seller's current prices on orders by others, or in the alternative, Buyer may cancel this contract without liability to Seller for breach or Seller's actual expense. The Seller warrants that no person or selling agency has been employed or retained to solicit or secure this contract upon an agreement or understanding for commission, percentage, brokerage, or contingent fee excepting bona fide employees of bona fide established commercial or selling agencies maintained by the Seller for the purpose of securing business. For breach or violation of this warranty, the Buyer shall have the right in addition to any other right or rights to cancel this contract without liability and to deduct from the contract price, or otherwise recover the full amount of such commission, percentage, brokerage or contingent fee.

13. **Warranty Products:** Seller warrants that the goods furnished will conform to the specifications, drawings and descriptions listed in the proposal invitation and to the sample(s) furnished by Seller, if any. In the event of a conflict between the specifications, drawings and descriptions, the specifications shall govern. Seller shall not limit or exclude any implied warranties and any attempt to do so shall render this contract voidable at the option of the Buyer.
14. **Safety Warranty:** Seller warrants that the product sold to Buyer shall conform to the standards promulgated by the U.S. Department of Labor under the Occupational Safety and Health Act (OSHA) of 1970. In the event the product does not conform to OSHA standards, Buyer may return the product for correction or replacement at the Seller's expense. In the event Seller fails to make the appropriate correction within 15 working days, correction made by Buyer will be at Seller's expense.
15. **No Warranty by Buyer against Infringements:** As part of this contract for sale, Seller agrees to ascertain whether goods manufactured in accordance with the specifications attached to this agreement will give rise to the rightful claim of any third person by way of infringement or the like. Buyer makes no warranty that the production of goods according to the specification will not give rise to such a claim, and in no event shall Buyer be liable to Seller for indemnification in the event that Seller is sued on the grounds of infringement or the like. If Seller is of the opinion that an infringement or the like will result, the Seller will notify Buyer to this effect in writing within two weeks after the signing of this agreement. If Buyer does not receive notice and is subsequently held liable for the infringement or the like, Seller will hold Buyer harmless. If Seller in good faith ascertains that production of the goods in accordance with the specifications will result in infringement or the like, this contract shall be null and void except that Buyer will pay Seller the reasonable cost of his search as to infringements.
16. **Right of Inspection:** Buyer shall have the right to inspect the goods at delivery before accepting them.
17. **Cancellation:** Buyer shall have the right to cancel for default all or any part of the undelivered portion of this order if Seller breaches any of the terms hereof including warranties of Seller or if the Seller becomes insolvent or commits acts of bankruptcy. Such right of cancellation is in addition to and not in lieu of any other remedies, which Buyer may have in law or equity.
18. **Termination:** The performance of work under this order may be terminated in whole or in part by the Buyer in accordance with this provision. Termination of work there under shall be effected by the delivery to the Seller of a "Notice of Termination" specifying the extent to which performance of work under the order is terminated and the date upon which such termination becomes effective. Such right of termination is in addition to and not in lieu of rights of Buyer set forth in Clause 15, herein.
19. **Force Majeure:** If by reason of Force Majeure, either party hereto shall be rendered unable wholly or in part to carry out its obligations under this Agreement then such party shall give notice and full particulars of Force Majeure in writing to the other party within a reasonable time after occurrence of the event or cause relied upon, and the obligation of the party giving such notice, so far as it is affected by such Force Majeure, shall be suspended during the continuance of the inability then claimed, except as hereinafter provided, but for no longer period, and such party shall endeavor to remove or overcome such inability with all reasonable dispatch. The term Force Majeure as employed herein, shall mean acts of God, strikes, lockouts, or other industrial disturbances, act of public enemy, orders of any kind of government of the United States or the State of Texas or any civil or military authority; insurrections; riots; epidemics; landslides; land sinkage; lighting; earthquake; fires; hurricanes; storms; floods; washouts; droughts; arrests; restraint of government and people; civil disturbances; explosions, breakage or accidents to machinery, pipelines or canals, or other causes not reasonably within the control of the party claiming such inability. It is understood and agreed that the settlement of strikes and lockouts shall be entirely within the discretion of the party having the difficulty, and that the above requirement that any Force Majeure shall be remedied with all reasonable dispatch shall not require the settlement of strikes and lockouts by acceding to the demands of the opposing party or parties when such settlement is unfavorable in the judgment of the party having the difficulty.
20. **Assignment Delegation:** No right or interest in this contract shall be assigned or delegation of any obligation made by Seller without the written permission of the Buyer. Any attempted assignment or delegation by Seller shall be wholly void and totally ineffective for all purposes unless made in conformity with this paragraph.
21. **Waiver:** No claim or right arising out of a breach of this contract can be discharged in whole or in part by a waiver or renunciation of the claim or right unless the waiver or renunciation is supported by consideration and is in writing signed by the aggrieved.
22. **Modifications:** This contract can be modified or rescinded only by a writing signed by both parties to the contract or their duly authorized agents.
23. **Interpretation Parole Evidence:** This writing is intended by the parties as a final expression of their agreement and is intended also as a complete and exclusive statement of the terms of their agreement. No course of prior dealings between the parties and no usage of the trade shall be relevant to supplement or explain any term used in this agreement. Acceptance or acquiescence in a course of performance rendered under this agreement shall not be relevant to determine the meaning of this agreement even though the accepting or acquiescing party has knowledge of the performance and opportunity for objection. Whenever a term defined by the Uniform Commercial Code is used in this agreement, the definition contained in the Code is to control.
24. **Applicable Law:** This agreement shall be governed by the Uniform Commercial Code. Wherever the term "Uniform Commercial Code" is used, it shall be construed as meaning the Uniform Commercial Code as adopted in the State of Texas effective and in force on the date of this agreement.
25. **Advertising:** Seller shall not advertise or publish, without Buyer's prior consent, the fact that Buyer has entered into this contract, except to the extent necessary to comply with proper requests for information from an authorized representative of the federal, state or local government.



26. **Right to Assurance:** Whenever one party to this contract in good faith has reason to question the other party's intent to perform he/she may demand that the other party give written assurance of his/hers business intent to perform. In the event that a demand is made and no assurance is given within five (5) days, the demanding party may treat this failure as an anticipatory repudiation of the contract.
27. **Venue:** Both parties agree that venue for any litigation arising from this contract shall lie in Hidalgo County, Texas.
28. **Prohibition Against Personal Interest in Contracts:** Any board member which has any substantial interest, either direct or indirect, in any business entity seeking to contract with the district, shall, before any vote or decision on any matter involving the business entity, file an affidavit stating the nature and extent of interest and shall abstain from any participation in the matter. This is not required if the vote or decision will not have any special effect on the entity other than its effect on the public. However, if a majority of the governing body are also required to file, and do file similar affidavits, then the member is not required to abstain from further participation. Vernon's Texas Codes Annotated, Local Government Code. Chapter 171.
29. **Penalties for Non-Performance:** If, at any time, the contractor fails to fulfill or abide by the terms, conditions, or specifications of the contract, the Edinburg Consolidated Independent School District reserves the right to:
- a. Purchase on the open market and charge the contractor the difference between contract and actual purchase price, or
  - b. Deduct such charges from existing invoice totals due at the time, or
  - c. Cancel the contract within thirty (30) days written notification of intent
30. **Right to Investigate:**
- a. Capacity
  - b. Financial Information
  - c. Business Records (Federally Funded Contracts)
31. **Bidder Qualification:** Bidders not on the District's proposal list, may be required to prove their qualifications concerning the following criteria:
- a. Financial capabilities
  - b. Bonding status
  - c. Contractual history (references)
  - d. Ability to fulfill and abide by the terms and specifications
  - e. Quality and stability of product and sources
32. **District Proposal Forms:** Proposal not submitted on District's proposal forms will be rejected. Faxed or e-mail submittals will not be accepted. These forms of submittals will be destroyed or deleted and the vendor will be notified immediately.
33. **Addendums:** It will be the Vendors responsibility to check the Purchasing website periodically for any and all addendums. It is also at the Districts discretion to fax or email addendums as deemed necessary.
34. **Delinquent School Taxes:** The Edinburg CISD shall not do business with any individual or company that is delinquent in the payment of their school taxes. In accordance with law, the District shall not enter into a contract or other transaction with a person indebted to the District, nor shall the District award a contract to or enter into a transaction with an apparent low Contractor or successful proposer indebted to the District.
- \_\_\_\_\_ I am not a delinquent taxpayer to the Edinburg CISD.
- \_\_\_\_\_ I am a delinquent taxpayer to Edinburg ISD (your proposal may be disqualified if your debt is not cleared prior to award.)
35. **"OR EQUAL" Products:** Whenever an article or material is defined by describing a proprietary product or by using the name of a manufacturer, the term "or equal", if not inserted, shall be implied. The specified article or material shall be understood as indicating the type, function, minimum standard of design, efficiency, and quality desired and shall not be construed as to exclude other manufactured products of comparable quality, design and efficiency. The District reserves the right to waive any or all technicalities, and shall be the sole judge in determining equality, technicalities and formalities. Bidders offering substitute items must indicate manufacturer's name and model number.
36. **Deviation(s) –** Any deviation(s) to the specification(s) shall be listed on a separate sheet(s) of paper and attached to the proposal response form identifying the section number, component(s) with deviation(s) and a clearly defined explanation for the deviation(s). It is the bidder's responsibility to submit a proposal that meets all mandatory specifications stated within. Because of the variations in manufacturer's construction, the bidder must compare their product proposal with the required listed minimum specifications and identify any deviations. Failure to properly identify deviations may render the bidder's proposal non-responsive and not capable of consideration for award. Bidders should note that a descriptive brochure of the model proposal may not be sufficient or acceptable as proper identification of deviations from the written specifications.
37. **Right to award:** The District reserves the right to award the proposal in its entirety, partially, or reject it. The District reserves the right to buy any and/or all supplies from any vendor.
38. **Right to increase or decrease quantities:** The District reserves the right to increase or decrease the number of articles called for in any item of the specifications or to eliminate items entirely. Bidder's proposal will be adjusted in accordance with the unit price quoted therein.
39. **Renewal Option for Term Contracts:** There will be a renewal option to extend this term contracts, if applicable, for an additional one (1) year period if all parties agree to the renewal in writing and all proposal prices, discounts, terms and conditions remain the same. In no instance shall this extension be considered automatic.

40. **Warranty & Guarantees:** Except as otherwise specified, the bidder warrants and guarantees all work against defects in materials, equipment or workmanship for one (1) year from the date of final acceptance. Upon receipt of written notice from the District of the discovery of any defects, the bidder shall remedy the defects and replace any property damaged there from occurring within the warranty and guarantee period.

41. **Evaluation Factors:** The proposal award shall be based on the following evaluation factors:  
a. the purchase price;  
b. the reputation of the vendor and of the vendor's goods or services;  
c. the quality of the vendor's goods or services;  
d. the extent to which the goods or services meet the district's needs;  
e. the vendor's past relationship with the district;  
f. the total long-term cost to the district to acquire the vendor's goods or services

42. **Non-Collusive Bidding Certification:** By submission of this proposal or proposal, the bidder certifies that:  
a. This bid or proposal has been independently arrived at without collusion with any other bidder or with any competitor;  
b. This bid or proposal has not been knowingly disclosed and will not be knowingly disclosed, prior to the opening of proposals, or proposals for this project, to any other bidder, competitor or potential competitor;  
c. No attempt has been or will be made to induce any other person, partnership or corporation to submit or not to submit a proposal or proposal;  
d. The person signing this proposal or proposal certifies that he has fully informed himself regarding the accuracy of the statements contained in this certification, and under the penalties being applicable to the bidder as well as to the person signing in its behalf.

43. **EEOC Non-Discrimination Statement:** It is the policy of Edinburg CISD not to discriminate on the basis of sex, age, handicap, religion, race, color, or national origin in its educational programs.

44. **Conflict of Interest Disclosure:** Pursuant to Chapter 176, Texas Local Government Code, vendors doing or seeking to do business with Edinburg CISD must submit a Conflict of Interest disclosure form if they have a business relationship as defined by Section 176.001 (1-a) with a local government entity and meet the disclosure requirements of Section 176.006(a). A person commits an offense (Class C misdemeanor) if they knowingly violate Section 176.006, Local Government Code.

45. **Certificate of Interested Parties:** All Bids, CSPs, RFPs, RFQs prior to award or award of Contract by the School Board will require that the Texas Ethics Commission (TEC) Form 1295 Electronic (on line) Vendor filing procedure be completed by Vendor. All Vendors being recommended to the Board of Trustees for award or renewal of award on Agenda must register and obtain a TEC Certification for the specific award. This certification Form 1295 must be electronically submitted, printed and notarized. Notarized form must be submitted as a required form for this solicitation. There is no charge for this TEC online process.

Texas Ethics Commission (TEC) Form 1295 must be completed (by firm – on line “New Form 1295 Certificate of Interested Parties Electronic Filing Application” site at: [https://www.ethics.state.tx.us/whatsnew/elf\\_info\\_form1295.htm](https://www.ethics.state.tx.us/whatsnew/elf_info_form1295.htm)). The TEC website includes Question/Answers and Video instructions.

46. **Declaration of Business Location – Texas Education Code 44.031 (b)(8).** By signing below, Contractor certified the Contractor's or the Contractor's ultimate parent company or majority owner:

\_\_\_\_ A. Has its principal place of business in the State of Texas; OR \_\_\_\_ B. Employs at least 500 persons in the State of Texas  
\_\_\_\_ C. Principal Place of business is not in the State of Texas: \_\_\_\_\_ (City, State)

47. **Owner(s) Name of Business:** By signing below, Contractor certified the owner(s) name of the business submitting proposal is/are: (Please print name(s) below. If not applicable, please indicate N/A.)

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
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\_\_\_\_\_

48. **Texas Historically Underutilized Business (HUB) - Texas Education Code 44.031(b)(6) or Small and Minority Firms, Women's Business Enterprises and Labor Surplus Area Firm:** Contractor certified the Bidder's company is HUB certified with the State of Texas.

\_\_\_\_ I am an Active certified HUB vendor. HUB expiration date: \_\_\_\_\_  
\_\_\_\_ Small and Minority Firms, Women's Business Enterprises and Labor Surplus Area Firms  
\_\_\_\_ I am neither.

49. **Contract Provisions for contracts under Federal Awards:** By submission of this proposal, Contractor agrees to comply with the following provisions.

- 49.1 Contracts for more than the simplified acquisition threshold currently set at \$150,000, which is the inflation adjusted amount determined by the Civilian Agency Acquisition Council and the Defense Acquisition Regulation 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 ECISD expends federal funds, ECISD 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.

Does Vendor agree? YES \_\_\_\_\_ Initials of Authorized Representative of Vendor

- 49.2 All contracts in excess of \$10,000 must address termination for cause and for convenience including the manner by which it will be effected and the basis for settlement.

Pursuant to Federal Rule (B) above, when ECISD expends federal funds, ECISD 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. ECISD also reserves the right to terminate the contract immediately, with written notice to vendor, for convenience, if ECISD believes, in its sole discretion that it is in the best interest of ECISD to do so. Vendor will be compensated for work performed and accepted and goods accepted by ECISD as of the termination date if the contract is terminated for convenience of ECISD. Any award under this procurement process is not exclusive and ECISD reserves the right to purchase goods and services from other vendors when it is in ECISD's best interest.

Does Vendor agree? YES \_\_\_\_\_ Initials of Authorized Representative of Vendor

- 49.3 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 ECISD expends federal funds on any federally assisted construction contract, the equal opportunity clause is incorporated by reference herein.

Does Vendor agree to abide by the above? YES \_\_\_\_\_ Initials of Authorized Representative of Vendor

- 49.4 Davis-Bacon Act, as amended (40 U.S.C. 3141-3148). When required by Federal program legislation, all prime construction contracts in excess of \$12,000 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 Finance 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 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 (20 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 sub-recipient must be prohibited from including, 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 entity must repair all suspected or reported violation to the Federal awarding agency.

Pursuant to Federal Rule (D) above, when ECISD expends federal funds during the term of an award for all contracts and subgrants for construction or repair, Vendor will be in compliance with all applicable Davis-Bacon Act provisions.

Does Vendor agree? YES \_\_\_\_\_ Initials of Authorized Representative of Vendor

- 49.5 Contract Work Hours and Safety Standards Act (40 U.S.C. 3701-3708). Where applicable, all contracts awarded 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 ECISD 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 ECISD resulting from this procurement process.

Does Vendor agree? YES \_\_\_\_\_ Initials of Authorized Representative of Vendor

- 49.6 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 sub recipient 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 sub recipient 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 ECISD, Vendor certifies that during the term of an award for all contracts by ECISD resulting from this procurement process, Vendor agrees to comply with all applicable requirements as referenced in Federal Rule (F)above.

Does Vendor agree? YES \_\_\_\_\_ Initials of Authorized Representative of Vendor

- 49.7 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 sub grants of amounts in excess of \$150,000 must contain a provision that requires the 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 ECISD, Vendor certifies that during the term of an award for all contracts by ECISD resulting from this procurement process, Vendor agrees to comply with all applicable requirements as referenced in Federal Rule (G)above.

Does Vendor agree? YES \_\_\_\_\_ Initials of Authorized Representative of Vendor

- 49.8 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 ECISD, Vendor certifies that during the term of an award for all contracts by ECISD 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.

Does Vendor agree? YES \_\_\_\_\_ Initials of Authorized Representative of Vendor

- 49.9 Byrd Anti-Lobbying Amendment (31 U.S.C. 1352)—Contractors that apply or proposal 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 award.

Pursuant to Federal Rule (I) above, when federal funds are expended by ECISD, Vendor certifies that during the term and after the awarded term of an award for all contracts by ECISD 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.

Does Vendor agree? YES \_\_\_\_\_ Initials of Authorized Representative of Vendor

- 49.10 An entity that is a state agency or agency of a political subdivision of a state 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 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; procuring solid waste management services in a manner that maximizes energy and resource recovery; and establishing an affirmative procurement program for procurement of recovered materials identified in the EPA guidelines.

Does Vendor agree to this guideline? YES \_\_\_\_\_ Initials of Authorized Representative of Vendor

49.11 §200.216 Prohibition on certain telecommunications and video surveillance services or equipment.

(a) Recipients and subrecipients are prohibited from obligating or expending loan or grant funds to:

- (1) Procure or obtain;
- (2) Extend or renew a contract to procure or obtain; or
- (3) Enter into a contract (or extend or renew a contract) to procure or obtain equipment, services, or systems that uses covered telecommunications equipment or services as a substantial or essential component of any system, or as critical technology as part of any system. As described in public Law 115-232, section 889, covered telecommunications equipment is telecommunications equipment produced by Huawei Technologies Company or ZTE Corporation (or any subsidiary or affiliate of such entities).
  - (i) For the purpose of public safety, security of government facilities, physical security surveillance of critical infrastructure, and other national security purposes, 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).
  - (ii) Telecommunications or video surveillance services provided by such entities or using such equipment.
  - (iii) Telecommunications or video surveillance equipment or services produced or provided by an entity that the Secretary of Defense, in consultation with the Director of the National Intelligence or the Director of the Federal Bureau of Investigation, reasonably believes to be an entity owned or controlled by, or otherwise connected to, the government of a covered foreign country.

(b) In implementing the prohibition under Public Law 115-232, section 889, subsection (f), paragraph (1), heads of executive agencies administering loan, grant, or subsidy programs shall prioritize available funding and technical support to assist affected businesses, institutions and organizations as is reasonably necessary for those affected entities to transition from covered communications equipment and services, to procure replacement equipment and services, and to ensure that communications service to users and customers is sustained.

Pursuant to the Federal Rules above, vendor certifies that it will not enter into a contract with the District to provide any of the prohibited equipment listed above.

Does Vendor agree to this guideline? YES \_\_\_\_\_ Initials of Authorized Representative of Vendor

49.12 §200.322 Domestic preferences for procurements.

(a) 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.

(b) For purposes of this section:

- (1) "Produced in the United States" means, for iron and steel products, that all manufacturing processes, from the initial melting stage through the application of coatings, occurred in the United States.
- (2) "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; glass, including optical fiber; and lumber.

Pursuant to the Federal Rule above, vendor certifies that it will, to the greatest extent practicable, enter into contracts with the District with items produced within the United States, as outlined above, and will include this requirement in any sub-awards for any District contract that is entered into.

Does Vendor agree? YES \_\_\_\_\_ Initials of Authorized Representative of Vendor

50. RECORD RETENTION REQUIREMENTS FOR CONTRACTS INVOLVING FEDERAL FUNDS: When federal funds are expended by ECISD 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.

Does Vendor agree? YES \_\_\_\_\_ Initials of Authorized Representative of Vendor

51. CERTIFICATION OF COMPLIANCE WITH THE ENERGY POLICY AND CONSERVATION ACT: When ECISD 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).

Does Vendor agree? YES \_\_\_\_\_ Initials of Authorized Representative of Vendor

52. CERTIFICATION OF EQUAL EMPLOYMENT STATEMENT: It is the policy of ECISD 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.

Does Vendor agree? YES \_\_\_\_\_ Initials of Authorized Representative of Vendor

53. CERTIFICATION OF COMPLIANCE WITH BUY AMERICA PROVISIONS: ECISD has a preference for domestic end products for supplies acquired for use in the United States when spending federal funds (purchases that are made with non-federal funds or grants are excluded from the Buy America Act). Vendor certifies that it is in compliance with all applicable provisions of the Buy America Act.

Does Vendor agree? YES \_\_\_\_\_ Initials of Authorized Representative of Vendor

54. CERTIFICATION OF ACCESS TO RECORDS – 2 C.F.R. §200.337: 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.

Does Vendor agree? YES \_\_\_\_\_ Initials of Authorized Representative of Vendor

55. CERTIFICATION OF EMPLOYMENT VERIFICATION FAR 22.18, 74 FR 2731, 48 CFR 52.222-54: As applicable, and as a condition for the award of any Federal contract at \$150,000 or greater, Vendor certifies that vendor is enrolled in, and is currently participating in, E-Verify or any other equivalent electronic verification of work authorization program operated by the U.S. Department of Homeland Security and does not knowingly employ any person who is an unauthorized alien in conjunction with the contracted services. A breach in compliance with immigration laws and regulations shall be deemed a material breach of the contract and may be subject to penalties up to and including termination of the contract.

Does Vendor agree? YES \_\_\_\_\_ Initials of Authorized Representative of Vendor

56. CERTIFICATION OF HEALTH AND SAFETY CERTIFICATIONS, LICENSING, AND REGULATIONS: As applicable to federal funds contracts, all contractors must meet applicable local, state, and federal health and safety certifications, licensing, or regulations which include, but are not limited to, facility use, food establishment, and authorized providers.

Does Vendor agree? YES \_\_\_\_\_ Initials of Authorized Representative of Vendor

57. CERTIFICATION OF COMPLIANCE WITH S/M/WBE/LABOR SURPLUS, 2 CFR 200.321: As applicable with certain federal funds contracts, requires contractors to encourage and facilitate participation by small businesses, minority owned firms, and women’s business enterprises, whenever to the maximum extent possible

Does Vendor agree? YES \_\_\_\_\_ Initials of Authorized Representative of Vendor

58. CERTIFICATION OF COMPLIANCE WITH TEXAS FAMILY CODE: Pursuant to Texas Family Code, Section 231.006, a child support obligor who is more than thirty (30) days delinquent in paying child support or a business entity in which the child support obligor is a sole proprietor, partner, shareholder, or owner with an ownership interest of at least twenty-five percent (25%) is not eligible to receive payments from State funds under a contract to provide property, materials, or services until all arrearages have been paid; the obligor is in compliance with a written repayment agreement or court order as to the existing delinquency; or a court of continuing jurisdiction over the child support order has granted the obligor an exemption as part of a court-supervised effort to improve earnings and child support payments. The undersigned proposer certifies that he or she, as the proposing individual, or the proposing business entity named in this contract, proposal or application, is not ineligible under Section 231.006 of the Texas Family Code, to receive the specified grant, loan or payment, and acknowledges that a contract resulting from this solicitation may be terminated and payment may be withheld if the certification provided herein is found to be inaccurate. NOTE: Owners not owning at least twenty-five percent (25%) of the business entity submitting this proposal need not execute this certification and acknowledgement.

Does Vendor agree? YES \_\_\_\_\_ Initials of Authorized Representative of Vendor

59. CERTIFICATION OF HOUSE BILL 89, SECTION 2270.001 TEXAS GOVERNMENT CODE: Vendor agrees that, under the provisions of Subtitle F, Title 10, Government Code Chapter 2270: Vendor does not boycott Israel currently; and Will not boycott Israel during the term of the contract. “Boycott Israel” means 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 specifically with Israel, or with a person or entity doing business in Israel or in an Israeli-controlled territory, but does not include an action made for ordinary business purposes; and “Company” means a for-profit sole proprietorship, organization, association, corporation, partnership, joint venture, limited partnership, limited liability partnership, or any limited liability company, including a wholly owned subsidiary, majority-owned subsidiary, parent company or affiliate of those entities or business associations that exist to make a profit.

Does Vendor agree? YES \_\_\_\_\_ Initials of Authorized Representative of Vendor

60. CERTIFICATION OF SENATE BILL 252, SECTION 2252 TEXAS GOVERNMENT CODE: Vendor agrees that, under the provisions of Subtitle F, Title 10, Government Code Chapter 2270: Vendor does not engage in business with Iran, Sudan, or foreign terrorist organizations and will not during the term of the contract

Does Vendor agree? YES \_\_\_\_\_ Initials of Authorized Representative of Vendor

61. CERTIFICATION OF SENATE BILL 13, SECTIONS 809 AND 2274 TEXAS GOVERNMENT CODE: Prohibition of Boycott Energy Companies. In accordance with Texas Government Code Chapter 2274, Professional (Contractor) verifies that it does not Boycott Energy Companies and agrees that during the term of this Agreement will not Boycott Energy Companies as that term is defined in Texas Government Code Section 809.001, as amended. This section does not apply if Professional (or Contractor) is a sole proprietor, a nonprofit entity, or a governmental entity; and only applies if: (i) Professional (or Contractor) has ten (10) or more fulltime employees and (ii) this Agreement has a value of \$100,000.00 or more to be paid under the terms of this Agreement.

Does Vendor agree? YES \_\_\_\_\_ Initials of Authorized Representative of Vendor

62. CERTIFICATION OF SENATE BILL 19, SECTION 2274 TEXAS GOVERNMENT CODE: In accordance with Texas Government Code Chapter 2274, Professional (Contractor) verifies that it does not have a practice, policy, guidance, or directive that discriminates against a firearm entity or firearm trade association; and (ii) will not discriminate during the term of the contract against a firearm entity or firearm trade association. This section only applies if: (i) Professional (or Contractor) has ten (10) or more fulltime employees and (ii) this Agreement has a value of \$100,000.00 or more to be paid under the terms of this Agreement; and does not apply: (i) if Professional (or Contractor) is a sole proprietor, a non-profit entity, or a governmental entity; (ii) to a contract with a sole-source provider; or (iii) to a contract for which none of the proposals from a company were able to provide the required certification.

Does Vendor agree? YES \_\_\_\_\_ Initials of Authorized Representative of Vendor

63. CERTIFICATION OF SENATE BILL 2116, SECTIONS 2274 AND 113 TEXAS GOVERNMENT CODE: PROHIBITION ON AGREEMENTS WITH CERTAIN FOREIGN-OWNED COMPANIES IN CONNECTION WITH CRITICAL INFRASTRUCTURE PROHIBITED CONTRACTS: (a) Company verifies that it will not enter into a contract or other agreement relating to critical infrastructure in this state with the District : (1) if, under the contract or other agreement, the company would be granted direct or remote access to or control of critical infrastructure in this state, excluding access specifically allowed by the governmental entity for product warranty and support purposes; and (2) if the governmental entity knows that the company is (A) owned by or the majority of stock or other ownership interest of the company is held or controlled by: (i) individuals who are citizens of China, Iran, North Korea, Russia, or a designated country; or (ii) a company or other entity, including a governmental entity, that is owned or controlled by citizens of or is directly controlled by the government of China, Iran, North Korea, Russia, or a designated country; or (B) headquartered in China, Iran, North Korea, Russia, or a designated country. (b) The prohibition described by Subsection (a) applies regardless of whether: (1) the company's or its parent company's securities are publicly traded; or (2) the company or its parent company is listed on a public stock exchange as: (A) Chinese, Iranian, North Korean, or Russian company; or (B) a company of a designated country. DESIGNATION OF COUNTRY AS THREAT TO CRITICAL INFRASTRUCTURE. (a) The governor, after consultation with the public safety director of the Department of Public Safety, may designate a country as a threat to critical infrastructure for purposes of this chapter.

Does Vendor agree? YES \_\_\_\_\_ Initials of Authorized Representative of Vendor

64. CERTIFICATION OF APPLICABILITY TO SUBCONTRACTORS: Vendor agrees that all contracts it awards pursuant to the Contract shall be bound by the foregoing terms and conditions.

Does Vendor agree? YES \_\_\_\_\_ Initials of Authorized Representative of Vendor

65. CERTIFICATION OF TEC 22.0834 CRIMINAL HISTORY RECORD INFORMATION REVIEW OF CERTAIN EMPLOYEES; FINGERPRINT BACKGROUND CRIMINAL HISTORY INFORMATION CHECKS: Vendors and all their employees that perform work and will have direct contact opportunities with ECISD students must undergo criminal history fingerprinting background checks and be approved by the District to be eligible to perform work at any District location. The District will be the final determiner of the definition of direct contact.

The vendor no longer has access to this required criminal history information to certify themselves so the approval must come from the District. Vendors must contact the District's Personnel Department to obtain instructions on how to complete this process and the Vendor or its employees will be responsible for the cost of these background checks. The Local Education Entity (LEE) Fast Pass option will be required. The District has an IdentoGO service located in its facilities that utilizes this option.

This requirement will not apply to construction, alteration, or repair to an instructional facility if the contractor uses separate sanitary facilities, installs a barrier fence, and has a policy that employees may not interact with students or enter areas used by students.

Vendor acknowledges the above requirements and will ensure required applicable background checks will be completed and approved by the District before any on site work begins by them or their employees.

Does Vendor agree? YES \_\_\_\_\_ Initials of Authorized Representative of Vendor

66. CERTIFICATION OF GOVERNMENT CODE 552.104(c) A person, including a board, may not include a provision in a contract related to a parade, concert, or other entertainment event paid for in whole or in part with public funds that prohibits or would otherwise prevent the disclosure of information relating to the receipt or expenditure of public or other funds by a board for the event. A contract provision that violates Government Code 552.104(c) is void.

Vendor acknowledges the above requirements and will not enter into such a contract with the District.

Does Vendor agree? YES \_\_\_\_\_ Initials of Authorized Representative of Vendor

67. CERTIFICATION OF GOVERNMENT CODE 2272.003(a): A district may not enter into a taxpayer resource transaction with an abortion provider or an affiliate of an abortion provider. Gov't Code 2272.003(a).

"Taxpayer resource transaction" means a sale, purchase, lease, donation of money, goods, services, or real property, or any other transaction between a governmental entity and a private entity that provides to the private entity something of value derived from state or local tax revenue, regardless of whether the governmental entity receives something of value in return.

"Affiliate" means a person or entity who enters into with another person or entity a legal relationship created or governed by at least one written instrument, including a certificate of formation, a franchise agreement, standards of affiliation, bylaws, or a license, that demonstrates:

1. Common ownership, management, or control between the parties to the relationship;
2. A franchise granted by the person or entity to the affiliate; or
3. The granting or extension of a license or other agreement authorizing the affiliate to use the other person's or entity's brand name, trademark, service mark, or other registered identification mark.

Vendor agrees that it is not an abortion provider or affiliate of an abortion provider as stated above.

Does Vendor agree? YES \_\_\_\_\_ Initials of Authorized Representative of Vendor

68. CERTIFICATION OF GOVERNMENT CODE 403.1067(A) LOBBYING RESTRICTION – TOBACCO EDUCATION GRANT FUNDS: A district receiving funds or grants from the Permanent Fund for Health and Tobacco Education and Enforcement may not use the funds to pay:

1. Lobbying expenses incurred by the district;
2. A person or entity that is required to register with the Texas Ethics Commission under Government Code Chapter 305 (Registration of Lobbyists);
3. Any partner, employee, employer, relative, contractor, consultant, or related entity of a person or entity described by item 2; or
4. A person or entity who has been hired to represent associations or other entities for the purpose of affecting the outcome of legislation, agency rules, ordinances, or other government policies.

Vendor agrees that it will not provide services listed above to the District with said funds.

Does Vendor agree? YES \_\_\_\_\_ Initials of Authorized Representative of Vendor

69. Debarment and Suspension (Executive Orders 12549 and 12689): By signing below Contractor certified that neither it nor its principals are currently listed on the government-wide exclusions in SAM as debarred, suspended, or otherwise excluded by agencies or declared ineligible under statutory or regulatory authority other than Executive Order 12549. Contractor further agrees to immediately notify the District if he/she is later listed on the government-wide exclusions in SAM, or is debarred, suspended, or otherwise excluded by agencies or declared ineligible under statutory or regulatory authority other than Executive Order 12549.

Does Vendor agree? YES \_\_\_\_\_ Initials of Authorized Representative of Vendor

**I, the undersigned authorize agent for the company named below, certify that the information concerning Section 1-69 listed above has been reviewed by me and the information furnished is true to the best of my knowledge. I further certify that I agree to comply with Sections 1-69 listed above.**

\_\_\_\_\_  
Print/Type Signature Name

\_\_\_\_\_  
Official Title

\_\_\_\_\_  
Authorized Signature

\_\_\_\_\_  
Date



**CONSTRUCTION AGREEMENT INSTRUCTION**

**THIS CONSTRUCTION AGREEMENT** is made by and between the Edinburg, Texas Consolidated Independent School District (“ECISD” or “Owner”), and \_ (“Contractor”).

**WHEREAS**, ECISD has offered Contractor -- and Contractor has accepted ECISD’s offer -- to perform work on the Project as defined herein. The “Standard Form of Agreement” between Owner and Contractor where the Basis of Payment is a Stipulated Sum will be, AIA Document A101, 2017 Electronic Format Edition. General Conditions for this effort will be defined through use of the AIA - A201 Instrument.

The AIA Contract Forms will be provided to the Contractor for review and final execution upon award of the Project.

**FELONY CONVICTION NOTIFICATION**

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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 the person or business entity failed to give notice as required by Subsection (a) or misrepresented the conduct resulting in the conviction. The district must compensate the person or business entity for services performed before the termination of the contract."

This Notice Is Not Required of a Publicly-Held Corporation

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

\_\_\_\_\_  
Vendor's Name

\_\_\_\_\_  
Authorized Company Official's Name (Printed)

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

\_\_\_\_\_  
Signature of Company Official

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

\_\_\_\_\_  
Signature of Company Official

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

\_\_\_\_\_  
Names of Felon(s)

\_\_\_\_\_  
Details of Conviction(s)

\_\_\_\_\_  
Signature of Company Official

# CONFLICT OF INTEREST QUESTIONNAIRE

**FORM CIQ**

## For vendor or other person doing business with local governmental entity

This questionnaire reflects changes made to the law by the H.B. 1491 80<sup>th</sup> Leg., Regular Session.

This questionnaire is being filed in accordance with Chapter 176, Local Government Code by a person who has a business relationship as defined by Section 176.001(1-a) with a local governmental entity and the person 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 7<sup>th</sup> business day after the date the person becomes aware of facts that require the statement to be filed. See Section 176.006, Local Government Code.

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

OFFICE USE ONLY	
Date Received	

1 Name of person doing business 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 September 1 of the year for which an activity described in Section 176.006 (a), Local Government Code, is pending and not later than the 7<sup>th</sup> business day after the date the originally filed questionnaire becomes incomplete or inaccurate.)

3

Name of local government officer with whom filer has employment or business relationship.

\_\_\_\_\_ Name of Officer

This section (item 3 including subparts A, B, C & D) must be completed for each officer with whom the filer has an employment or other business relationship as defined by Section 176.001(1-a), Local Government Code. Attached additional pages to this form CIQ as necessary.

- A. Is the local government officer named in this section receiving or likely to receive taxable income, other than investment income, from the filer of the questionnaire?  
 Yes     No
- B. Is the filer of the questionnaire receiving or likely to receive taxable income, other than investment income?  
 Yes     No
- C. Is the filer of this questionnaire employed by a corporation or other business entity with respect to which the local government officer serves as an officer or director, or holds an ownership of 10 percent or more?  
 Yes     No
- D. Describe each employment or business relationship with the local government officer named in this section.

4

\_\_\_\_\_ Signature of person doing business with the governmental entity

\_\_\_\_\_ Date

## CERTIFICATION OF INTERESTED PARTIES – FORM 1295

### Definitions and Instructions for Completing Form 1295

Edinburg Consolidated Independent School District 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 Edinburg CISD from entering into a contract resulting from a Bid, CSP, RFP, RFQ, Inter-local Cooperative Quote with a business entity unless the business entity submits a Disclosure of Interested Parties – Form 1295 to Edinburg CISD at the time the business entity submits the signed contract. The Texas Ethics Commission has adopted rules requiring the business entity to file Form 1295 electronically with the Texas Ethics Commission.

**As a “business entity,” vendors must electronically complete, print, manually fill out Unsworn Declaration portion and sign. Once form is completed, submit with your proposals or contracts even if no interested parties exist.**

Proposers must file Certificate of Interested Parties – Form 1295 with the Texas Ethics Commission using the following online application: [https://www.ethics.state.tx.us/whatsnew/elf\\_info\\_form1295.htm](https://www.ethics.state.tx.us/whatsnew/elf_info_form1295.htm)

- Proposers must use the filing application on the Texas Ethics Commission’s website (see link above) to enter the required information on Form 1295.
- Proposers must print a copy of the completed form, which will include a certification of filing containing a unique certification number.
- The Form 1295 must be printed and then signed by an authorized agent of the business entity.
- The completed Form 1295 with the certification of filing must be filed with Edinburg Consolidated Independent School District by including a copy of the completed form with the proposal response.
- Edinburg CISD must acknowledge the receipt of the filed Form 1295 by notifying the Texas Ethics Commission of the receipt of the filed Form 1295 no later than the 30<sup>th</sup> day after the date the contract binds all parties to the contract.
- After Edinburg CISD acknowledges the Form 1295, the Texas Ethics Commission will post the completed Form 1295 to its website within seven (7) business days after receiving notice from Edinburg CISD.

### Instructions to Vendors:

1. Read these instructions,
2. Go to the Ethics Commission Website [https://www.ethics.state.tx.us/whatsnew/elf\\_info\\_form1295.htm](https://www.ethics.state.tx.us/whatsnew/elf_info_form1295.htm),
3. Register and complete Form 1295 online - include the bid/proposal # and the contract/Bid,CSP,RFQ,RFP name.
4. Print a copy of the submitted Form 1295 and sign - it will have a certification # in the top right corner,
5. Include a copy of the completed, signed Form 1295 with the proposal response.

### Definitions:

- **Interested Party:** a person who:
  - 1) has controlling interest in a business entity with whom Edinburg CISD contracts; or
  - 2) actively participates in facilitating a contract or negotiating the terms of a contract, including a broker, intermediary, adviser, or attorney for the business entity.
- **Controlling Interest** means:
  - 1) an ownership interest or participating interest in a business entity by virtue of units, percentage, shares, stock, or otherwise that exceeds 10 percent;
  - 2) 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
  - 3) 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.
- **Intermediary:** a person who actively participates in the facilitation of the contract or negotiating the contract, including a broker, advisor, attorney, or representative of or agent for the business entity who:
  - 1) receives compensation from the business entity for the person’s participation;
  - 2) communicates directly with the governmental entity or state agency on behalf of the business entity regarding the contract; and
  - 3) is not an employee of the business entity.
- **Business Entity:** includes an entity through which business is conducted with a governmental entity or state agency, regardless of whether the entity is a for-profit or nonprofit entity.

### Resources:

#### Form 1295 Frequently Asked Questions:

- [https://www.ethics.state.tx.us/whatsnew/FAQ\\_Form1295.html](https://www.ethics.state.tx.us/whatsnew/FAQ_Form1295.html)

#### Instructional Video – First Time Business User:

- <https://www.ethics.state.tx.us/filinginfo/videos/Form1295/FirstLogin-Business/Form1295Login-Business.html>

#### Instructional Video – How to Create a Certificate:

- <https://www.ethics.state.tx.us/filinginfo/videos/Form1295/CreateCertificate/CreateCertificate.html>

A person or business entity entering into a contract and/or agreement with ECISD is required by the new Government Code Statute 2252.908, to complete Form 1295 "Certificate of Interested Parties". This form must be submitted online at [http://www.ethics.state.tx.us/whatsnew/elf\\_info\\_form1295.htm](http://www.ethics.state.tx.us/whatsnew/elf_info_form1295.htm). Once the online submission has been processed and a claim number has been issued, the form must be printed with the claim number, Unsworn Declaration must be manually filled out and signed. Submit form along with this solicitation documents. IF Form 1295 is not submitted along with this solicitation documents, your response may be considered "non-responsive" and may be disqualified.

<b>CERTIFICATE OF INTERESTED PARTIES</b>		<b>FORM 1295</b>	
		1 of 1	
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.		<b>OFFICE USE ONLY</b>	
<b>1 Name of business entity filing form, and the city, state and country of the business entity's place of business.</b>  <b>Vendor Name</b>		<b>CERTIFICATION OF FILING</b> Certificate Number:	
<b>2 Name of governmental entity or state agency that is a party to the contract for which the form is being filed.</b>  Edinburg CISD		Date Filed:  Date Acknowledged:	
<b>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.</b>  Use District's Proposal # & Proposal Title located on cover page of solicitation			
4	Name of Interested Party	City, State, Country (place of business)	Nature of interest (check applicable)
			<input type="checkbox"/> Controlling <input type="checkbox"/> Intermediary
<h1 style="font-size: 100px; opacity: 0.5;">Example</h1>			
<b>5 Check only if there is NO Interested Party.</b> <input type="checkbox"/>			
<b>6 UNSWORN DECLARATION</b>			
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____. <div style="display: flex; justify-content: flex-end; margin-right: 100px;"> <span>(month)</span>    <span>(year)</span> </div>			
_____ Signature of authorized agent of contracting business entity (Declarant)			

**DEVIATION FORM**

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**(This form must be signed)**

1. DEVIATION(S) – Any deviations to the attached specifications shall be listed below, or on a separate sheet of paper, and attached to the proposal response form identifying the section number, item number and a clearly defined explanation for the deviations.
2. It is the bidder's responsibility to submit a proposal that meets all mandatory specifications stated within. Because of the variations in manufacturer's construction, the bidder must compare their product proposal with the required listed minimum specifications and identify any deviations.
3. Failure to properly identify deviations may render the bidder's proposal non-responsive and not capable of consideration for award.
4. Bidders should note that a descriptive brochure of the model proposal may not be sufficient or acceptable as proper identification of deviations from the written specifications.

NO - Deviations: \_\_\_\_\_ YES - Deviations: \_\_\_\_\_

**List any deviations your company is submitting below: (List on separate page, if necessary)**

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\_\_\_\_\_  
Company Name

\_\_\_\_\_  
Print Name of Authorized Company Official

\_\_\_\_\_  
Signature of Authorized Company Official

**WAGE RATE**

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General Decision Number: TX20210255 02/25/2022

Superseded General Decision Number: TX20200255

State: Texas

Construction Type: Building County: Hidalgo County in Texas.

BUILDING CONSTRUCTION PROJECTS (does not include single family homes or apartments up to and including 4 stories).

Note: Contracts subject to the Davis-Bacon Act are generally required to pay at least the applicable minimum wage rate required under Executive Order 14026 or Executive Order 13658. Please note that these Executive Orders apply to covered contracts entered into by the federal government that are subject to the Davis-Bacon Act itself, but do not apply to contracts subject only to the Davis-Bacon Related Acts, including those set forth at 29 CFR 5.1(a)(2)-(60).

If the contract is entered into on or after January 30, 2022, or the contract is renewed or extended (e.g., an option is exercised) on or after January 30, 2022: Executive Order 14026 generally applies to the contract. The contractor must pay all covered workers at least \$15.00 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on the contract in 2022.

If the contract was awarded on or between January 1, 2015 and January 29, 2022, and the contract is not renewed or extended on or after January 30, 2022: Executive Order 13658 generally applies to the contract. The contractor must pay all covered workers at least \$11.25 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on that contract in 2022.

The applicable Executive Order minimum wage rate will be adjusted annually. If this contract is covered by one of the Executive Orders and a classification considered necessary for performance of work on the contract does not appear on this wage determination, the contractor must still submit a conformance request.

Additional information on contractor requirements and worker protections under the Executive Orders is available at <https://www.dol.gov/agencies/whd/government-contracts>.

Modification Number	Publication Date
0	01/07/2022
1	02/25/2022

BOIL0074-003 01/01/2021

## Edinburg Consolidated Independent School District

### Texas Building Construction Trades Prevailing Wage Rates Determination 2/25/2022

Worker Classification	Prevailing Wage Rate	Fringes
Boiler Maker	\$29.47	\$24.10
Power Equipment Operator		
1. Tower Crane	\$32.85	\$13.10
2. Cranes with pile Driving or Caisson Attachment and Hydraulic Crane 60 tons and above	\$28.75	\$10.60
3. Hydraulic cranes 59 Tons and under	\$32.35	\$13.10
Iron Worker, Ornamental	\$26.01	\$ 7.56
Plumber	\$31.14	\$12.43
Brick Layer	\$16.17	\$ 0.00
Carpenter	\$14.21**	\$ 2.22
Cement Mason/Concrete Finisher	\$12.46**	\$ 0.00
Electrician	\$18.44	\$ 4.53
Insulator – Mechanical (duct, pipe & mechanical system insulation)	\$11.54**	\$ 2.17
Iron Worker, Reinforcing	\$12.01**	\$ 0.00
Iron Worker, Structural	\$15.04	\$ 4.34
Laborer – Common or General	\$ 8.00**	\$ 0.00
Laborer – Mason Tender – Brick	\$10.00**	\$ 0.00
Laborer – Mason Tender – Cement/Concrete	\$10.89**	.96
Laborer – Pipelayer	\$11.00**	\$ 3.47
Laborer – Roof Tearoff	\$10.06**	\$ 0.00
Operator – Backhoe/Excavator/Trackhoe	\$14.04**	\$ 1.01
Operator – Bobcat/Skid Steer/Skid Loader	\$13.93**	\$ 0.00
Operator – Bulldozer	\$18.29	\$ 1.31
Operator – Drill	\$16.22	.34
Operator – Forklift	\$14.83**	\$ 0.00
Operator – Grader/Blade	\$10.00**	\$ 0.00
Operator – Loader	\$12.87**	.70
Operator – Mechanic	\$17.00	\$ 0.00
Operator – Paver (asphalt, aggregate, and concrete)	\$16.03	\$ 0.00
Operator – Roller	\$12.70**	\$ 0.00
Painter (brush, roller and spray)	\$11.27**	\$ 0.00
Pipefitter	\$15.22	\$ 3.16
Roofer	\$11.42**	\$ 0.00
Sheet Metal Worker (HVAC Duct Installation only)	\$18.40	\$ 2.12
Sheet Metal Worker (Excludes HVAC Duct Installation)	\$21.13	\$ 6.53
Tile Finisher	\$11.22**	\$ 0.00
Tile Setter	\$12.15**	\$ 0.00
Truck Driver – Dump Truck	\$12.39**	\$ 1.18
Truck Driver – Flatbed Truck	\$19.65	\$ 8.57
Truck Driver – Semi-trailer Truck	\$12.50**	\$ 0.00
Truck Driver – Water Truck	\$12.00**	\$ 4.11
Welders – Receive rate prescribed for craft performing operation to which welding is incidental.		



\*\* Workers in this classification may be entitled to a higher minimum wage under Executive Order 14026 (\$15.00) or 13658 (\$11.25). Please see the Note at the top of the wage determination for more information.

Note: Executive Order (EO) 13706, Establishing Paid Sick Leave for Federal Contractors applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2017. If this contract is covered by the EO, the contractor must provide employees with 1 hour of paid sick leave for every 30 hours they work, up to 56 hours of paid sick leave each year. Employees must be permitted to use paid sick leave for their own illness, injury or other health-related needs, including preventive care; to assist a family member (or person who is like family to the employee) who is ill, injured, or has other health-related needs, including preventive care; or for reasons resulting from, or to assist a family member (or person who is like family to the employee) who is a victim of, domestic violence, sexual assault, or stalking. Additional information on contractor requirements and worker protections under the EO is available at <https://www.dol.gov/agencies/whd/government-contracts>.

Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clauses (29CFR 5.5 (a) (1) (ii)).

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The body of each wage determination lists the classification and wage rates that have been found to be prevailing for the cited type(s) of construction in the area covered by the wage determination. The classifications are listed in alphabetical order of ""identifiers"" that indicate whether the particular rate is a union rate (current union negotiated rate for local), a survey rate (weighted average rate) or a union average rate (weighted union average rate).

#### Union Rate Identifiers

A four letter classification abbreviation identifier enclosed in dotted lines beginning with characters other than ""SU"" or ""UAVG"" denotes that the union classification and rate were prevailing for that classification in the survey. Example: PLUM0198-005 07/01/2014. PLUM is an abbreviation identifier of the union which prevailed in the survey for this classification, which in this example would be Plumbers. 0198 indicates the local union number or district council number where applicable, i.e., Plumbers Local 0198. The next number, 005 in the example, is an internal number used in processing the wage determination. 07/01/2014 is the effective date of the most current negotiated rate, which in this example is July 1, 2014.

Union prevailing wage rates are updated to reflect all rate changes in the collective bargaining agreement (CBA) governing this classification and rate.

#### Survey Rate Identifiers

Classifications listed under the ""SU"" identifier indicate that no one rate prevailed for this classification in the survey and the published rate is derived by computing a weighted average rate based on all the rates reported in the survey for that classification. As this weighted average rate includes all rates reported in the survey, it may include both union and non-union rates. Example: SULA2012-007 5/13/2014. SU indicates the rates are survey rates based on a weighted average calculation of rates and are not majority rates. LA indicates the State of Louisiana. 2012 is the year of survey on which these classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination. 5/13/2014 indicates the survey completion date for the classifications and rates under that identifier.

Survey wage rates are not updated and remain in effect until a new survey is conducted.

Union Average Rate Identifiers

Classification(s) listed under the UAVG identifier indicate that no single majority rate prevailed for those classifications; however, 100% of the data reported for the classifications was union data. EXAMPLE: UAVG-OH-0010 08/29/2014. UAVG indicates that the rate is a weighted union average rate. OH indicates the state. The next number, 0010 in the example, is an internal number used in producing the wage determination. 08/29/2014 indicates the survey completion date for the classifications and rates under that identifier.

A UAVG rate will be updated once a year, usually in January of each year, to reflect a weighted average of the current negotiated/CBA rate of the union locals from which the rate is based.

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**WAGE DETERMINATION APPEALS PROCESS**

1. Has there been an initial decision in the matter? This can be:

- \* an existing published wage determination
- \* a survey underlying a wage determination
- \* a Wage and Hour Division letter setting forth a position on a wage determination matter
- \* a conformance (additional classification and rate) ruling

On survey related matters, initial contact, including requests for summaries of surveys, should be with the Wage and Hour Regional Office for the area in which the survey was conducted because those Regional Offices have responsibility for the Davis-Bacon survey program. If the response from this initial contact is not satisfactory, then the process described in 2.) and 3.) should be followed.

With regard to any other matter not yet ripe for the formal process described here, initial contact should be with the Branch of Construction Wage Determinations. Write to:

Branch of Construction Wage Determinations  
Wage and Hour Division  
U.S. Department of Labor  
200 Constitution Avenue, N.W. Washington, DC 20210

2. If the answer to the question in 1 is yes, then an interested party (those affected by the action) can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Write to:

Wage and Hour Administrator  
U.S. Department of Labor  
200 Constitution Avenue, N.W.  
Washington, DC 20210

The request should be accompanied by a full statement of the interested party's position and by any information (wage payment data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

3. If the decision of the Administrator is not favorable, an interested party may appeal directly to the Administrative Review Board (formerly the Wage Appeals Board). Write to:

Administrative Review Board  
U.S. Department of Labor

200 Constitution Avenue, N.W.  
Washington, DC 20210

4. All decisions by the Administrative Review Board are final.

**END OF GENERAL DECISION**

## Edinburg Consolidated Independent School District Substitute W-9 & Direct Deposit Authorization Form

Complete form if: 1. You are a U.S. entity (including a resident alien) 2. You are a vendor that provides goods or services to ECISD; AND 3. You will receive payment from the Edinburg Consolidated ISD	New Request <input type="checkbox"/>	Update – Select from the following: Tax ID <input type="checkbox"/> Legal Name <input type="checkbox"/> Vendor Order Address <input type="checkbox"/> Direct Deposit <input type="checkbox"/> Contact Information <input type="checkbox"/> Vendor Payment Address <input type="checkbox"/>
Individual/Company/Entity Legal Name (Must match TIN below): _____ Taxpayer Identification Number (TIN) _____ - _____ Federal Tax ID Number (FID) _____ - _____		DBA Name (IF Applicable): _____ OR SSN – Individual/Sole Proprietor _____ - _____
<b>Vendor Contact Information:</b>		
Name: _____	Title: _____	Phone: _____ Fax: _____
<b>Vendor Type – Select 5 only one of the following boxes:</b>		
<input type="checkbox"/> Individual/Sole Proprietorship <input type="checkbox"/> C-Corporation <input type="checkbox"/> S-Corporation <input type="checkbox"/> Partnership <input type="checkbox"/> Trust/Estate <input type="checkbox"/> Other: Explain _____ <input type="checkbox"/> Limited Liability Company (LLC). Enter the tax classification (C=C corporation, S=S corporation, P=Partnership) _____ <input type="checkbox"/> Exempt payee code (if any) _____ <input type="checkbox"/> Exemption from FATCA reporting code (if any) _____		
<b>Order Address:</b>  Street/PO Box: _____ Second Line: _____ City: _____ State: _____ Zip Code: _____	<b>Payment Remittance Address:</b> <input type="checkbox"/> Check if Order Address is same as Payment Address Street/PO Box: _____ Second Line: _____ City: _____ State: _____ Zip Code: _____	
<b>Banking Information:</b>		
In an effort to process your payment faster, we request that you complete the ACH enrollment section below. All fields must be completed for direct deposit setup. Attach a voided check or letter from your financial institution.		
Account Type:      Checking <input type="checkbox"/> Savings <input type="checkbox"/>	Email for Direct Deposit Notification: _____	
Bank Name: _____	ABA Routing Number: _____	
Bank Address: _____	Account Number: _____	
City: _____ State: _____ Zip Code: _____	Phone: _____ Fax: _____	
<b>W-9 Certification</b> 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 Services (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. <b>Certification Instructions:</b> 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.  Signature: _____ Date: _____ Print Name/Title: _____	<b>Direct Deposit Authorization and Agreement</b> I authorize Edinburg Consolidated Independent School District (ECISD) to initiate direct deposit of funds to the account and financial institution indicated above, and to recover funds deposited in error in necessary, in compliance with Texas and U.S. Law, and the Automatic Clearing House (ACH) rules. I understand that:  1. It is my responsibility to provide accurate and current banking information. Notification of direct deposits will be by e-mail; and it is my responsibility to provide a valid e-mail address.  2. It is my responsibility to verify payment has been credited to my account, and that ECISD assumes no liability for overdrafts for any reasons.  3. This authorization will remain in effect until; (a) a written request is received from a vendor officer to change or terminate direct deposit agreement; (b) notification is sent by my bank that the account is no longer valid.  Signature: _____ Date: _____ Print Name/Title: _____	
Send completed form to: ECISD requestor or: Mail to: Edinburg Consolidated Independent School District, ATTN: Accounts Payable, PO Box 990, Edinburg, TX 78540 OR; E-mail: <a href="mailto:ECISDinvoice@ecisd.us">ECISDinvoice@ecisd.us</a> , OR; Fax: 956-383-4354. Any Questions on this form, call 956-289-2300 ext. 2074		
<b>Finance Office Use Only: Updated Record on:</b>	<b>Updated by:</b>	<b>Bank Code:      Vendor #:</b>

**TAX EXEMPT ORGANIZATION**

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**CERTIFICATE PART 1 – GENERAL**

**1.1 DEFINITION**

- A. This Contract is to be performed for an exempt organization as defined by Title 2; Subtitle E; Chapter 150 of the Texas Limited Sales, Excise and Use Tax Act and Section 151.311 of the State Statutes. The Owner will furnish the Contractor proof or Certificate of Exemption upon award of contract.
- B. Proposer shall not include sales tax in their Proposal.

REFERENCE CHECK QUESTIONNAIRE

Reference for: \_\_\_\_\_

Reference Name: \_\_\_\_\_  
(Firm name)

\_\_\_\_\_  
(Person Contacted)

We request your responses to the below questions. Contractor is to submit this questionnaire to 3 references. Upon completion, email questionnaire at ClauDina E. Longoria to d.longoria@ecisd.us on or before proposal due date/time.

1. How well did the contractor meet the project budget?  Fair  Good  Excellent

Comments:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

2. Was the contractor able to comply with the project schedule?  Fair  Good  Excellent

Comments:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

3. Did the quality of work meet your expectations?  Fair  Good  Excellent

Comments:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

4. Was the contractor responsive to your concerns and requests?  Fair  Good  Excellent

Comments:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

5. How well did the contractor meet the overall contractual obligations?  Fair  Good  Excellent

Comments:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

For ECISD Use:

Person conducting reference check: \_\_\_\_\_

Date reference questionnaire was conducted or sent: \_\_\_\_\_

## SPECIAL CONDITIONS

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These SPECIAL CONDITIONS are incorporated as part of the Contract Documents between Owner and Contractor.

### 1. Parties to the Project

- 1.1 "Owner" shall mean The Edinburg Consolidated Independent School District.
- 1.2 "Contractor" shall mean the person, firm, or corporation which has executed the Construction Agreement with the Owner and is thus solely responsible to the Owner for the execution and completion of the Work. The term "Contractor" and "General Contractor" shall be interchangeable.
- 1.3 "Subcontractor" shall mean any person, firm or corporation having a contract with Contractor to furnish labor, material, services, equipment or any combination thereof for the work on this project.

### 2. Interpreting the Contract Documents

- 2.1 In the event of conflicts or discrepancies among the Contract Documents, interpretations will be based on the following priorities:
  1. Construction Agreement
  2. Special Conditions
  3. Supplementary General Conditions to AIA Document A201-2017
  4. Specifications then Plan Drawings
  5. Executed Change Orders
  6. General Conditions of the Contract for Construction, AIA Document A201-2017
- 2.2 In the case of an inconsistency between Drawings and Specifications or within either Document not clarified by addendum, the better quality and greater quantity of Work shall be provided in accordance with the Project Architect's interpretation and Owner's approval/ agreement.

### 3. Trenching and Shoring (As required)

- 3.1 General Contractor shall bear sole responsibility for design and execution of acceptable trenching and shoring procedures, in accordance with State of Texas statutory requirements and local/ regional ordinances and standards.

Texas Health and Safety Code § 756.023, and OSHA Regulations 1926.652-653.

- 3.2 On trench excavations in excess of five feet in depth, Contractor shall pay a qualified engineer, experienced in the engineering, design and preparation of drawings and specifications for compliance with state requirements for trenching and shoring, to prepare and professionally seal detailed drawings and specifications directing Contractor in the safe execution of trenching and shoring.
- 3.3 Costs for trenching and shoring engineering and execution shall appear as a pay line item in the "Schedule of Values." Contractor shall attach to pay request a notarized letter from shoring engineer that designed Contractor's trenching and shoring systems addressed to Owner attesting that engineer has (1) reviewed trenching and shoring systems installed in field and found them in conformance with shoring engineer's detailed plans and specifications, (2) line item on Contractor's pay request accurately represents work installed and materials on site, and (3) engineer recommends payment to Contractor of line item for trenching and shoring based on engineer's observations. Contractor's monthly Application for Payment that is submitted without the required letter from Contractor's shoring engineer is subject to return without review until letter is submitted.

**4. Prevailing Wage Rates**

4.1 Attention is called to Chapter Section 2258.021 of the Texas Government Code which, among other things, provides that it shall be mandatory upon Contractor and any subcontractor to pay a worker employed by it or on behalf of it:

1. not less than the general prevailing rate of hourly 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 hourly wages for legal holiday and overtime work.

This section does not apply to maintenance work.

4.2 In compliance with Section 2258.022 of the Texas Government Code, Owner has determined that the general prevailing rate of wages in the locality in which the work under this contract is to be performed shall be those rates as determined by surveys conducted by the General Services Commission of the State of Texas for Building - Hidalgo County.

**5. Right of Entry**

5.1 The Owner reserves the right of entry to the property at all times for inspection of the work.

5.2 The Owner may perform collateral work or have work under separate contracts performed on the property.

**6. Workers' Compensation Insurance Coverage**

**6.1 Definitions:**

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

2. Duration of the project - includes the time from the beginning of the work on the project until 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, Section 406.096) - includes all persons or entities performing all or part of the services Contractor has undertaken to perform on the project, regardless of whether that person contracted directly with Contractor and regardless of whether that person has employees. This includes, without limitation, independent contractors, subcontractors, leasing companies, motor carriers, owner-operators, employees of any such entity, or employees of any entity which furnishes persons to provide services on the project. "Services" include, without limitation, providing, hauling, or delivering equipment or materials, or providing labor, transportation, or other service related to the project. "Services" does not include activities unrelated to the project, such as food/beverage vendors, office supply deliveries, and delivery of portable toilets.

6.2 Contractor shall provide coverage, based on proper reporting of classification codes and payroll amounts and filing of any coverage agreements, which meets the statutory requirements of Texas Labor Code, Section 401.011(44) for all employees of Contractor providing services on the project, for the duration of the project.

6.3 Contractor must provide a certificate of coverage to the governmental entity prior to being awarded the contract.

6.4 If the coverage period shown on Contractor's current certificate of coverage ends at a time within the duration of the project, 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.

- 6.5 Contractor shall obtain from each person providing services on a project, and provide 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 no later than seven days after receipt by 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; and
  2. No later than seven days after receipt by Contractor, a new certificate of coverage showing extension of coverage, if the coverage period shown on the current certificate ends during the duration of the project.
- 6.6 Contractor shall retain all required certificates of coverage for the duration of the project, and for one year thereafter.
- 6.7 Contractor shall notify the Owner in writing by certified mail or personal delivery, within 10 days after Contractor knew or should have known, of any change that materially affects the provision of coverage of any person providing services on the project.
- 6.8 Contractor shall post on each project site a notice, in the text, form and manner prescribed by the Texas Workers<sup>1</sup> 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.
- 6.9 Contractor shall contractually require each person with whom it contracts to provide services on a project, to:
  1. provide coverage, based on proper reporting of classification codes and payroll amounts and filing of any coverage agreements, which meets the statutory requirements of Texas Labor Code, Section 401.011(44) for all of its employees providing services on the project, for the duration of the project;
  2. provide to 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 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 Contractor (i) a certificate of coverage, prior to the other person beginning work on the project; and (ii) 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 Owner in writing by certified mail or personal delivery, within 10 days after the person knew or should have known, of any change that materially affects the 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 this section 6.9 with the certificates of coverage to be provided to the person for whom they are providing services.
- 6.10 By signing the Construction Agreement or providing or causing to be provided a certificate of coverage, Contractor represents to the Owner that all employees of 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 Contractor to administrative penalties, criminal penalties, civil penalties, or other civil actions.

6.11 Contractor's failure to comply with any of the provisions contained in the above Section 6 is a breach of contract by Contractor which entitles the Owner to declare the contract void if Contractor does not remedy the breach within ten days after receipt of notice of breach from the Owner.

**7. Prohibition on Drugs, Tobacco and Alcohol**

7.1 Owner has designated the Project area and work site a "tobacco, alcoholic beverage, and drug (illicit or non-prescribed controlled drugs) free" area.

7.2 Smoking, vaping, and chewing of tobacco products is prohibited on Owner's property. Contractor shall post no smoking and no tobacco signs in number, in form, and in locations as approved by the Owner.

7.3 Drugs, vaping, drug paraphernalia, alcohol, weapons and firearms are strictly prohibited on Owner's property. Possession of such items, or being under the influence of drugs or alcohol, shall be prosecuted to the full extent of the law.

7.4 Contractor shall notify his employees, vendors, and all subcontractors to enforce the prohibitions in this Section 7. Contractor and any subcontractor shall ensure compliance with this Section 7 for all personnel under their direct or indirect supervision.

**8. Criminal History Notification (TEX. EDUC. CODE § 44.034)**

8.1 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. This provision applies to all subcontractors and sub-subcontractors.

8.2 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 1.1 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.

Additionally, selected contractor will always follow the District's security procedures by requiring all his/her personnel working on any campus sites to be properly badged/identified after successfully being cycled through the State's Raptor ID system.

**9. Prohibition on Gratuities**

The Owner may, by written notice to Contractor, cancel the Contract for Construction without liability to Contractor if it is determined by the Owner that gratuities, in the form of entertainment, gifts, or anything of monetary value, were offered or given by Contractor, or any agent, or representative of Contractor, to any officer or employee of the Independent School District with a view toward securing a contract or securing favorable treatment with respect to the awarding, amending, or making of any determinations with respect to the performing of such a contract. In the event the Construction Agreement is canceled by the Owner pursuant to this provision, Owner shall be entitled, in addition to any other rights and remedies, to recover or withhold the amount of the cost incurred by Contractor in providing such gratuities.

**10. Prohibition on Advertising**

Contractor or any Subcontractors shall not advertise or publish without the Owner's prior written consent, any pictures, photographs, video tapes, computer schematics, or other depictions of the work in progress, or the completed project, except to the extent necessary to comply with proper requests for information from an

authorized representative of the federal, state or local government. This prohibition shall extend to all print and electronic media (including the Internet).

## 11. Scheduling of Work

- 11.1 The work shall be carefully scheduled and executed in a manner that will cause the least possible interference with the Owner's operations and property.
- 11.2 It is specifically understood and agreed between Owner and Contractor, that time is of the essence in completing this project. Contractor agrees it shall work five days during each calendar week, normally Monday through Friday, until final completion of the project, subject to state and national holidays customarily observed by Contractor.
- 11.3 In the event weather conditions, natural disasters, or other events beyond the control of Contractor prevent Contractor from working Monday through Friday, or Contractor is delayed as a result of any act of the Owner, Contractor may apply to the Architect/Engineer for an extension of the substantial completion date that is commensurate with the number of days lost due to any of the above conditions. Contractor must make application for an extension of time within seven (7) days of the events causing the delay. Failure to timely make request for extension is a waiver of the right to extension for that particular incident. A waiver of a prior right of an extension shall not waive the right to request an extension as a result of subsequent events. The request will be submitted to the Architect/Engineer along with any documents supporting the request.
- 11.4 In the event the project is not substantially completed by the contract deadline, or as it may be extended as provided above, no progress payments will be made on or beyond the date for substantial completion, until the project is substantially completed and accepted as that term is defined in these Contract Documents. This right to withhold payment is in addition to any other rights or remedies in these Contract Documents for failure to substantially complete the project by the deadline and to fully and finally complete the project.
- 11.5 Prior to beginning the actual work, the Architect of Record and designated Design Team, Contractor and Owner's representative will meet on site to discuss the scheduling and coordination of the work.
- 11.6 If applicable, the Owner may relocate and/or install certain outside utilities as noted on the plans. If required, this work will begin prior to execution of this contract and be under way as this project starts. Contractor shall coordinate his operations with the Owner to help expedite the work of both parties.
- 11.7 The Owner may provide certain work under separate contract. This work may begin before or while work under this contract is in progress. Contractor shall coordinate his operations with the Owner to help expedite the work of both parties.
- 11.8 The Contractor shall, prior to beginning work, prepare and submit a proposed schedule of work to the Owner for his approval. Work schedule to be planned in coordination with District personnel and performed such that minimal interference to District staff and students occurs. Recommended construction hours are between 7:00 am and 5:00 pm.

## 12. Progress Meetings

Contractor shall meet with the Architect of Record and appropriate Design Team members and Owner's representative as often as necessary to maintain communications between all parties as may be necessary to maintain scheduling and execution of the work in a manner which is least disruptive to the Owner.

## 13. Maintenance Manuals and Recommendations

Contractor shall furnish the Owner two (2) copies of maintenance manuals and recommendations and one (1) pdf and one (1) hard copy for all work installed. Maintenance recommendations shall be furnished in a form approved by the Project Architect and shall be neatly type written, bound and delivered to Owner within ten (10) days of the date of Substantial Completion.

14. Manufacturer's Directions

All manufactured articles, materials, appliances and equipment shall be applied, installed, connected, erected, used, cleaned, conditioned and placed in operation as directed by the representative manufacturers, insofar as these directions are applicable to this particular project and are not in conflict with superior requirements in the specifications.

15. Prohibition on Hazardous Materials

15.1 Contractor shall comply with Federal and State Regulations to verify use of only "lead free" and "asbestos free" materials".

15.2 Contractor shall provide written certification for himself, all Subcontractors, vendors, suppliers, and other entities, stating that materials and/or equipment used in the construction of the project do not contain lead or asbestos in any form or concentration.

16. Record Drawings, As-built Drawings

16.1 Contractor shall provide as-built drawings which clearly show all differences between the contract work as drawn and as actually installed, as well as work added to the contract which is not indicated on the contract drawings.

16.2 Special attention should be paid to precisely documenting changes to concealed work, meaning work installed underground or in areas which cannot be readily inspected by use of access panels, inspection plates or other removable features.

16.3 Contractor shall maintain a set of record drawings at the job site. These drawings shall be kept legible and current and shall be available for inspection at all times by the Owner or Architect/Engineer.

16.4 Upon final completion of the work, Contractor shall transfer the changes noted on the record drawings to the as-built drawings.

16.5 As-built drawings shall contain the names, addresses and phone numbers of all the Subcontractors and shall be signed by Contractor.

16.6 As-built drawings shall be prepared on e-file, PDF format, and plain bond based reproductions paid for by Contractor. The Architect/Engineer's original drawings will be made available to a commercial blueprint or copy company as selected by Contractor. As-builts shall be provided for all sheets of the drawings for each phase of the work proposal.

16.7 In showing changes in the work or added work, use the same legends as used on the contract drawings. The as-built drawings shall consist of a complete set of bond based reproductions. If no changes are made on a particular as-built drawing, a notation reading "No Change" shall be made in the lower right hand corner of the drawing.

16.8 Upon completion of the as-built drawings, Contractor shall submit one set to the Project Architect/Design Team for approval. Any changes required by the Project Architect must be made. Upon receipt of approval of modified drawings, Contractor shall deliver the e-file and one bond copy to the Owner and/or Project Architect.

16.9 The Project Architect shall be the sole judge of acceptability of the as-built drawings. Final payment on the project will not be made until the as-builts and e-file copy as described above are delivered to and accepted by the Project Architect.

17. Storage

Contractor shall provide suitable storage sheds containers or other means to protect and secure all stored material on site. Sheds or other types of covers shall have a neat appearance.

18. Heating, Cooling, and Lighting

Adequate lighting must be provided throughout the project. The permanent HVAC system should be put in operation as soon as possible and shall be used to dry out the building and to provide suitable conditions for finish work.

19. Protection of Property

19.1 Contractor shall protect walks, curbing, drives, parking lots, planting beds, shrubs, trees and lawn areas. All damage caused by Contractor or any Subcontractors shall be remedied at the expense of Contractor.

19.2 Contractor shall provide necessary barricades to protect persons/students entering, leaving or walking around the building during the course of the work or during periods when no work is in progress but when conditions around the project could pose a danger.

20. Telephone

Contractor shall provide a land line telephone for all persons employed on the project. Contractor shall pay for the installation, maintenance, removal, and for all charges for the use of this telephone, except charges for long distance calls which shall be paid by the party making those calls.

21. Fences

Contractor must provide temporary fencing and other barricades to protect stored materials on the site and provide a secure and safe work area around the project. Contractor must coordinate size, location and appearance of all fenced storage and work areas with the Owner's/Architect/Engineer's approval prior to erection.

22. Offices

Contractor shall provide his own office on the premises, maintain it, and remove it when directed by the Owner or the Architect/Engineer. Contractor shall coordinate size and location of all offices with the Owner and Architect/Engineer prior to erection or placement on the premises as may be necessary.

23. Miscellaneous

23.1 Nothing in these Special Conditions shall be construed to diminish the duties, responsibilities and obligations of Contractor as contained in the Construction Agreement between the Owner and Contractor.

23.2 Owner's rules and regulations relating to drug policy, tobacco policy, sexual harassment policy, State of Texas and Texas Education Agency facilities laws, regulations and guidelines, city building codes, ADA guidelines and regulations, and without limitation by enumeration, any other applicable rule or regulation, shall apply to the Architect/Engineer, Contractor and subcontractors on any School District project while on the construction site. The Project Architect and Contractor will be expected to be knowledgeable of all the laws, policies, and regulations listed above. Owner's policies are available from the Assistant to the Superintendent, upon request.

23.3 Contractor and subcontractors shall ensure that on-site fraternization will not occur between personnel under Contractor's or subcontractor's direct or indirect supervision, and students, school employees and the general public.

23.4 All Title VI, Title IX and other applicable Federal and State Regulations shall be complied with and enforced.

23.5 All dates contained or implied in the Contract Documents commence with the date stated in the Construction Agreement, unless otherwise expressly stated.



- 23.6 Expenses incurred by Contractor, and of its employees, and any subcontractors and their employees in connection with travel shall be borne exclusively by Contractor or the subcontractor, in accordance with their respective policy. Such expense includes, without limitation by enumeration, telephone, meals, lodging, transportation and subsistence. In no event shall Contractor or any subcontractor be entitled to any additional compensation from Owner as a result of incurring such expenses.
- 23.7 Construction meetings between the Owner, Architect/Engineer and Contractor will be held a minimum of one time per week, or more frequently as deemed necessary by the Owner or Architect/Engineer, through Final Acceptance and Approval of the project by the Owner.
- 23.8 Acceptance of substantial completion and Final Acceptance and Approval by the Owner is contractual, with the Owner making the final decision.
- 23.9 The date of beginning of Work and the time for completion of Work as specified in the Contract Documents are essential conditions of this Contract. The Work shall be commenced on a date to be specified in the "Notice to Proceed." Contractor agrees that the Work shall be prosecuted regularly and diligently, without interruption, at such a rate of progress as will ensure full completion thereof within the time specified. It is expressly agreed by Contractor that the time for the completion of the Work described herein is a reasonable time for completion.

If Contractor shall neglect, fail or refuse to substantially complete the Work within the time indicated by Contractor in his proposal, or any proper extension thereof granted by the Owner, then Contractor does hereby agree, as a part consideration for the awarding of this Contract, to pay to Owner the amount specified in the Contract, not as a penalty but as liquidated damages for such breach of Contract, as provided in these contract documents, for each and every calendar day that Contractor shall be in default after the time stipulated in the Contract for substantial completion of the Work.

In the event Owner is entitled to liquidated damages under any provision of the Contract Documents, Owner may deduct the amounts of liquidated damages from the next payment due Contractor following the event giving rise to an assessment of liquidated damages, or Owner, at its option, may assess the liquidated damages and deduct them from the final payment due Contractor. In the event the liquidated damages due Contractor should exceed the amount of the final payment due Contractor, Contractor shall pay Owner the difference within fifteen (15) days of receipt of written notice from Owner of the balance due. Owner may offset any liquidated damages due from Contractor at any time against any sums due Contractor by Owner.

If Contractor shall neglect, fail or refuse to substantially complete the Work within the time indicated by Contractor in his proposal, or any proper extension thereof granted by the Owner, then Contractor does hereby agree, as a part consideration for the awarding of this Contract, to pay to Owner the amount specified in the Contract, not as a penalty but as liquidated damages for such breach of Contract, as provided in these contract documents, for each and every calendar day that Contractor shall be in default after the time stipulated in the Contract for substantial completion of the Work.

The amount of liquidated damages set forth in the Construction Agreement is agreed upon by and between Contractor and the Owner because of the impracticality and extreme difficulty of ascertaining the actual damages the Owner would sustain in the events described in those articles. Contractor warrants and represents the stipulated amounts set forth in the Construction Agreement are not a penalty but rather constitute a fair estimation by the parties of the actual damages that Owner would incur under the circumstances; and Contractor further warrants and represents it will not contest this fair estimation in the event any provision of the Contract Documents requires payment of this stipulated amount.

Contractor shall not be charged with liquidated damages or any excess costs when the delay in completion of the Work is due:

1. To any performance, priority or allocated order duly issued by the State or Federal Government.
  2. To unforeseeable cause beyond the control and without the fault or negligence of Contractor, including but not limited to, acts of God, or of the public enemy, acts of another contractor in performance of a contract with the Owner, fires, floods, epidemics, quarantine restrictions, strikes, or freight embargoes.
- 23.10 The failure to enforce the breach of any term or condition contained in these Contract Documents shall never be construed as a waiver to enforce the same or any subsequent breach within the time prescribed by law.
- 23.11 Contractor shall save and keep Owner and Owner's property free from all mechanic's and materialmen's liens and all other liens and claims, legal or equitable arising out of Contractor's work hereunder. In the event any such lien or claim is filed by anyone claiming by, through, or under Contractor, Contractor shall remove and discharge same within ten (10) days of the filing thereof.
- 23.12 In the event Owner or Architect/Engineer perform tests to evidence compliance with the plans and specifications, and if such tests reveal a failure to meet the requirements of the plans and specifications, such tests shall be paid for by Contractor. Contractor shall then verify by independent tests that work has been done to correct all discrepancies.
- 23.13 The Architect/Owner will provide sufficient competent personnel, together with its Consultants, working under the supervision of a qualified Architect/Engineer, for the inspection of the work while such work is in progress to ascertain that the completed work will comply in all respects with the standards and requirements set forth in the specifications. Contractor will be responsible for payment of City inspection personnel if major work related issues are schedule outside of the normal business hours, as is required by the City of Edinburg. Notwithstanding such inspection, the Contractor will be held responsible for the acceptability of the finished work.
- 23.14 The Architect / Engineer and Owner and their representatives shall at all times have access to the work whenever it is in preparation or progress and the Contractor shall provide proper facilities for such access and for inspection.
- 23.15 If the specifications, the Architect's/Engineer's instructions, laws, ordinances, or any public authority require any work to be specially tested or approved, the Contractor shall give the Consultant timely notice of its readiness for inspection. Inspections by the Consultant shall be made promptly and where practicable at the source of supply. If any work should be covered up without approval or consent of the Architect/ Engineer, it must be uncovered at the Contractor's expense, unless the Consultant has unreasonably delayed inspection.
- 23.16 The Owner reserves the option of testing any and all materials used in this construction. All testing will be made by an independent laboratory designated and paid by the Owner, unless otherwise stated in the specifications of the items to be tested. Any costs associated with retesting of materials shall be the responsibility of the contractor as required by the District. Any construction materials not meeting specifications may be rejected at contractor's expense or may be accepted by the District provided an appropriate deduction is granted and agreed upon by the Design Consultant (s). District personnel must be notified 24 hours in advance of materials testing.
- 23.17 Contractor will coordinate with Owner to move onto site. Contractor shall not commence work at site under this Contract until he obtains all required insurance and submits appropriate certifications. Contractor shall, prior to commencement of Work, submit evidence satisfactory to Owner that payment and performance bonds have been issued in the required amounts.
- 23.18 Contractor shall inspect any surfaces for level tolerances and "bird baths," and rectify any such deficiencies.

- 23.19 Submittal of required as-built drawings, warranties, manuals and documents will be submitted to Owner prior to final acceptance phase.
- 23.20 All guarantees and warranties will be properly assigned to Owner and approved by Owner prior to Final Acceptance and Approval.
- 23.21 All record documents will be properly marked.
- 23.22 Any critical work left incomplete or unfinished shall, on the recommendations of the Architect/Engineer, be completed within specifications by Owner or its independent contractor. The cost of such completion shall deducted from the contract amount by change order.
- 23.23 When applicable, special emphasis will be made by Contractor to ensure effective and efficient drainage of all construction sites and parking areas during all phases of construction.
- 23.24 With the exception of such provisions, obligations, duties and responsibilities that are clearly limited to Contractor in these Contract Documents, all the terms, covenants, conditions, rules and requirements imposed upon Contractor in these Contract Documents shall equally apply to and govern the conduct and performance of any of Contractor's subcontractors, sub-subcontractors and their employees.
- 23.25 Contractor shall submit one hard copy of shop drawings together with a scanned PDF of same, product data bond to the Project Architect unless stated differently elsewhere in the contract documents. The Project Architect will not accept shop drawings or other submittals unless Contractor has first reviewed and corrected them and certifies that requirements of the contract documents have been met.
- 23.26 If a dimensional discrepancy exists, Contractor shall take field measurements required for proper fabrication and installation of work. Upon commencement of any item of work, Contractor shall be responsible for dimensions related to such item of Work and shall make any corrections necessary to make work properly fit at no additional cost to Owner.
- 23.27 Contractor shall carefully study and compare Contract Documents with existing conditions at Project site and shall at once report in writing to the Project Architect any error, inconsistency or omission he may discover or any materials, systems, procedures, or methods of construction, either shown on Contract Drawings or specified, which he feels are incorrect, inadequate, obsolete, or unsuitable for purpose intended, or which he would not be satisfied to warranty as specified. Contractor shall not proceed with any work in such areas until written instructions are received from Owner/Project Architect. Failure to report a conflict in Contract Documents shall be conclusive evidence that Contractor has elected to proceed in more expensive manner.
- 23.28 Before ordering any material or doing any work, Contractor shall verify all dimensions and check all conditions in order to assure himself/ herself that they properly reflect those on Drawings. Any inconsistency shall be brought to the attention of the Owner/Project Architect. In the event that discrepancies occur between ordered material and actual conditions, of which the Owner/Project Architect was not notified beforehand, costs to correct such discrepancies shall be borne by Contractor.
- 23.29 Failure to submit a written plan indicating action by Contractor to regain time schedule for completion of work within contract time shall be grounds to deny any related extension request.
- 23.30 All insurance coverage required to be provided by Contractor in these Contract Documents shall be on an occurrence basis. **Owner will not accept any claims made coverage.** Each policy of insurance to be purchased and maintained by Contractor and each certificate of insurance for said insurance shall contain a complete waiver of subrogation against Owner, Architect/Engineer. Each certificate shall also list Owner, Project Architect and Design Team as a party insured. If Owner is



damaged by failure of Contractor to maintain required insurance, then Contractor shall bear all reasonable costs properly attributed thereto.

- 23.31 No sureties will be accepted by Owner who are now in default or delinquent on any bonds or who are interested in any litigation pending against Owner or Contractor during term of this Contract. A surety upon any bond furnished in connection with this Contract shall be by a company holding a certificate of authority as an acceptable surety on Federal Bonds and as acceptable reinsuring company listed in the Federal Register of the Department of Treasury's latest annual edition of surety companies. The surety company or companies furnishing surety bonds for this Contract must show a Department of Treasury underwriting limitation not less than total amount of the Contract. Should any surety be determined unsatisfactory at any time by Owner, notice will be given to Contractor, and Contractor shall immediately provide a new surety acceptable to Owner at no additional cost to Owner. This Contract shall not be valid nor will any payments be due or paid until approval of each bond by Owner.
- 23.32 Owner shall have the right to operate equipment until defects are corrected and warranties met, and shall have the right to operate rejected equipment until it is replaced without charge for depreciation, use or wear.
- 23.33 Contractor shall observe the following policies of employment:
1. Contractor and Contractor's Subcontractors shall not discriminate against any employee or applicant for employment because of race, religion, color, sex or national origin, age, or other impermissible discriminatory reason. Contractor shall ensure that applicants are employed and that employees are treated during employment without regard to their race, religion, color, sex, national origin, age, or other impermissible discriminatory reason. Such actions shall include, but not be limited to, the following: employment, upgrading, demotion or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. Contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices setting forth policies of non-discrimination.
  2. Contractor and Contractor's Subcontractors shall, in all solicitations or advertisements for employees placed by them or on their behalf, state that all qualified applicants will receive consideration for employment without regard to race, religion, color, sex, national origin, age, or other impermissible discriminatory reason.
- 23.34 Time is of the essence of each and every portion of this Contract and of the Specifications wherein a definite and certain length of time is fixed for the performance of any act whatsoever, and where under the Contract an additional time is allowed for the completion of any work, the new time fixed by such an extension shall be of the essence of this Contract.
- 23.35 The plans and specifications may make mention of items "By Owner", "To be Furnished By Owner", "To Be Furnished and Installed by Owner", etc. These items are not a part of the Contract, NIC.
- 23.36 The plans and specifications are written to explain what to do, not how to do it. It is assumed and will be required that all workmanship be in a good and workmanlike manner, in accordance with industry standards and in compliance with current approved standards and codes for that particular phase of the work. No careless or slovenly work of any form will be accepted.
- 23.37 All references to published standards, codes, and statutes shall be to the current edition as of the agreement date unless specific edition is referenced.
- 23.38 No request for the substitution of products in place of those specified shall be considered after the Contract has been executed, except as specified under the conditions set forth in the General Requirements of the Project Manual. By making requests for substitutions, Contractor (1) represents that Contractor has personally investigated the proposed substitute product and determined that it is

equal or superior in all respects to that specified; (2) represents that Contractor will provide same warranty for substitution that Contractor would for that specified; (3) certifies that cost data presented is complete and includes all related costs under this Contract except Architect/Engineer' redesign costs, and waives all claims for additional costs related to substitution which subsequently become apparent; and (4) will coordinate installation of accepted substitute, making such changes as may be required for Work to be complete in all respects.

- 23.39 The Project Architect may appoint an employee or other person to assist him during the construction. These representatives will be instructed to assist Contractor in interpreting the Contract Documents; however, such assistance shall not relieve Contractor from any responsibility as set forth by the Contract Documents. The fact that the Project Architect's Representative may have allowed work not in accordance with the Contract Documents shall not prevent the Project Architect from insisting that the faulty work be corrected to conform with the Contract Documents and Contractor shall correct same.
- 23.40 The reference in the Contract Documents to "fully performed or accepted" or similar phrases refers to the final phase of the construction process and includes final acceptance and approval by Owner. This phase will include the installation, testing and satisfactory operation of all major systems designated by the Owner. All building permits, applicable releases, operating certificates, certificates of occupancy, warranties, mechanical/maintenance training, recommendations and manuals, manufacturer's directions and manuals, completed punch list items, property insurance transfer from Contractor to Owner, "as built" drawings, installation of any permanent locks, key transmittal, samples, final cleaning, materials/supply stock will also be completed to the Owner's satisfaction, if applicable, and in Owner's possession prior to this phase. In essence, the facility must be fully and finally completed for use and occupancy to the Owner's satisfaction and all improvements and equipment installed in a good and workmanlike manner and functioning as intended in accordance with the design and specifications.
- 23.41 Contractor hereby assigns to Owner any and all claims for overcharges associated with the Contract which arise under the antitrust laws of the United States, 15 U.S.C.A. § 1, *et seq.* (1973).
- 23.42 The extent to which Owner may extend indemnity and waivers of subrogation to other parties shall be governed and limited by State law where applicable.
- 23.43 All work under this contract shall conform to the requirements of these specifications.
- 23.44 All labor, materials, equipment, supervision and other services required for this construction will be furnished in accordance with plans and specifications as prepared by the Consultant (architect / engineer).
- 23.45 All work to be performed in close association with project architect, engineer (Consultant) or designer. Before civil, site improvements proceed, verify locations with the Operation's staff and Consultants.
- 23.46 Edinburg CISD along with their Consultant personnel have delineated work areas and access routes. Any damaged property not otherwise mentioned within plans or specifications to be installed, shall be the responsibility of the contractor (product and installation) as approved by District personnel.
- 23.47 Contractor will not be allowed use of existing bathrooms and will provide for his personnel's needs through the lease / rental of portable bathroom units at his own expense. The location / placement of these units will be mutually agreed to by Owner and Contractor prior to placement.
24. Security Measures
- 24.1 A contractor's superintendent shall be on the job at all times that construction workers are present at the construction site. This superintendent shall be familiar with and able to direct the various trades personnel regarding proper completion of work. All construction personnel shall wear safety vests,

hard hats and appropriate (closed shoe) footwear protection at a minimum. Other personal injury protection gear may be required to perform duties on site and will be the responsibility of the General Contractor as well as the sub-contractors. Use or storage of explosives or other volatile materials on this site is expressly forbidden.

25. Utilities

25.1 Contractor to provide for his own utility requirements. Directional bores/trenching will not begin until adequate and reasonable measures have been made to determine existing underground utilities/easements. This will require coordination with local utilities and District personnel.

26. Building Permit and Taxes

26.1 A building permit may be required for the construction of this project and will be the responsibility of the General Contractor.

27. Material Deliveries

27.1 District Operation staff shall explain how material deliveries are to arrive and where materials and workman tool boxes may be store at the pre-construction meeting.

28. Changes in the Work

28.1 In giving instructions, the Owner shall have authority to make minor changes in the work not involving cost and not inconsistent with the purposes of the work, but otherwise, except in an emergency endangering life or property, no extra work or change shall be made unless in pursuance of a written order by the Owner, and no claim for an addition to the Contract Sum shall be valid unless the additional work was so ordered.

29. Competency of Bidders

29.1 The Bidder must be capable of performing each of the various items of work bid upon. Upon request, the successful Bidder shall submit a complete statement of his financial resources and his previous experience in similar work.

30. Guarantee of Work

30.1 All workmanship, equipment and materials, furnished or installed by the Contractor shall be guaranteed for a period represented in the applicable specification of system in question against faulty workmanship or defective materials. The warranty period shall begin on the date of substantial completion and acceptance of the project by the Owner and extend for a minimum period of 365 days thereafter. Warranty periods on punch list items shall begin when items are approved as corrected.

31. Final Clean-Up

31.1 Upon completion of the work and before acceptance and final payment is made, the Contractor shall clean and remove from the site of the work all brush, trash, surplus and discarded materials, temporary services, materials and debris of every kind. The Contractor shall leave the site of the work in a neat and orderly condition equal to that which originally existed. Waste materials removed from the site shall be disposed of at locations satisfactory to the project architect / engineer and shall be considered incidental to the bid.

32. Correction of Work before Final Payment

32.1 The Contractor shall promptly remove from the premises all materials and work condemned by the Owner/Consultant as failing to meet Contract requirements, whether incorporated in the work or not. The contractor shall promptly replace and re-execute his own work in accordance with the Contract and without expense to the Owner and shall bear the expense of making "good" all work of other contractors destroyed or damaged by such removal or replacement.

If the Contractor does not take action to remove such condemned materials and work within ten (10) days after written notice, the Owner may remove them and may store the material at the expense of the Contractor. If the Contractor does not pay the expense of such removal and storage within ten days' time thereafter, the Owner may, upon ten days' written notice, sell such materials at auction or at private sale and shall pay the Contractor any net proceeds thereof, after deducting all costs and expenses that should have been borne by the Contractor.

**33. Project Description, Products and Installation**

- 33.1 It will be the contractor's responsibility to repair any underground utilities punctured/ broken during trenching/ boring operations in a timely manner. Be advised that electrical, gas, data, water and sewage lines serving the campuses are essential to everyday campus operations and damage to any of these utilities requires repair immediately and without pause. Directional bores/trenching will not begin until adequate and reasonable measures have been made to determine existing underground utilities/easements. This will require coordination with local utilities and District personnel.
- 33.2 All prospective contractors are encouraged to visit the site in order to properly gauge the proposed improvements. It is expected that the contractor will work closely with the Owner/Architect as the improvements are planned and construction activities progress.
- 33.3 The improvements at these distinct campus sites will create complete, finished and operational improvements. These improvements shall include all components and accessories required to provide a complete, operational and cleanly finished installation. Work shall be substantially complete as described within the contract documents.
- 33.4 This job will be as described in the attached design and specifications.

DOCUMENT 000101 - PROJECT TITLE PAGE

1.1 PROJECT MANUAL VOLUME 1

- A. UTRGV-Edinburg CISD Early College High School
- B. UTRGV and Edinburg CISD
- C. Edinburg, Texas
- D. Architect Project No. E2002822



GMS ARCHITECTS

- E. 
- F. GMS Architects
- G. 1150 Paredes Line Road
- H. Brownsville, TX 78521
- I. Phone: 956.546.0110
- J. Issued: September 9, 2022

END OF DOCUMENT 000101

## DOCUMENT 002513 - PREBID MEETINGS

### 1.1 PREBID MEETING

A. **Owner** and **Architect** will conduct a Prebid meeting as indicated below:

1. Meeting Date: September 21, 2022.
2. Meeting Time: 11:00am local time.
3. Location: ECISD Facilities Department  
1305 E. Schunior  
Edinburg, Texas 78541

B. Attendance:

1. Prime Bidders: Attendance at Prebid meeting is recommended.
2. Subcontractors: Attendance at Prebid meeting is recommended.

C. Agenda: Prebid meeting agenda will include review of topics that may affect proper preparation and submittal of bids, including the following:

1. Procurement and Contracting Requirements:
  - a. Advertisement for Bids.
  - b. Instructions to Bidders.
  - c. Bidder Qualifications.
  - d. Bonding.
  - e. Insurance.
  - f. Bid Security.
  - g. Bid Form and Attachments.
  - h. Bid Submittal Requirements.
  - i. Notice of Award.
2. Communication during Bidding Period:
  - a. Obtaining documents.
  - b. Bidder's Requests for Information.
  - c. Bidder's Substitution Request/Prior Approval Request.
  - d. Addenda.
3. Contracting Requirements:
  - a. Agreement.
  - b. The General Conditions.
  - c. The Supplementary Conditions.
  - d. Other Owner requirements.
4. Construction Documents:
  - a. Scopes of Work.
  - b. Temporary Facilities.

- c. Use of Site.
  - d. Work Restrictions.
  - e. Alternates, Allowances, and Unit Prices.
  - f. Substitutions following award.
5. Separate Contracts:
- a. Work by Owner.
6. Schedule:
- a. Project Schedule.
  - b. Contract Time.
  - c. Liquidated Damages.
  - d. Other Bidder Questions.
- D. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes and will issue thru an Addendum to all parties on project bidders list.
- 1. Sign-in Sheet: Minutes will include list of meeting attendees.

END OF DOCUMENT 002513



## DOCUMENT 003132 - GEOTECHNICAL DATA

### 1.1 GEOTECHNICAL DATA

- A. This Document with its referenced attachments is part of the Procurement and Contracting Requirements for Project. They provide Owner's information for Bidders' convenience and are intended to supplement rather than serve in lieu of Bidders' own investigations. They are made available for Bidders' convenience and information. This Document and its attachments are not part of the Contract Documents.
- B. Because subsurface conditions indicated by the soil borings are a sampling in relation to the entire construction area, and for other reasons, the Owner, the Architect, the Architect's consultants, and the firm reporting the subsurface conditions do not warranty the conditions below the depths of the borings or that the strata logged from the borings are necessarily typical of the entire site. Any party using the information described in the soil borings and geotechnical report shall accept full responsibility for its use.
- C. Soil-boring data for Project, obtained by Raba Kistner, dated August 29, 2022 is available for viewing as appended to this Document.
- D. A geotechnical investigation report for Project, prepared by Raba Kistner, dated August 29, 2022 is available for viewing as appended to this Document.
  - 1. The opinions expressed in this report are those of a geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by a geotechnical engineer. Owner is not responsible for interpretations or conclusions drawn from the data.
  - 2. Any party using information described in the geotechnical report shall make additional test borings and conduct other exploratory operations that may be required to determine the character of subsurface materials that may be encountered.

END OF DOCUMENT 003132



**GEOTECHNICAL ENGINEERING STUDY**

**FOR**

**PROPOSED EDINBURG CISD AND  
UTRGV COLLEGIATE HIGH SCHOOL  
EDINBURG, HIDALGO COUNTY, TEXAS**

---



Raba Kistner, Inc.  
800 East Hackberry  
McAllen, TX 78501  
www.rkci.com

P 956.682.5332  
F 956.682.5487  
TBPE Firm F-3257  
TBAE Firm BR 3427

Project No. AMA22-048-00  
August 29, 2022

Mr. Victor Gonzalez  
Director for Facilities  
Edinburg Consolidated Independent School District (Edinburg CISD)  
1305 E. Schunior  
Edinburg, Texas 78541

**RE: Geotechnical Engineering Study  
Proposed Edinburg CISD and UTRGV Collegiate High School  
Near the Northwest Corner of the Intersection of  
E. Freddy Gonzalez Drive and U.S. 281 Frontage Road  
Edinburg, Hidalgo County, Texas**

Dear Mr. Gonzalez:

**RABA KISTNER Consultants, Inc. (RKCI)** is pleased to submit the report of our Geotechnical Engineering Study for the above-referenced project. This study was performed in accordance with **RKCI** Proposal No. PMA22-057-00, dated July 21, 2022. Written authorization to proceed with this study was received by our firm via electronic-mail attachment on Tuesday, July 26, 2022. The purpose of this study was to evaluate subsurface conditions at the subject site, and to prepare an engineering report presenting foundation and pavement design and construction recommendations for the proposed school campus.

The following report contains our foundation and pavement recommendations and considerations based on our current understanding of the design tolerances, and structural and pavement loads. If any of these parameters change, then there may be alternatives for value engineering of the foundation and pavement systems, and **RKCI** recommends that a meeting be held with Edinburg CISD (CLIENT) and the design team to evaluate these alternatives.



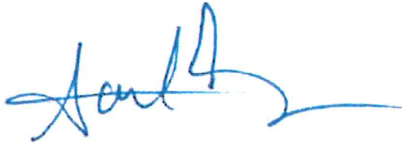
Project No. AMA22-048-00  
August 29, 2022

2

We appreciate the opportunity to be of professional service to you on this project. Should you have any questions about the information presented in this report, please call. We look forward to assisting Edinburg CISD during the construction of the project by conducting the construction materials engineering and testing services (quality assurance program).

Very truly yours,

**RABA KISTNER CONSULTANTS, INC.**



Saul Cruz, EIT  
Graduate Engineer

Attachments

SC/KML

Copies Submitted:      Above (1)



Katrin M. Leonard, P.E.  
Vice President

Aug. 29, 2022

**GEOTECHNICAL ENGINEERING STUDY**

For

**PROPOSED EDINBURG CISD AND UTRGV COLLEGIATE HIGH SCHOOL  
NEAR THE NORTHWEST CORNER OF THE INTERSECTION OF  
E. FREDDY GONZALEZ DRIVE AND U.S. 281 FRONTAGE ROAD  
EDINBURG, HIDALGO COUNTY, TEXAS**

Prepared for

**EDINBURG CISD**  
Edinburg, Texas

Prepared by

**RABA KISTNER CONSULTANTS, INC.**  
McAllen, Texas

**PROJECT NO. AMA22-048-00**

August 29, 2022

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- Boring Location Map
- Logs of Borings
- Key to Terms and Symbols
- Results of Soil Sample Analyses
- Lime Series Determination
- Important Information About Your Geotechnical Engineering Report



## INTRODUCTION

**RABA KISTNER Consultants, Inc. (RKCI)** has completed the authorized subsurface exploration, and foundation and pavement recommendations for the proposed school campus to be located near the northwest corner of E. Freddy Gonzalez Drive and U.S. 281 Frontage Road in Edinburg, Hidalgo County, Texas. This report briefly describes the procedures utilized during this study and presents our findings along with our recommendations for site preparation, and foundation and pavement design and construction considerations for the proposed school campus.

## PROJECT DESCRIPTION

We understand that the proposed project consists of the design and construction of a two-story, irregular-shaped, about 76,000 ft<sup>2</sup>, educational building, and its associated parking and driveway areas. The proposed school campus is planned to be located within an undeveloped tract of land, situated near the northwest corner of E. Freddy Gonzalez Drive and U.S. 281 Frontage Road in Edinburg, Hidalgo County, Texas. The proposed educational building is expected to create relatively light to moderate loads to be carried by the foundation system, which is anticipated to consist of a shallow foundation system. The pavement systems are anticipated to consist of either flexible (asphalt) and/or rigid (concrete) pavement system.

For purposes of this geotechnical engineering report, the finished grade elevation (FGE) of the proposed educational building was assumed to be about 1 ft (12 inches) above the ground surface elevation existing at the time of our study, since no site grading information was provided to us at the time of the preparation of this report.

On the basis of our telephone conversation held with Mr. Victor Gonzalez, Director for Facilities with Edinburg Consolidated Independent School District (Edinburg CISD), on Thursday, August 18, 2022, we understand that about six school buses, twice a day, five days a week, are anticipated to service the school campus.

## LIMITATIONS

This engineering report has been prepared in accordance with accepted Geotechnical Engineering practices in the region of South Texas for the use of Edinburg CISD (CLIENT) and its representatives for design purposes. This report may not contain sufficient information for purposes of other parties or other uses and is not intended for use in determining construction means and methods.

The recommendations submitted in this report are based on the data obtained from eight borings drilled within the site, our understanding of the project information provided to us by the CLIENT, and the assumption that site grading will result in only minor changes in the topography existing at the time of our study. If the project information described in this report is incorrect, is altered, or if new information is available, we should be retained to review and modify our recommendations.

This report may not reflect the actual variations of the subsurface conditions across the subject site. The nature and extent of variations across the subject site may not become evident until construction commences. The construction process itself may also alter subsurface conditions. If variations appear evident at the time of construction, it may be necessary to reevaluate our recommendations after performing on-site observations and tests to establish the engineering impact of the variations.

The scope of our Geotechnical Engineering Study does not include an environmental assessment of the air, soil, rock, or water conditions either on or adjacent to the subject site. No environmental opinions are presented in this report. **RKCI**'s scope of work does not include the investigation, detection, or design related to the prevention of any biological pollutants. The term "biological pollutants" includes, but is not limited to, mold, fungi, spores, bacteria, and viruses, and the byproduct of any such biological organisms.

If final grade elevations are significantly different from the grades assumed in this report, our office should be informed about these changes. If needed and/or desired, we will reexamine our analyses and make supplemental recommendations.

### BORINGS AND LABORATORY TESTS

Subsurface conditions at the subject site were evaluated by conducting eight borings as shown in the following table:

Proposed Structure	Number of Borings	Depth, ft. *	Boring Identification
Educational Building	1	50	B-1
	2	30	B-2 and B-3
Driveway and Parking Lot Areas	5	5	P-1 through P-5

\* below the ground surface elevation existing at the time of our study.

The borings (designated as "B-" and "P-") were drilled on Tuesday, August 9, 2022, at the locations shown on the Boring Location Map, Figure 1. The boring locations are approximate and were located in the field by an **RKCI** representative based on the untitled and undated site plan provided to us via electronic-mail attachment by the CLIENT on Wednesday, July 20, 2022. The borings were drilled using a truck-mounted, rotary-drilling rig. The borings were drilled utilizing straight flight augers and were backfilled with the auger cuttings following completion of the drilling operations. During the drilling operations, Split-Spoon (with Standard Penetration Test, SPT) and Shelby-tube (ST) samples were collected.

The SPT and ST samples were obtained in accordance with accepted standard practices and the penetration test results are presented as "blows per foot" on the boring logs. Representative portions of the samples were sealed in containers to reduce moisture loss, labeled, packaged, and transported to our laboratory for subsequent testing and classification.

In the laboratory, each sample was evaluated and visually classified by a member of our Geotechnical Engineering staff in general accordance with the Unified Soil Classification System (USCS). The geotechnical

engineering properties of the strata were evaluated by the following laboratory tests: natural moisture content, Atterberg limits, unconfined compressive strength, dry unit weight determinations, a lime series, a corrosivity test (including electrical resistivity, pH, and chloride and sulfate content determinations), and percent passing a No. 200 sieve determinations.

With the exception of the laboratory corrosivity test, sulfate content determinations, and lime series test results, the results of the field and laboratory tests are presented in graphical or numerical form on the boring logs illustrated on Figures 2 through 9. A key to the classification of terms and symbols used on the logs is presented on Figure 10. The results of the laboratory and field testing are also tabulated on Figure 11 for ease of reference. Further, the results of the lime series test are presented on Figure 12 and discussed in a subsequent section of this report.

The corrosion potential of the subsurface soils to concrete and uncoated steel was preliminarily evaluated by conducting laboratory analyses (pH, electrical resistivity, sulfate content and chloride content) on a single bulk soil sample obtained within the educational building footprint area from an approximate depth of about 2 ft below the ground surface elevations existing at the time of our study. The laboratory test results are presented and discussed in a subsequent section of this report.

SPT results are noted as “blows per ft” on the boring logs and on Figure 11, where “blows per ft” refers to the number of blows by a falling 140-lb (pound) hammer required for 1 ft of penetration into the subsurface materials.

Samples will be retained in our laboratory for 30 days after submittal of this report. Other arrangements may be provided at the written request of the CLIENT.

## **GENERAL SITE CONDITIONS**

### **SITE DESCRIPTION**

The subject site for the proposed school campus is near the northwest corner of E. Freddy Gonzalez Drive and U.S. 281 Frontage Road in Edinburg, Hidalgo County, Texas. At the time of our field activities, the project site can be described as an undeveloped, tract of land with an asphalt-paved, access road and parking lot along the center of the subject site. In general, the topography at the subject site is relatively flat, with a visually estimated vertical relief of about 3 ft across the site. Surface drainage is estimated to be poor. The project site is bounded to the north by an existing educational building; to the east by U.S. 281 Frontage Road; to the south by E. Freddy Gonzalez Drive; and to the west by S. 21<sup>st</sup> Avenue.

### **SITE GEOLOGY**

A cursory review of the Geologic Atlas of Texas (McAllen-Brownsville Sheet, dated 1976), published by the Bureau of Economic Geology at the University of Texas at Austin, indicates that the subject site appears to be located within the Lissie Formation consisting of clays, silts, sands, gravel, and caliche deposits of the Quaternary epoch (Pleistocene period).



According to the Soil Survey of Hidalgo County, Texas, published by the United States Department of Agriculture - Soil Conservation Service, in cooperation with the Texas Agricultural Experiment Station, the project site appears to be located within the Hidalgo soil association consisting of deep, moderately permeable soils that typically have a dark grayish-brown, sandy clay loam surface layer. The corresponding soil symbol appears to be 31, Hidalgo-Urban land complex.

### SEISMIC COEFFICIENTS

Based upon a review of Section 1613 *Earthquake Loads* of the 2015 International Building Code (IBC), the following information has been summarized for seismic considerations associated with this site.

- Site Class Definition (Chapter 20 of the American Society of Civil Engineers [ASCE] 7): **Class D**. Based on the soil borings conducted for this investigation, the upper 100 feet of soil may be may be characterized as a stiff soil profile.
- Risk-Targeted Maximum Considered Earthquake Ground Motion Response Accelerations for the Conterminous United States of a 0.2-Second, Spectral Response Acceleration (5% of Critical Damping) (Figure 1613.3.1(1)):  **$S_s = 0.043g$** . Note that the value taken from Figure 1613.3.1(1) is based on Site Class B and is adjusted as per 1613.3.3 below.
- Risk-Targeted Maximum Considered Earthquake Ground Motion Response Accelerations for the Conterminous United States of a 1-Second, Spectral Response Acceleration (5% of Critical Damping) (Figure 1613.3.1(2)):  **$S_1 = 0.015g$** . Note that the value taken from Figure 1613.3.1(2) is based on Site Class B and is adjusted as per 1613.3.3 below.
- Value of Site Coefficient (Table 1613.3.3 (1)): *from worksheet*  **$F_a = 1.6$** .
- Value of Site Coefficient (Table 1613.3.3 (2)): *from worksheet*  **$F_v = 2.4$** .

The Maximum Considered Earthquake Spectral Response Accelerations are as follows:

- 0.2 sec., adjusted based on equation 16-37: *from worksheet*  **$S_{ms} = 0.069g$** .
- 1 sec., adjusted based on equation 16-38: *from worksheet*  **$S_{m1} = 0.035g$** .

The Design Spectral Response Acceleration Parameters are as follows:

- 0.2 sec., based on equation 16-39: *from worksheet*  **$S_{DS} = 0.046g$** .
- 1 sec., based on equation 16-40: *from worksheet*  **$S_{D1} = 0.023g$** .

Based on the parameters listed above, the critical nature of the structure, Tables 1613.3.5(1) and 1613.3.5(2), and calculations performed using a Java program titled, "Seismic Hazard Curves and Uniform Hazard Response Spectra" published by the United States Geological Survey (USGS) website, the Seismic Design Category for both short period and 1 second response accelerations is **A**. As part of the assumptions required to complete the calculations, a Risk Category of **II** was selected.

### STRATIGRAPHY

With the exception of Boring P-1, the subsurface stratigraphy at this site can be described by a single generalized stratum with similar physical and engineering characteristics. This stratum consists of dark brown to light brown, firm to hard, lean clay soils, lean clay soils with sand, sandy lean clay soils, and fat clay soils. This layer was noted in the borings from the ground surface elevation existing at the time of our drilling operations, and extending down to at least the termination depths of the borings. Measured moisture contents range from about 10 to 24 percent. This stratum is classified as moderately plastic to plastic, with measured plasticity indices ranging from 16 to 38 percent. Percent passing a No. 200 sieve tests demonstrate percent fines ranging from 69 to 96 percent. SPT N-values ranging from 5 blows to 49 blows per foot of penetration were measured for this stratum. These soils are classified as CL soils and/or CH soils in general accordance with the USCS.

It should be noted that a layer of brown, loose to medium dense, clayey sand soils was encountered in Boring P-1, from the ground surface elevation existing at the time of our drilling operations, and extending down to at least the termination depth of this boring. Measured moisture contents were about 8 and 19 percent. This stratum is classified as moderately plastic, with a single measured plasticity index of 19 percent. A single percent passing a No. 200 sieve test demonstrates a percent fine of 48 percent. Two SPT N-values of 8 blows and 12 blows per foot of penetration were measured for this stratum. These soils are classified as SC soils in general accordance with the USCS.

### CORROSIVITY POTENTIAL

The corrosivity characteristics of the subsurface soils were preliminarily evaluated by conducting a pH test, an electrical resistivity test, a sulfate content test, and a chloride content test. These tests were conducted on a single bulk specimen from the subsurface soils obtained from Boring B-1 from a depth of about 2 ft below the ground surface elevation existing at the time of our study. Laboratory test results are summarized in the following table:

Sample Location	Electrical Resistivity (ohm-cm)	pH	Sulfate Content (ppm)	Chloride Content (mg/kg)
Boring B-1	883.2	8.71	140	215

Where: ppm = parts per million  
mg/kg = milligrams per kilogram

The results of the laboratory chloride content test conducted on the composite soil samples indicate a relatively moderate to low potential for corrosion to buried metals. The electrical resistivity laboratory test result indicate that the subsurface soils have an extremely aggressive corrosion potential to buried metals. According to the American Concrete Institute (ACI) document titled "Guide to Durable Concrete" (ACI 201), concrete usually provides protection against rusting of adequately embedded steel because of the highly alkaline environment of the Portland cement paste. The adequacy of that protection is dependent upon the amount of concrete cover, the quality of the concrete, the details of the construction, and the degree of exposure to chlorides from concrete-making components and external sources. It is

recommended that no chloride-containing admixtures be utilized in the concrete mixes for this project. Consideration should also be given to implementing corrosion protection measures for buried metals in direct contact with the soil, such as coating metal structural elements, pipings, and/or fittings. The pH laboratory test result indicate that the surficial native soils are strongly alkaline. On the basis of the laboratory sulfate content test result, the subsurface soils appear to result in a mild exposure of concrete to corrosion. According to this laboratory test result, the native clay soils result in a Class 0 severity of potential exposure of concrete to corrosion. The ACI 201 Guide indicates no special cementitious material requirements for sulfate resistance for a Class 0 exposure.

### **GROUNDWATER**

Groundwater was encountered during our drilling operations only in Boring B-1 at a depth of about 15 ft below the ground surface elevations existing at the time of our study. The boreholes were left open for the duration of the field exploration phase to allow monitoring of water levels. It is possible for groundwater to exist beneath this site at shallower depths on a transient basis following periods of precipitation. Fluctuations in groundwater levels occur due to variations in rainfall and surface water runoff. The construction process itself may also cause variations in the groundwater level.

Based on the findings in the borings and on our experience in this region, we believe that groundwater seepage encountered during site earthwork activities and shallow foundation construction may be controlled using temporary earthen berm and conventional sump-and-pump dewatering methods.

## **FOUNDATION ANALYSIS**

### **EXPANSIVE, SOIL-RELATED MOVEMENTS**

The anticipated ground movements due to swelling of the underlying soils at the site were estimated for slab-on-grade construction using the empirical procedure, Texas Department of Transportation (TxDOT) Tex-124-E, Method for Determining the Potential Vertical Rise (PVR). PVR values ranging from about 1-1/4 inches were estimated for the stratigraphic conditions encountered in the borings. The PVR values were estimated using a surcharge load of 1 pound per square inch (psi) for the concrete slab and dry moisture conditions within the regional zone of seasonal moisture variation.

The TxDOT method of estimating expansive, soil-related movements is based on empirical correlations utilizing the measured plasticity indices and assuming typical seasonal fluctuations in moisture content. If desired, other methods of estimating expansive, soil-related movements are available, such as estimations based on swell tests and/or soil-suction analyses. However, the performance of these tests and the detailed analysis of expansive, soil-related movements were beyond the scope of the current study. It should also be noted that actual movements can exceed the estimated PVR values due to isolated changes in moisture content (such as due to leaks, landscape watering, etc.) or if water seeps into the soils to greater depths than the assumed active zone depth due to deep trenching or excavations.



### **PVR REDUCTION RECOMMENDATIONS**

As mentioned previously, for purposes of this geotechnical engineering report, the FGE of the proposed educational building was assumed to be about 1 ft (12 inches) above the ground surface elevation existing at the time of our study, since no site grading information was provided to us at the time of the preparation of this report.

To reduce expansive, soil-related movements in at-grade construction beneath the educational building footprint area to about 1 inch, we recommend to remove about 1 ft (12 inches) of the existing subgrade soils, and place properly-compacted, suitable, select fill materials up to the proposed educational building's FGE. Keep in mind that the estimated PVR values are computed based on the recommendations for the selection and placement of suitable, select fill materials which are addressed in the *Foundation Construction Considerations* section of the report.

**Drainage Considerations** When overexcavation and select fill replacement is selected as a method to reduce the potential for expansive, soil-related movements at any site, considerations of surface and subsurface drainage may be crucial to construction and adequate foundation performance of the soil-supported structure. Filling an excavation in relatively impervious clay soils with relatively pervious select fill material creates a "bathtub" beneath the structure, which can result in ponding or trapped water within the fill unless good surface and subsurface drainage is provided.

Water entering the fill surface during construction or entering the fill exposed beyond the structure lines after construction may create problems with fill moisture control during compaction and increased access for moisture to the underlying expansive clays both during and after construction.

Several surface and subsurface drainage design features and construction precautions can be used to limit problems associated with fill moisture. These features and precautions may include, but are not limited to, the following:

- Installing berms or swales on the uphill side of the construction area to divert surface runoff away from the excavation/fill area during construction;
- Sloping of the top of the subgrade with a minimum downward slope of 1.5 percent out to the base of a dewatering trench located beyond the structure's perimeter;
- Sloping the surface of the fill during construction to promote runoff of rain water to drainage features until the final lift is placed;
- Sloping of a final, well-maintained, impervious clay or pavement surface (downward away from the proposed structure) over the select fill material and any perimeter drain extending beyond the structure lines, with a minimum gradient of 6 in. in 5 ft;
- Constructing final surface drainage patterns to prevent ponding and limit surface water infiltration at and around the structure's perimeter;
- Locating the water-bearing utilities, roof drainage outlets, and irrigation spray heads outside of the select fill and perimeter drain boundaries; and
- Raising the elevation of the ground level floor slab.



Details relative to the extent and implementation of these considerations must be evaluated on a project-specific basis by all members of the project design team. Many variables that influence fill drainage considerations may depend on factors that are not fully developed in the early stages of design. For this reason, drainage of the fill should be given consideration at the earliest possible stages of the project.

## FOUNDATION RECOMMENDATIONS

### SITE GRADING

Site grading plans can result in changes in almost all aspects of foundation recommendations. We have prepared the foundation recommendations based on the assumption that the FGE will be about (1 ft) 12 inches above the ground surface elevation existing at the time of our study and the stratigraphic conditions encountered in the borings at the time of our study. If site grading plans differ from the assumed finished grades, we must be retained to review the site grading plans prior to bidding the project for construction. If needed and/or if desired, we will reexamine our analyses and make supplemental recommendations.

### SHALLOW FOUNDATIONS

The proposed educational building may be founded on conventional spread and/or continuous footing foundations in conjunction with a fill-supported concrete slab, provided that the shallow foundation system can be designed to withstand the anticipated soil-related movements (see the *Foundation Analyses* section of this report) without impairing either the structural or the operational performance of the proposed building structure.

#### Allowable Soil-Bearing Capacity

Shallow foundation founded on new, properly-compacted, suitable, select fill materials, following the implementation of the ground improvement procedures presented in the *PVR Reduction Recommendation* subsection of the *Foundation Analysis* section of this report may be proportioned using the design parameters shown in the following table:

Minimum depth below final grade:	24 in.
Minimum beam width:	12 in.
Maximum allowable soil-bearing pressure for continuous footings-grade beams:	1,700 psf
Maximum allowable soil-bearing pressure for spread footings-widened beams:	2,100 psf

where psf = pounds per square feet.

The maximum allowable soil-bearing pressures presented previously will provide a factor of safety of about 3 with respect to the measured soil shear strengths, provided that the subgrade is prepared in accordance with the recommendations outlined in the *Site Preparation* subsection of the *Foundation Construction Considerations* section of this report, and that the site improvement procedure included in

the *PVR Reduction Recommendations* subsection of the *Foundation Analyses* section of this report is properly implemented. Provided that the site improvement procedure recommended in this report is properly implemented, then it is anticipated that total settlements will be in the order of about 1 inch. Differential settlements typically are estimated to be about one-half the total estimated settlement for most subsurface conditions.

Furthermore, the design parameters presented on the previous table are contingent upon the fill materials being selected and placed in accordance with the recommendations presented in the *Select Fill* subsection of the *Foundation Construction Considerations* section of this report. Should select fill selection and placement differ from the recommendations presented herein, **RKCI** should be informed of the deviations in order to reevaluate our recommendations and design criteria.

#### **Wire Reinforcement Institute (WRI) Criteria**

Slab-on-fill shallow foundations may also be designed using WRI design criteria. On the basis of the subsurface stratigraphy encountered, a general effective plasticity index for the proposed educational building's of 27 percent and a climatic rating ( $C_w$ ) of 15 should be utilized for the design of the proposed building's foundation.

#### **AREA FLATWORK**

It should be noted that ground-supported flatwork such as walkways, courtyards, sidewalks, etc., will be subject to the same magnitude of potential soil-related movements as discussed previously (see the *Foundation Analyses* section of this report). Thus, where these types of elements abut rigid building foundations or isolated structures, differential movements should be anticipated. As a minimum, we recommend that flexible joints be provided where such elements abut the main structure to allow for differential movement at these locations. Where the potential for differential movement is objectionable, it may be beneficial to consider methods of reducing anticipated movements to match the adjacent building performance.

### **FOUNDATION CONSTRUCTION CONSIDERATIONS**

#### **SITE DRAINAGE**

Drainage is an important key to the successful performance of any foundation. Good surface drainage should be established prior to and maintained after construction to help prevent water from ponding within or adjacent to the structure's foundation, and to facilitate rapid drainage away from the structure's foundation. Failure to provide positive drainage away from the structure can result in localized differential vertical movements in the soil-supported foundations and floor slabs.

Current ordinances, in compliance with the Americans with Disabilities Act (ADA), may dictate maximum slopes for walks and drives around and into new buildings. These slope requirements can result in drainage problems for buildings supported on expansive soils. We recommend that, on all sides of the structure, the maximum permissible slope be provided away from the structure.

Also to help control drainage in the vicinity of the structure, we recommend that roof/gutter downspouts and landscaping irrigation systems not be located adjacent to the structure's foundation. Where a select fill overbuild is provided outside of the floor slab/foundation footprint, the surface should be sealed with an impermeable layer (pavement or clay cap) to reduce infiltration of both irrigation and surface waters. Careful consideration should also be given to the location of water bearing utilities, as well as to provisions for drainage in the event of leaks in water bearing utilities. All leaks should be immediately repaired.

Other drainage and subsurface drainage issues are discussed in the *Foundation Analysis* section of this report.

### **SITE PREPARATION**

The proposed educational building areas and all areas to support select fill should be stripped of all pavement constituents, all vegetation, and/or organic topsoil down to a minimum depth of 8 inches and extending a minimum of 5 ft beyond the footprint of the proposed building. Further, we recommend that the site improvement procedure presented in the *PVR Reduction Recommendations* section of this report be implemented in order to reduce expansive, soil-related movements in at-grade construction to about 1 inch.

Beyond the structure pad footprint, existing utilities and trenches that are not removed should be properly abandoned. This would include grouting abandoned pipes and sealing off granular fill in trenches to prevent the migration and seepage of water into the foundation areas of the new structure.

Exposed subgrade should be thoroughly proofrolled in order to locate and densify any weak, compressible zones. A minimum of 5 passes of a fully-loaded dump truck or a similar heavily-loaded piece of construction equipment should be used for planning purposes. Proofrolling operations should be observed by the Geotechnical Engineer or his/her representative to document subgrade conditions and preparation. Weak or soft areas identified during proofrolling activities should be treated with hydrated lime or Portland cement or removed and replaced with suitable, compacted select fill in accordance with the recommendations presented under the *Select Fill* subsection of this section of the report. If the treatment option is selected, the weak or soft areas may be mixed with hydrated lime or Portland cement down to a minimum depth of 8 inches in order to aid in drying the soils and develop a firm working surface. Proofrolling operations and any excavation/backfill activities should be observed by **RKCI** representatives to document subgrade preparation.

Upon completion of the proofrolling operations and just prior to fill placement, the exposed subgrade should be moisture-conditioned by scarifying to a minimum depth of 8 in. and recompacting to a minimum of 98 percent of the maximum dry density as determined from ASTM D698, Compaction Test. The moisture content of the fill should be maintained within the range of the optimum moisture content to three percentage points above the optimum moisture content until the final lift of fill is permanently covered.



### **SELECT FILL**

Materials used as select fill for final site grading preferably should be crushed stone or gravel aggregate. We recommend that materials specified for use as select fill meet the TxDOT 2014 Standard Specification for Construction and Maintenance of Highways, Streets, and Bridges, Item 247, Flexible Base, Type A through Type E, Grades 1, 2, 3, and 5.

Alternatively, the following soils, as classified according to the USCS, may be considered satisfactory for use as select fill materials at this site: SC, GC, CL, and combinations of these soils. In addition to the USCS classification, alternative select fill materials shall have a maximum liquid limit of 40 percent, a plasticity index between 7 and 18 percent, and a maximum particle size not exceeding 4 inches or one-half the loose lift thickness, whichever is smaller. In addition, if these materials are utilized, grain size analyses and Atterberg Limits must be performed during placement at a minimum rate of one test each per 5,000 cubic yards of material due to the high degree of variability associated with pit-run materials.

If the above listed alternative materials are being considered for bidding purposes, the materials should be submitted to the Geotechnical Engineer for pre-approval a minimum of 10 working days or more prior to the bid date. Failure to do so will be the responsibility of the General Contractor. The General Contractor will also be responsible for ensuring that the properties of all delivered alternate select fill materials are similar to those of the pre-approved submittal. It should also be noted that when using alternative fill materials, difficulties may be experienced with respect to moisture control during and subsequent to fill placement, as well as with erosion, particularly when exposed to inclement weather. This may result in sloughing of beam trenches and/or pumping of the fill materials.

Soils classified as CH, MH, ML, SM, GM, OH, OL, and Pt under the USCS and not meeting the alternative select fill material requirements, are **not** considered suitable for use as select fill materials at this site.

Select fill should be placed in loose lifts **not** exceeding 8 in. in thickness and compacted to at least 98 percent of the maximum dry density as determined by ASTM D698. The moisture content of the fill should be maintained within the range of two percentage points below the optimum moisture content to two percentage points above the optimum moisture content until the final lift of fill is permanently covered.

The select fill should be properly compacted in accordance with these recommendations and tested by **RKCI** personnel for compaction as specified.

### **SHALLOW FOUNDATION EXCAVATIONS**

Shallow foundation excavations should be observed by the Geotechnical Engineer or his/her representative prior to placement of reinforcing steel and concrete. This is necessary to document that the bearing soils at the bottom of the excavations are similar to those encountered in the borings and that excessive soft/loose materials and water are not present in the excavations. If soft/loose soil pockets are encountered in the foundation excavations, they should be removed and replaced with a compacted non-expansive fill material or lean concrete up to the design foundation bearing elevation.

Disturbance from foot traffic and from the accumulation of excess water can result in losses in bearing capacity and increased settlement. If inclement weather is anticipated at the time construction, consideration should be given to protecting the bottoms of beam trenches by placing a thin mud mat (layer of flowable fill or lean concrete) at the bottom of trenches immediately following excavation. This will reduce disturbance from foot traffic and will impede the infiltration of surface water. All necessary precautions should be implemented to protect open excavations from the accumulation of surface water runoff and rain.

#### **EXCAVATION SLOPING AND BENCHING**

Excavations that extend to or below a depth of 5 ft below construction grade shall require the General Contractor to develop a trench safety plan to protect personnel entering the trench or trench vicinity. The collection of specific geotechnical data and the development of such a plan, which could include designs for sloping and benching or various types of temporary shoring, is beyond the scope of the current study. Any such designs and safety plans shall be developed in accordance with current Occupational Safety and Health Administration (OSHA) guidelines and other applicable industry standards.

#### **EXCAVATION EQUIPMENT**

The boring logs are not intended for use in determining construction means and methods and may therefore be misleading if used for that purpose. We recommend that General Contractors and their subcontractors interested in bidding on the work perform their own tests in the form of test pits to determine the quantities of the different materials to be excavated, as well as the preferred excavation methods and equipment for this site.

#### **WET WEATHER CONDITIONS**

Earthwork contractors should be made aware of the moisture sensitivity of the near surface soils and potential compaction difficulties. If construction is undertaken during wet weather conditions, the surficial soils may become saturated, soft, and unworkable. Drainage trenches within the soils to be excavated, reworked and/or recompacted may be required. Additionally, subgrade stabilization techniques, such as chemical (cement, flyash or hydrated lime) treatment, may be required to provide a more weather-resistant working surface during pad construction. Therefore, we recommend that consideration be given to construction during the dryer months. Alternatively, the contractor should protect all exposed areas once topsoil has been stripped, as well as provide positive drainage during earthwork operations.

#### **UTILITIES**

Utilities which project through slab-on-grade, slab-on-fill, "floating" floor slabs, or any other rigid unit should be designed with either some degree of flexibility or with sleeves. Such design features will help reduce the risk of damage to the utility lines as vertical movements occur.

Our experience indicates that significant settlement of backfill can occur in utility trenches, particularly when trenches are deep, when backfill materials are placed in thick lifts with insufficient compaction, and when water can access and infiltrate the trench backfill materials. The potential for water to access the backfill is increased where water can infiltrate flexible base materials due to insufficient penetration of curbs, and at sites where geological features can influence water migration into utility trenches. It is our belief that another factor which can significantly impact settlement is the migration of fines within the backfill into the open voids in the underlying free-draining bedding material.

To reduce the potential for settlement in utility trenches, we recommend that consideration be given to the following:

- Backfill materials should be placed and compacted in controlled lifts appropriate for the type of backfill and the type of compaction equipment being utilized and backfilling procedures should be tested and documented.
- Curbs should be installed to a sufficient depth to reduce water infiltration beneath the curbs into the pavement base materials (see also the *Foundation Analyses* section of this report).
- Consideration should be given to wrapping free-draining bedding gravels with a geotextile fabric (similar to Mirafi 140N or CONTECH C-Drain Geocomposite) to reduce the infiltration and loss of fines from backfill material into the interstitial voids in bedding materials.

### **PAVEMENT RECOMMENDATIONS**

Recommendations for both flexible and rigid pavements for a 20-year design period are presented in this report. The CLIENT may select either pavement type depending on the performance criteria established for the proposed project. In general, flexible pavement systems have a lower initial construction cost as compared to rigid pavements. However, maintenance requirements over the life of the pavement are typically much greater for flexible pavements. This typically requires regularly scheduled observation and repair, as well as overlays and/or other pavement rehabilitation at approximately one-half to two-thirds of the design life. Rigid pavements are generally more "forgiving", and therefore tend to be more durable and require less maintenance after construction.

For either pavement type, drainage conditions will have a significant impact on long-term performance, particularly where permeable base materials are utilized in the pavement section. Drainage considerations are discussed in more detail in a subsequent section of this report.

### **SUBGRADE CONDITIONS**

A single generalized subgrade condition has been assumed for this site. The predominant subgrade soils used in developing the pavement sections for this project are the moderately plastic to plastic subgrade, clay soils. On the basis of our past experience with similar subsurface conditions in this area, a design California Bearing Ratio (CBR) value of 3 was assigned to evaluate the pavement components. This design CBR value assumes that the subgrade soils will be prepared in accordance with the recommendations



stated in the *Subgrade Preparation* subsection of the *Pavement Construction Guidelines* section of this report.

### **SULFATE CORROSION POTENTIAL**

As discussed in a previous section of this report, the potential concentration of soluble sulfates within the pavement areas were preliminarily evaluated by conducting two laboratory sulfate content tests. The result of these laboratory tests are as follows:

<b>Boring Location</b>	<b>Approximate Depth Below the Ground Surface Elevations Existing at the Time of our Study (ft)</b>	<b>Sulfate Content (ppm)</b>
P-1	1	120
P-5	1	120

Where ppm = parts per million

On the basis of the sulfate content test results, the tested on-site clay soils do not appear to have a potential to cause sulfate-induced heave. Typically, the concentration of soluble sulfate on soils becomes a concern when the concentration reaches about 3,000 ppm and higher. The sulfate concentration in soils may vary over short distances, and as such, additional testing is recommended at the time of construction to confirm the concentration of sulfates in the exposed subgrade soils within the subject pavement areas.

### **LIME TREATMENT OF SUBGRADE**

In general, the subgrade soils at this site are moderately plastic to plastic in nature and can be difficult to work with, particularly during periods of inclement weather. The strength properties of the moderately plastic to highly plastic subgrade soils may be increased by treating the upper 8 to 12 inches with hydrated lime. A sufficient quantity of hydrated lime should be mixed with the subgrade soils to decrease the plasticity index of the soil-lime mixture to 18 or less and to increase the pH of the soil-lime mixture to at least 12.4. The laboratory lime series testing performed for the subgrade clays indicates an optimum hydrated lime content of about 3 percent (Please refer to Figure 12 of the Attachments for the lime series test results). For construction purposes, we recommend that the percent of hydrated lime treatment be determined by appropriate laboratory testing at the time of construction.

### **DESIGN INFORMATION**

The following recommendations for the pavement sections are based on our past experience with similar subgrade soils; assumed traffic loadings; and design procedures published by the American Association of State Highway and Transportation Officials (AASHTO). The pavement design and analyses are based directly on the 1993 and 1997 editions of the "Guide for the Design of Pavement Structure" by AASHTO.

The pavement systems for the proposed school campus can be divided into two general areas, each with different loading conditions and performance criteria. These areas are:

- Automobile drives and parking lots (light vehicular traffic); and
- Driveways, bus lanes, and drive-in lanes (heavy vehicular traffic).

For a 20-year design period, Equivalent Single Axle Loads (ESAL's) were estimated for an assumed traffic loading of 1 tractor-trailer truck per day for the light vehicular traffic areas. This corresponds to about 17,500 ESAL's. For the heavy vehicular traffic areas, ESAL's were estimated for the CLIENT-provided traffic loading of six school buses, twice a day, five days a week, for a 20-year design period. This corresponds to about 100,000 ESAL's. It is recommended that the project Civil Engineer review the above-mentioned levels of traffic and design period to ensure that they are appropriate for the intended use of the proposed school campus.

### **FLEXIBLE PAVEMENTS**

The following equivalent flexible pavement section alternatives are available for this site:

<b>Pavement Area</b>	<b>LTS (in)</b>	<b>FBM (in.)</b>	<b>HMAC (in.)</b>
Automobile Drives and Parking Lots (Light Vehicular Traffic)	8	6	2
Driveways, Bus Lanes, and Drive-in Lanes (Heavy Vehicular Traffic)	12	8	2

Where:           LTS =Lime-Treated Subgrade  
                      FBM = Flexible Base Material  
                      HMAC = Hot-Mix Asphaltic Concrete Surface Course

The existing asphaltic concrete surface and flexible base material courses may be reused as flexible base materials, provided that these existing materials are processed and treated in such a way as to comply with the requirements of the *Flexible Base Course* subsection of the *Pavement Reconstruction Considerations* section of this report. Care should be exercised as to not contaminate the existing HMAC and FBM materials with the underlying subgrade soils.

### **Garbage Dumpsters**

Where flexible pavements are constructed at any site, it is recommended that reinforced concrete pads be provided in front of and beneath trash receptacles. The dumpster trucks should be parked on the concrete pads when the receptacles are lifted. It is suggested that such pads also be provided in drives where the dumpster trucks make turns with small radii to access the receptacles. The concrete pads at this site should be a minimum of 6 inches thick and reinforced with conventional steel reinforcing bars, and underlain by 12 inches of lime-treated subgrade.



**RIGID PAVEMENTS**

The following rigid pavement sections are available for this site:

Pavement Area	Lime-Treated Subgrade (in.)	Reinforced Concrete (in.)
Automobile Drives and Parking Lots (Light Duty)	8	5-1/2
Driveways, Bus Lanes, and Drive-in Lanes (Heavy Vehicular Traffic)	12	6

We recommend that the concrete pavements be reinforced with welded wire mats or bar mats. As a minimum, the welded wire mats should be 6 x 6 in., W4.0 x W4.0, and the bar mats should be No. 3 reinforcing bars spaced 18 in. on center in both directions. The concrete reinforcing should be placed approximately 1/3 the slab thickness below the surface of the slab, but not less than 2 in. The reinforcing should not extend across expansion joints.

Joints in concrete pavements aid in the construction and control the location and magnitude of cracks. Where practical, lay out the construction, expansion, control and sawed joints to form square panels, but not to exceed American Concrete Institute (ACI) Code recommendations. The ratio of slab length-to-width should not exceed 1.25. Recommended joint spacings are 15 ft longitudinal and 15 ft transverse.

All control joints should be formed or sawed to a depth of at least 1/4 the thickness of the concrete slab. Sawing of control joints should begin as soon as the concrete will not ravel, generally the day after placement. Control joints may be hand formed or formed by using a premolded filler. We recommend that all longitudinal and transverse construction joints be dowelled to promote load transfer. Expansion joints are needed to separate the concrete slab from fixed objects such as drop inlets, light standards and buildings. Expansion joint spacings are not to exceed a maximum of 75 ft and no expansion or construction joints should be located in a swale or drainage collection locations.

If possible, the pavement should develop a minimum slope of 0.015 ft/ft to provide surface drainage. Reinforced concrete pavement should cure a minimum of 7 days before allowing any traffic.

**PAVEMENT CONSTRUCTION CONSIDERATIONS**

**SUBGRADE PREPARATION**

Areas to support pavements should be stripped of all existing pavement constituents, vegetation and/or organic topsoil down to a minimum depth of 8 inches and extend a minimum of 2 ft beyond the pavement perimeters. Upon completion of site stripping activities, the exposed subgrade should be thoroughly proofrolled in accordance with the *Site Preparation* subsection recommendations provided in the *Foundation Construction Considerations* section of this report. Likewise, upon completion of the

proofrolling activities and just prior to select fill placement, the exposed subgrade should be scarified and recompacted as recommended in such subsection.

### **DRAINAGE CONSIDERATIONS**

As with any soil-supported structure, the satisfactory performance of a pavement system is contingent on the provision of adequate surface and subsurface drainage. Insufficient drainage which allows saturation of the pavement subgrade and/or the supporting granular pavement materials will greatly reduce the performance and service life of the pavement systems.

Surface and subsurface drainage considerations crucial to the performance of pavements at this site include (but are not limited to) the following:

- 1) Any known natural or man-made subsurface seepage at the site which may occur at sufficiently shallow depths as to influence moisture contents within the subgrade should be intercepted by drainage ditches or below grade French drains.
- 2) Final site grading should eliminate isolated depressions adjacent to curbs which may allow surface water to pond and infiltrate into the underlying soils. Curbs should completely penetrate flexible base materials and should be installed to sufficient depth to reduce infiltration of water beneath the curbs.
- 3) Pavement surfaces should be maintained to help minimize surface ponding and to provide rapid sealing of any developing cracks. These measures will help reduce infiltration of surface water downward through the pavement section.

### **LIME TREATMENT OF SUBGRADE**

Lime treatment of the subgrade soils should be in accordance with the TxDOT 2014 Standard Specifications for Construction and Maintenance of Highways, Streets and Bridges, Item 260, Lime Treatment (Road Mixed). Lime-treated subgrade soils should be compacted to a minimum of 95 percent of the maximum dry density at a moisture content within the range of two percentage points below the optimum moisture content to two percentage points above the optimum moisture content as determined by ASTM D1557.

### **ON-SITE CLAY FILL**

The pavement recommendations presented in this report were prepared assuming that on-site soils will be used for site grading in the proposed pavement areas. If used, we recommend that on-site soils be placed in loose lifts not exceeding 8 in. in thickness and compacted to a minimum of 98 percent of the maximum dry density as determined from ASTM D698. The moisture content of the subgrade should be maintained within the range of two percentage points below the optimum moisture content to two percentage points above the optimum moisture content until permanently covered. We recommend that on-site fill materials be free of roots, vegetation, and/or other organic or degradable material. We also recommend that the maximum particle size not exceed 4 in. or one half the lift thickness, whichever is smaller.

### **SELECT FILL**

If implemented, select fill materials utilized for achieving finished subgrade elevations in pavement areas should be in accordance with the *Select Fill* subsection recommendations provided in the *Foundation Construction Considerations* section of this report.

### **LIME TREATMENT OF SUBGRADE**

Lime treatment of the subgrade soils should be in accordance with the TxDOT 2014 Standard Specifications for Construction and Maintenance of Highways, Streets and Bridges, Item 260, Lime Treatment (Road Mixed). Lime-treated subgrade soils should be compacted to a minimum of 98 percent of the maximum dry density at a moisture content within the range of one percentage point below optimum moisture content to three percentage points above the optimum moisture content as determined by ASTM D698.

### **FLEXIBLE BASE COURSE**

The flexible base course should consist of material conforming to TxDOT 2014 Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges, Item 247, Flexible Base, Type A through Type E, Grades 1, 2, 3, and 5.

The flexible base course should be placed in lifts with a maximum compacted thickness of 8 in. and compacted to a minimum of 95 percent of the maximum dry density as determined by ASTM D1557. The moisture content of the base course materials should be maintained within the range of three percentage points below the optimum moisture content to three percentage points above the optimum moisture content until permanently covered.

If the existing asphaltic concrete surface course and flexible base materials are being considered to be reused as flexible base materials, such materials should be processed and treated in such a way as to comply with the TxDOT 2014 Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges, Item 251, Reworking Base Courses.

### **ASPHALTIC CONCRETE SURFACE COURSE**

The asphaltic concrete surface course should conform to TxDOT 2014 Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges, Item 341, Dense-Graded Hot-Mix Asphalt, Type D. The asphaltic concrete should be compacted to a minimum of 92 percent of the maximum theoretical specific gravity (Rice) of the mixture determined according to Test Method Tex-227-F. Pavement specimens, which shall be either cores or sections of asphaltic pavement, will be tested according to Test Method Tex-207-F. The nuclear-density gauge or other methods which correlate satisfactorily with results obtained from project roadway specimens may be used when approved by the Engineer. Unless otherwise shown on the plans, the Contractor shall be responsible for obtaining the required roadway specimens at their expense and in a manner and at locations selected by the Engineer.



### **PORTLAND CEMENT CONCRETE**

The Portland cement concrete pavement should be air entrained to result in a 4 percent plus/minus 1 percent air, should have a maximum slump of 5 inches, and should have a minimum 28-day compressive strength of 3,500 psi. A liquid membrane-forming curing compound should be applied as soon as practical after broom finishing the concrete surface. The curing compound will help reduce the loss of water from the concrete. The reduction in the rapid loss in water will help reduce shrinkage cracking of the concrete.

## **CONSTRUCTION RELATED SERVICES**

### **CONSTRUCTION MATERIALS ENGINEERING AND TESTING SERVICES**

As presented in the attachment to this report, *Important Information About Your Geotechnical Engineering Report*, subsurface conditions can vary across a project site. The conditions described in this report are based on interpolations derived from a limited number of data points. Variations will be encountered during construction, and only the geotechnical design engineer will be able to determine if these conditions are different than those assumed for design.

Construction problems resulting from variations or anomalies in subsurface conditions are among the most prevalent on construction projects and often lead to delays, changes, cost overruns, and disputes. These variations and anomalies can best be addressed if the geotechnical engineer of record, **Raba Kistner**, is retained to perform the construction materials engineering and testing services during the construction of the project. This is because:

- **RKCI** has an intimate understanding of the geotechnical engineering report's findings and recommendations. **RKCI** understands how the report should be interpreted and can provide such interpretations on site, on the CLIENT's behalf.
- **RKCI** knows what subsurface conditions are anticipated at this site.
- **RKCI** is familiar with the goals of the CLIENT and the project's design professionals, having worked with them in the development of the project geotechnical workscope. This enables **RKCI** to suggest remedial measures (when needed) which help meet others' requirements.
- **RKCI** has a vested interest in client satisfaction, and thus assigns qualified personnel whose principal concern is client satisfaction. This concern is exhibited by the manner in which contractors' work is tested, evaluated and reported, and in selection of alternative approaches when such may become necessary.
- **RKCI** cannot be held accountable for problems which result due to misinterpretation of our findings or recommendations when we are not on hand to provide the interpretation which is required.

**BUDGETING FOR CONSTRUCTION TESTING**

Appropriate budgets need to be developed for the required construction materials engineering and testing services. At the appropriate time before construction, we advise that **RKCI** and the project designers meet and jointly develop the testing budgets, as well as review the testing specifications as it pertains to this project.

Once the construction testing budget and scope of work are finalized, we encourage a preconstruction meeting with the selected General Contractor to review the scope of work to make sure it is consistent with the construction means and methods proposed by the contractor. **RKCI** looks forward to the opportunity to provide continued support on this project, and would welcome the opportunity to meet with the Project Team to develop both a scope and budget for these services.

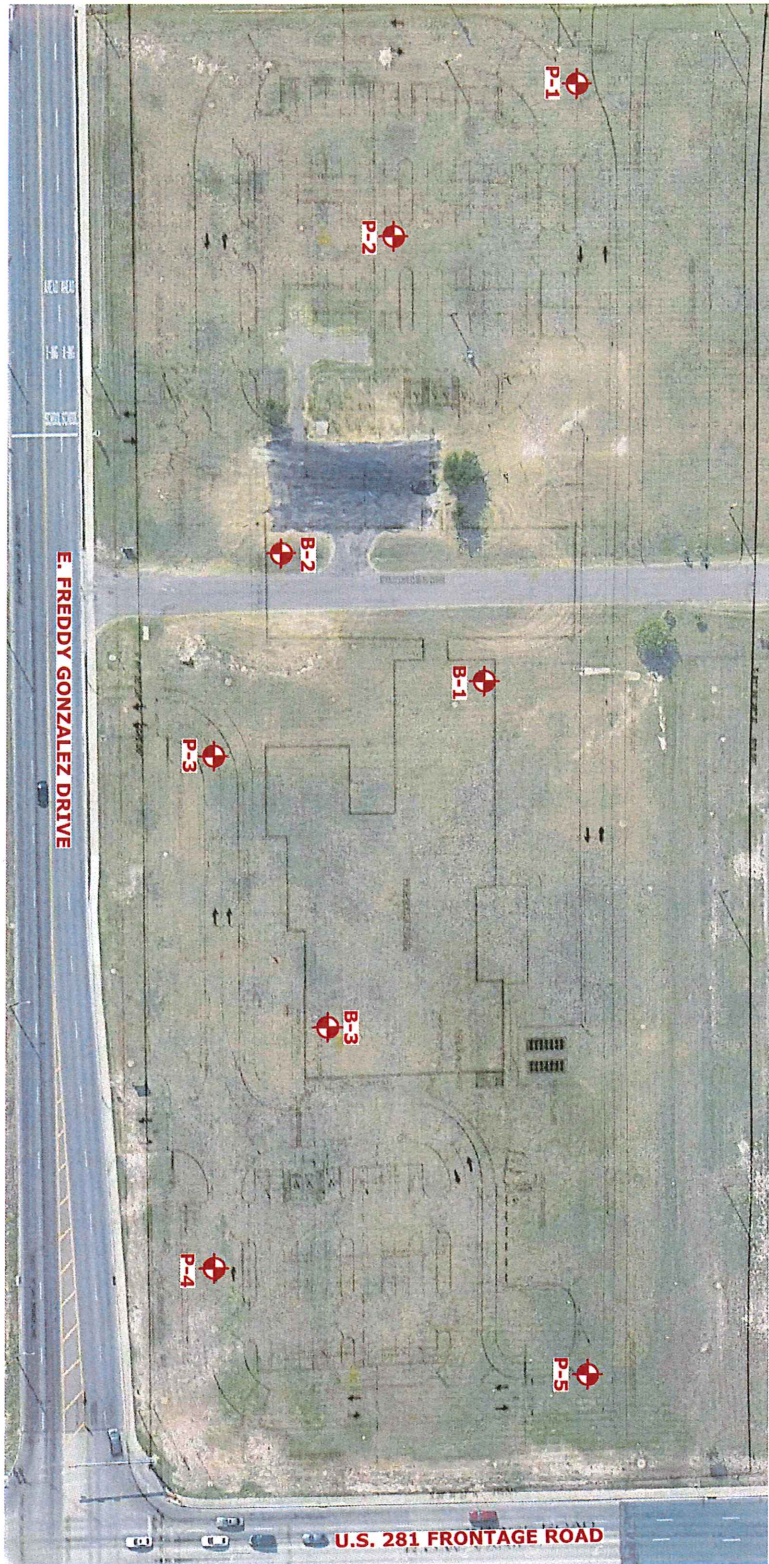
\* \* \* \* \*

The following figures are attached and complete this report:

- |                    |                                 |
|--------------------|---------------------------------|
| Figure 1           | Boring Location Map             |
| Figure 2 through 9 | Logs of Borings                 |
| Figure 10          | Key to Terms and Symbols        |
| Figure 11          | Results of Soil Sample Analyses |
| Figure 12          | Lime Series Determination       |

## ATTACHMENTS





**BORING LOCATION MAP  
PROP. EDINBURG CISD AND UTRGV  
COLLEGIATE HIGH SCHOOL**  
NWC OF E. FREDDY GONZALEZ DRIVE  
AND U.S. 281 FRONTAGE ROAD  
EDINBURG, HIDALGO COUNTY, TEXAS

**RABA  
KISTNER**  
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Facilities • Infrastructure  
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www.rkci.com  
TBPB Firm F-3257

REVISIONS:  
No. DATE DESCRIPTION

No.	DATE	DESCRIPTION

PROJECT No.:  
AM22-048-00  
ISSUE DATE: 08-29-22  
DRAWN BY: DV  
CHECKED BY: AD  
REVIEWED BY: SC

**FIGURE**  
**1**

# LOG OF BORING NO. B-1

Prop. Edinburg CISD and UTRGV Collegiate High School  
 NWC of E. Freddy Gonzalez Drive and U.S. 281 Frontage Road  
 Edinburg, Hidalgo County, Texas



**DRILLING METHOD:** Straight Flight Auger

**LOCATION:** See Figure 1

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WEIGHT, pcf	SHEAR STRENGTH, TONS/FT <sup>2</sup>						PLASTICITY INDEX	%-200	
						0.5	1.0	1.5	2.0	2.5	3.0			3.5
			SURFACE ELEVATION: Existing Grade, ft											
5	/	X	<b>SANDY LEAN CLAY (CL)</b> firm to stiff, dark brown to brown, with calcareous nodules	5		●	-	X				19		
10				10		●							66	
11				11		●								
10	-	X	<b>LEAN CLAY with SAND (CL)</b> stiff to very stiff, brown	13		●	-	X				27		
15				15	▽		●			●	●		83	
19				19		●								
20	/	X	<b>FAT CLAY (CH)</b> very stiff to hard, brown to light brown	21		●	-	X		X		38		
25				25		●								
30				30		●								
35			35		●									
38			38		●									

<b>DEPTH DRILLED:</b> 50.0 ft	<b>DEPTH TO WATER:</b> 15 ft	<b>PROJ. No.:</b> AMA22-048-00
<b>DATE DRILLED:</b> 8/9/2022	<b>DATE MEASURED:</b> 8/9/2022	<b>FIGURE:</b> 2a

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT



# LOG OF BORING NO. B-1

Prop. Edinburg CISD and UTRGV Collegiate High School  
 NWC of E. Freddy Gonzalez Drive and U.S. 281 Frontage Road  
 Edinburg, Hidalgo County, Texas



**DRILLING METHOD:** Straight Flight Auger

**LOCATION:** See Figure 1

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WEIGHT, pcf	SHEAR STRENGTH, TONS/FT <sup>2</sup>						PLASTICITY INDEX	%-200	
						0.5	1.0	1.5	2.0	2.5	3.0			3.5
			SURFACE ELEVATION: Existing Grade, ft											
45	/	X	<b>FAT CLAY (CH)</b> very stiff to hard, brown to light brown <i>(continued)</i>	39			●		*			29		
49				45			●							
49				49			●							
50			Boring terminated at a depth of about 50 ft.											
55			NOTES: During the drilling operations, groundwater was encountered at a depth of about 15 ft. Upon completion of the drilling operations, groundwater was measured at a depth of about 33.5 ft.											
60														
65														
70														
75														

<b>DEPTH DRILLED:</b> 50.0 ft <b>DATE DRILLED:</b> 8/9/2022	<b>DEPTH TO WATER:</b> 15 ft <b>DATE MEASURED:</b> 8/9/2022	<b>PROJ. No.:</b> AMA22-048-00 <b>FIGURE:</b> 2b
--	--	---

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

# LOG OF BORING NO. B-2

Prop. Edinburg CISD and UTRGV Collegiate High School  
 NWC of E. Freddy Gonzalez Drive and U.S. 281 Frontage Road  
 Edinburg, Hidalgo County, Texas



**DRILLING METHOD:** Straight Flight Auger

**LOCATION:** See Figure 1

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WEIGHT, pcf	SHEAR STRENGTH, TONS/FT <sup>2</sup>						PLASTICITY INDEX	%-200
						0.5	1.0	1.5	2.0	2.5	3.0		
			SURFACE ELEVATION: Existing Grade, ft										
5	[Symbol]	[Symbol]	<b>SANDY LEAN CLAY (CL)</b> stiff to very stiff, dark brown to brown, with calcareous nodules	15		●	✕	✕				28	
				12		●						63	
				10		●	✕					20	
				16		●						70	
10	[Symbol]	[Symbol]	<b>LEAN CLAY (CL)</b> very stiff to hard, brown			●		✕					
				15		●		✕					
				20		●							
				25		●							
25	[Symbol]	[Symbol]		33		●							
30	[Symbol]	[Symbol]		34		●							
			Boring terminated at a depth of about 30 ft.  NOTES: Upon completion of the drilling operations, the boring was observed dry.										
35													

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

<b>DEPTH DRILLED:</b> 30.0 ft <b>DATE DRILLED:</b> 8/9/2022	<b>DEPTH TO WATER:</b> DRY <b>DATE MEASURED:</b> 8/9/2022	<b>PROJ. No.:</b> AMA22-048-00 <b>FIGURE:</b> 3
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# LOG OF BORING NO. B-3

Prop. Edinburg CISD and UTRGV Collegiate High School  
 NWC of E. Freddy Gonzalez Drive and U.S. 281 Frontage Road  
 Edinburg, Hidalgo County, Texas



**DRILLING**

**METHOD:** Straight Flight Auger

**LOCATION:** See Figure 1

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WEIGHT, pcf	SHEAR STRENGTH, TONS/FT <sup>2</sup>						PLASTICITY INDEX	% -200
						0.5	1.0	1.5	2.0	2.5	3.0		
SURFACE ELEVATION: Existing Grade, ft													
			<b>SANDY LEAN CLAY (CL)</b> firm to stiff, dark brown, with calcareous nodules	7									60
				9									22
			<b>LEAN CLAY with SAND (CL)</b> stiff to very stiff, brown	10									76
				16									36
			<b>FAT CLAY (CH)</b> very stiff to hard, brown, with black ferrous stains	23									
				37									
				41									
			Boring terminated at a depth of about 30 ft.										
			NOTES: Upon completion of the drilling operations, the boring was observed dry.										
<b>DEPTH DRILLED:</b>	30.0 ft			<b>DEPTH TO WATER:</b>	DRY			<b>PROJ. No.:</b>	AMA22-048-00				
<b>DATE DRILLED:</b>	8/9/2022			<b>DATE MEASURED:</b>	8/9/2022			<b>FIGURE:</b>	4				

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

### LOG OF BORING NO. P-1

Prop. Edinburg CISD and UTRGV Collegiate High School  
 NWC of E. Freddy Gonzalez Drive and U.S. 281 Frontage Road  
 Edinburg, Hidalgo County, Texas



**DRILLING METHOD:** Straight Flight Auger

**LOCATION:** See Figure 1

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WEIGHT, pcf	SHEAR STRENGTH, TONS/FT <sup>2</sup>						PLASTICITY INDEX	%-200	
						0.5	1.0	1.5	2.0	2.5	3.0			3.5
			SURFACE ELEVATION: Existing Grade, ft											
	[Symbol]	[Symbol]	<b>CLAYEY SAND (SC)</b> loose to medium dense, brown	8		●								48
5				12		●	- - -	X						19
			Boring terminated at a depth of about 5 ft.											
			NOTES: Upon completion of the drilling operations, the boring was observed dry.											
10														
15														
20														
25														
30														
35														
<b>DEPTH DRILLED:</b> 5.0 ft			<b>DEPTH TO WATER:</b> DRY			<b>PROJ. No.:</b> AMA22-048-00								
<b>DATE DRILLED:</b> 8/9/2022			<b>DATE MEASURED:</b> 8/9/2022			<b>FIGURE:</b> 5								

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT



# LOG OF BORING NO. P-2

Prop. Edinburg CISD and UTRGV Collegiate High School  
 NWC of E. Freddy Gonzalez Drive and U.S. 281 Frontage Road  
 Edinburg, Hidalgo County, Texas



**DRILLING METHOD:** Straight Flight Auger

**LOCATION:** See Figure 1

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WEIGHT, pcf	SHEAR STRENGTH, TONS/FT <sup>2</sup>							PLASTICITY INDEX	%-200
						0.5	1.0	1.5	2.0	2.5	3.0	3.5		
			SURFACE ELEVATION: Existing Grade, ft											
	[Symbol]	[Symbol]	<b>SANDY LEAN CLAY (CL)</b> stiff, brown	11			●	---	X				16	
5				10			●							
			Boring terminated at a depth of about 5 ft.											
			NOTES: Upon completion of the drilling operations, the boring was observed dry.											
10														
15														
20														
25														
30														
35														

<b>DEPTH DRILLED:</b> 5.0 ft <b>DATE DRILLED:</b> 8/9/2022	<b>DEPTH TO WATER:</b> DRY <b>DATE MEASURED:</b> 8/9/2022	<b>PROJ. No.:</b> AMA22-048-00 <b>FIGURE:</b> 6
---	--	--

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

# LOG OF BORING NO. P-3

Prop. Edinburg CISD and UTRGV Collegiate High School  
 NWC of E. Freddy Gonzalez Drive and U.S. 281 Frontage Road  
 Edinburg, Hidalgo County, Texas



**DRILLING METHOD:** Straight Flight Auger

**LOCATION:** See Figure 1

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WEIGHT, pcf	SHEAR STRENGTH, TONS/FT <sup>2</sup>						PLASTICITY INDEX	%-200		
						0.5	1.0	1.5	2.0	2.5	3.0			3.5	4.0
			SURFACE ELEVATION: Existing Grade, ft			10	20	30	40	50	60	70	80		
	[Symbol]	[Symbol]	<b>SANDY LEAN CLAY (CL)</b> stiff to firm, brown	10		●									
5				6		●	←	X						16	
			Boring terminated at a depth of about 5 ft.												
			NOTES: Upon completion of the drilling operations, the boring was observed dry.												

<b>DEPTH DRILLED:</b> 5.0 ft	<b>DEPTH TO WATER:</b> DRY	<b>PROJ. No.:</b> AMA22-048-00
<b>DATE DRILLED:</b> 8/9/2022	<b>DATE MEASURED:</b> 8/9/2022	<b>FIGURE:</b> 7

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

# LOG OF BORING NO. P-4

Prop. Edinburg CISD and UTRGV Collegiate High School  
 NWC of E. Freddy Gonzalez Drive and U.S. 281 Frontage Road  
 Edinburg, Hidalgo County, Texas



**DRILLING METHOD:** Straight Flight Auger

**LOCATION:** See Figure 1

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WEIGHT, pcf	SHEAR STRENGTH, TONS/FT <sup>2</sup>								PLASTICITY INDEX	%-200
						0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0		
			SURFACE ELEVATION: Existing Grade, ft												
	[Symbol]	[Symbol]	<b>SANDY LEAN CLAY (CL)</b> firm to stiff, brown	6		●	×	---	---	×			24		
5				15		●								71	
			Boring terminated at a depth of about 5 ft.												
			NOTES: Upon completion of the drilling operations, the boring was observed dry.												

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

<b>DEPTH DRILLED:</b> 5.0 ft	<b>DEPTH TO WATER:</b> DR	<b>PROJ. No.:</b> AMA22-048-00
<b>DATE DRILLED:</b> 8/9/2022	<b>DATE MEASURED:</b> 8/9/2022	<b>FIGURE:</b> 8

# LOG OF BORING NO. P-5

Prop. Edinburg CISD and UTRGV Collegiate High School  
 NWC of E. Freddy Gonzalez Drive and U.S. 281 Frontage Road  
 Edinburg, Hidalgo County, Texas



**DRILLING METHOD:** Straight Flight Auger

**LOCATION:** See Figure 1

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WEIGHT, pcf	SHEAR STRENGTH, TONS/FT <sup>2</sup>							PLASTICITY INDEX	%-200
						0.5	1.0	1.5	2.0	2.5	3.0	3.5		
			SURFACE ELEVATION: Existing Grade, ft											
	[Symbol]	[Symbol]	<b>SANDY LEAN CLAY (CL)</b> stiff to very stiff, brown	14		●								
5				17		●	x	-----	x				26	
			Boring terminated at a depth of about 5 ft.											
			NOTES: Upon completion of the drilling operations, the boring was observed dry.											
10														
15														
20														
25														
30														
35														
<b>DEPTH DRILLED:</b> 5.0 ft			<b>DEPTH TO WATER:</b> DRY			<b>PROJ. No.:</b> AMA22-048-00								
<b>DATE DRILLED:</b> 8/9/2022			<b>DATE MEASURED:</b> 8/9/2022			<b>FIGURE:</b> 9								

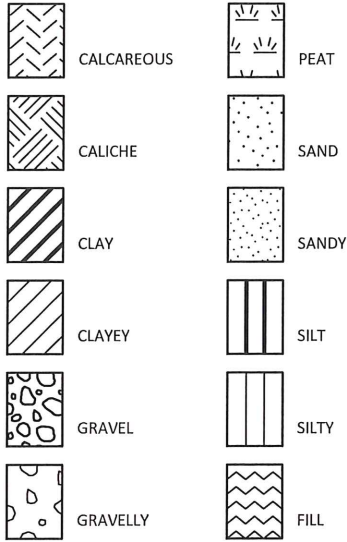
NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT



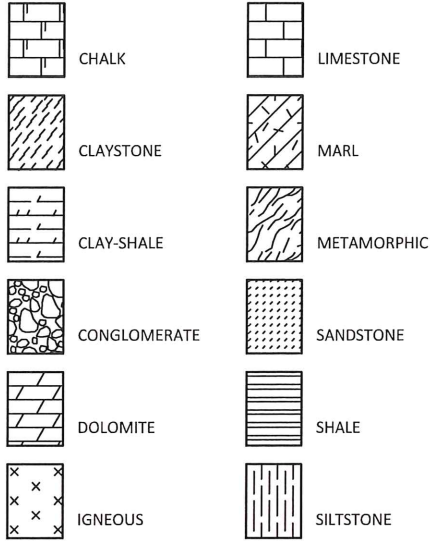
# KEY TO TERMS AND SYMBOLS

## MATERIAL TYPES

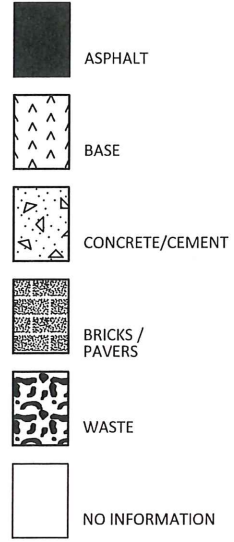
### SOIL TERMS



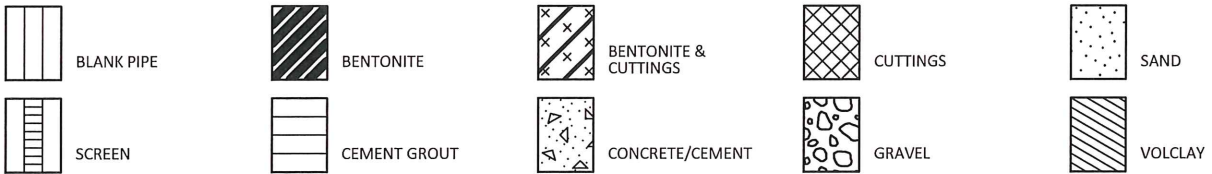
### ROCK TERMS



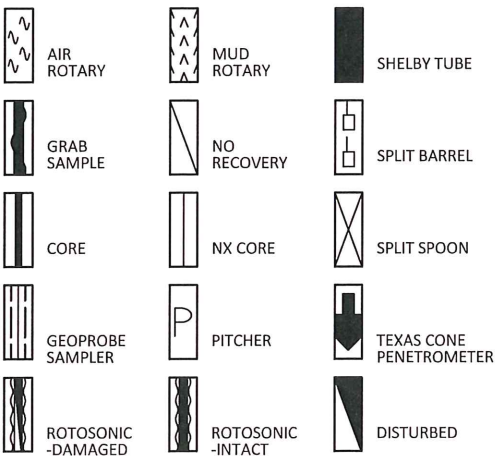
### OTHER



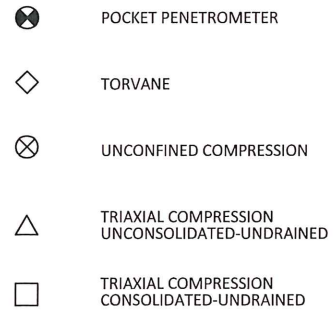
## WELL CONSTRUCTION AND PLUGGING MATERIALS



## SAMPLE TYPES



## STRENGTH TEST TYPES



NOTE: VALUES SYMBOLIZED ON BORING LOGS REPRESENT SHEAR STRENGTHS UNLESS OTHERWISE NOTED

PROJECT NO. AMA22-048-00

## KEY TO TERMS AND SYMBOLS (CONT'D)

### TERMINOLOGY

Terms used in this report to describe soils with regard to their consistency or conditions are in general accordance with the discussion presented in Article 45 of SOILS MECHANICS IN ENGINEERING PRACTICE, Terzaghi and Peck, John Wiley & Sons, Inc., 1967, using the most reliable information available from the field and laboratory investigations. Terms used for describing soils according to their texture or grain size distribution are in accordance with the UNIFIED SOIL CLASSIFICATION SYSTEM, as described in American Society for Testing and Materials D2487-06 and D2488-00, Volume 04.08, Soil and Rock; Dimension Stone; Geosynthetics; 2005.

The depths shown on the boring logs are not exact, and have been estimated to the nearest half-foot. Depth measurements may be presented in a manner that implies greater precision in depth measurement, i.e. 6.71 meters. The reader should understand and interpret this information only within the stated half-foot tolerance on depth measurements.

RELATIVE DENSITY		COHESIVE STRENGTH			PLASTICITY	
<u>Penetration Resistance Blows per ft</u>	<u>Relative Density</u>	<u>Resistance Blows per ft</u>	<u>Consistency</u>	<u>Cohesion TSF</u>	<u>Plasticity Index</u>	<u>Degree of Plasticity</u>
0 - 4	Very Loose	0 - 2	Very Soft	0 - 0.125	0 - 5	None
4 - 10	Loose	2 - 4	Soft	0.125 - 0.25	5 - 10	Low
10 - 30	Medium Dense	4 - 8	Firm	0.25 - 0.5	10 - 20	Moderate
30 - 50	Dense	8 - 15	Stiff	0.5 - 1.0	20 - 40	Plastic
> 50	Very Dense	15 - 30	Very Stiff	1.0 - 2.0	> 40	Highly Plastic
		> 30	Hard	> 2.0		

### ABBREVIATIONS

B = Benzene T = Toluene E = Ethylbenzene X = Total Xylenes BTEX = Total BTEX TPH = Total Petroleum Hydrocarbons ND = Not Detected NA = Not Analyzed NR = Not Recorded/No Recovery OVA = Organic Vapor Analyzer ppm = Parts Per Million	Qam, Qas, Qal = Quaternary Alluvium Qat = Low Terrace Deposits Qbc = Beaumont Formation Qt = Fluvialite Terrace Deposits Qao = Seymour Formation Qle = Leona Formation Q-Tu = Uvalde Gravel Ewi = Wilcox Formation Emi = Midway Group Mc = Catahoula Formation El = Laredo Formation Kknm = Navarro Group and Marlbrook Marl Kpg = Pecan Gap Chalk Kau = Austin Chalk	Kef = Eagle Ford Shale Kbu = Buda Limestone Kdr = Del Rio Clay Kft = Fort Terrett Member Kgt = Georgetown Formation Kep = Person Formation Kek = Kainer Formation Kes = Escondido Formation Kew = Walnut Formation Kgr = Glen Rose Formation Kgrr = Upper Glen Rose Formation Kgrl = Lower Glen Rose Formation Kh = Hensell Sand
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PROJECT NO. AMA22-048-00

# KEY TO TERMS AND SYMBOLS (CONT'D)

## TERMINOLOGY

### SOIL STRUCTURE

Slickensided	Having planes of weakness that appear slick and glossy.
Fissured	Containing shrinkage or relief cracks, often filled with fine sand or silt; usually more or less vertical.
Pocket	Inclusion of material of different texture that is smaller than the diameter of the sample.
Parting	Inclusion less than 1/8 inch thick extending through the sample.
Seam	Inclusion 1/8 inch to 3 inches thick extending through the sample.
Layer	Inclusion greater than 3 inches thick extending through the sample.
Laminated	Soil sample composed of alternating partings or seams of different soil type.
Interlayered	Soil sample composed of alternating layers of different soil type.
Intermixed	Soil sample composed of pockets of different soil type and layered or laminated structure is not evident.
Calcareous	Having appreciable quantities of carbonate.
Carbonate	Having more than 50% carbonate content.

## SAMPLING METHODS

### RELATIVELY UNDISTURBED SAMPLING

Cohesive soil samples are to be collected using three-inch thin-walled tubes in general accordance with the Standard Practice for Thin-Walled Tube Sampling of Soils (ASTM D1587) and granular soil samples are to be collected using two-inch split-barrel samplers in general accordance with the Standard Method for Penetration Test and Split-Barrel Sampling of Soils (ASTM D1586). Cohesive soil samples may be extruded on-site when appropriate handling and storage techniques maintain sample integrity and moisture content.

### STANDARD PENETRATION TEST (SPT)

A 2-in.-OD, 1-3/8-in.-ID split spoon sampler is driven 1.5 ft into undisturbed soil with a 140-pound hammer free falling 30 in. After the sampler is seated 6 in. into undisturbed soil, the number of blows required to drive the sampler the last 12 in. is the Standard Penetration Resistance or "N" value, which is recorded as blows per foot as described below.

### SPLIT-BARREL SAMPLER DRIVING RECORD

Blows Per Foot	Description
25 .....	25 blows drove sampler 12 inches, after initial 6 inches of seating.
50/7" .....	50 blows drove sampler 7 inches, after initial 6 inches of seating.
Ref/3" .....	50 blows drove sampler 3 inches during initial 6-inch seating interval.

NOTE: To avoid damage to sampling tools, driving is limited to 50 blows during or after seating interval.

# RESULTS OF SOIL SAMPLE ANALYSES

PROJECT NAME: Prop. Edinburg CISD and UTRGV Collegiate High School  
 NWC of E. Freddy Gonzalez Drive and U.S. 281 Frontage Road  
 Edinburg, Hidalgo County, Texas

FILE NAME: AMA22-048-00.GPJ

8/29/2022

Boring No.	Sample Depth (ft)	Blows per ft	Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	USCS	Dry Unit Weight (pcf)	% -200 Sieve	Shear Strength (tsf)	Strength Test
B-1	0.0 to 1.5	5	16	36	17	19	CL				
	2.5 to 4.0	10	18						66		
	5.0 to 6.5	11	19								
	7.5 to 9.0	13	20	46	19	27	CL				
	10.0 to 12.0		21						83	2.25	PP
	15.0 to 16.5	19	20								
	20.0 to 21.5	21	23	64	26	38	CH				
	25.0 to 26.5	31	21								
	30.0 to 31.5	32	19								
	35.0 to 36.5	38	21								
	40.0 to 41.5	39	19	50	21	29	CH				
	45.0 to 46.5	45	21								
	48.5 to 50.0	49	23								
	B-2	0.0 to 1.5	15	10	47	19	28	CL			
2.5 to 4.0		12	16						63		
5.0 to 6.5		10	18	39	19	20	CL				
7.5 to 9.0		16	19						70		
10.0 to 12.0			20							2.25	PP
15.0 to 17.0			23							2.25	PP
20.0 to 21.5		25	24								
25.0 to 26.5		33	16								
B-3	0.0 to 1.5	7	13						60		
	2.5 to 4.0	9	21	42	20	22	CL				
	5.0 to 6.5	10	19								
	7.0 to 9.0		21						76	2.10	PP
	10.0 to 11.5	16	21	55	19	36	CH				
	15.0 to 17.0		20							2.15	PP
	20.0 to 21.5	23	21								
	25.0 to 26.5	37	16								
P-1	0.0 to 1.5	8	8						48		
	3.5 to 5.0	12	19	36	17	19	SC				
P-2	0.0 to 1.5	11	17	33	17	16	CL				
	3.5 to 5.0	10	18								
P-3	0.0 to 1.5	10	10								
	3.5 to 5.0	6	15	32	16	16	CL				
P-4	0.0 to 1.5	6	10	42	18	24	CL				
	3.5 to 5.0	15	10						71		

PP = Pocket Penetrometer TV = Torvane UC = Unconfined Compression FV = Field Vane UU = Unconsolidated Undrained Triaxial

CU = Consolidated Undrained Triaxial CNBD = Could Not Be Determined NP = Non-Plastic PROJECT NO. AMA22-048-00

**RABAKISTNER**

FIGURE 11a



## RESULTS OF SOIL SAMPLE ANALYSES

PROJECT NAME: Prop. Edinburg CISD and UTRGV Collegiate High School  
 NWC of E. Freddy Gonzalez Drive and U.S. 281 Frontage Road  
 Edinburg, Hidalgo County, Texas

FILE NAME: AMA22-048-00.GPJ

8/29/2022

Boring No.	Sample Depth (ft)	Blows per ft	Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	USCS	Dry Unit Weight (pcf)	% -200 Sieve	Shear Strength (tsf)	Strength Test
P-5	0.0 to 1.5	14	11								
	3.5 to 5.0	17	10	43	17	26	CL				

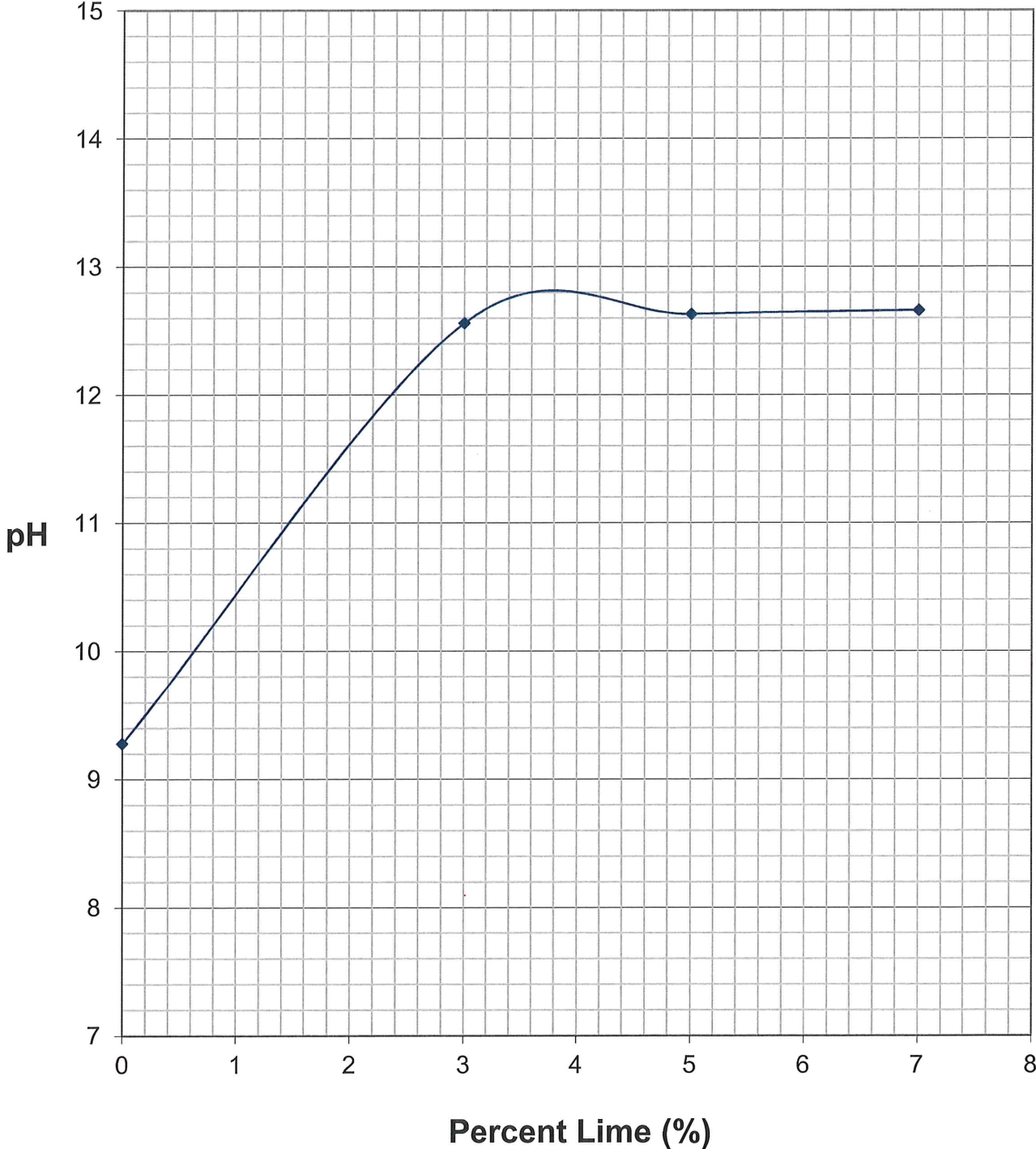
PP = Pocket Penetrometer TV = Torvane UC = Unconfined Compression FV = Field Vane UU = Unconsolidated Undrained Triaxial

CU = Consolidated Undrained Triaxial CNBD = Could Not Be Determined NP = Non-Plastic PROJECT NO. AMA22-048-00

**RABAKISTNER**

FIGURE 11b

# Lime Series Determination



Project No. AMA22-048-00

Figure 12



## Important Information about This

# Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

### Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical-engineering study conducted for a civil engineer may not fulfill the needs of a constructor — a construction contractor — or even another civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client. No one except you should rely on this geotechnical-engineering report without first conferring with the geotechnical engineer who prepared it. *And no one — not even you — should apply this report for any purpose or project except the one originally contemplated.*

### Read the Full Report

Serious problems have occurred because those relying on a geotechnical-engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

### Geotechnical Engineers Base Each Report on a Unique Set of Project-Specific Factors

Geotechnical engineers consider many unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk-management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical-engineering report that was:

- not prepared for you;
- not prepared for your project;
- not prepared for the specific site explored; or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical-engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light-industrial plant to a refrigerated warehouse;
- the elevation, configuration, location, orientation, or weight of the proposed structure;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes—even minor ones—and request an

assessment of their impact. *Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

### Subsurface Conditions Can Change

A geotechnical-engineering report is based on conditions that existed at the time the geotechnical engineer performed the study. *Do not rely on a geotechnical-engineering report whose adequacy may have been affected by:* the passage of time; man-made events, such as construction on or adjacent to the site; or natural events, such as floods, droughts, earthquakes, or groundwater fluctuations. *Contact the geotechnical engineer before applying this report to determine if it is still reliable.* A minor amount of additional testing or analysis could prevent major problems.

### Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ — sometimes significantly — from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide geotechnical-construction observation is the most effective method of managing the risks associated with unanticipated conditions.

### A Report's Recommendations Are Not Final

Do not overrely on the confirmation-dependent recommendations included in your report. *Confirmation-dependent recommendations are not final*, because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations *only* by observing actual subsurface conditions revealed during construction. *The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's confirmation-dependent recommendations if that engineer does not perform the geotechnical-construction observation required to confirm the recommendations' applicability.*

### A Geotechnical-Engineering Report Is Subject to Misinterpretation

Other design-team members' misinterpretation of geotechnical-engineering reports has resulted in costly



problems. Confront that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Constructors can also misinterpret a geotechnical-engineering report. Confront that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing geotechnical construction observation.

### **Do Not Redraw the Engineer's Logs**

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical-engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

### **Give Constructors a Complete Report and Guidance**

Some owners and design professionals mistakenly believe they can make constructors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give constructors the complete geotechnical-engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise constructors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure constructors have sufficient time* to perform additional study. Only then might you be in a position to give constructors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

### **Read Responsibility Provisions Closely**

Some clients, design professionals, and constructors fail to recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help

others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

### **Environmental Concerns Are Not Covered**

The equipment, techniques, and personnel used to perform an *environmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical-engineering report does not usually relate any environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own environmental information, ask your geotechnical consultant for risk-management guidance. *Do not rely on an environmental report prepared for someone else.*

### **Obtain Professional Assistance To Deal with Mold**

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the *express purpose* of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold-prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, many mold- prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical- engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; *none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.*

### **Rely, on Your GBC-Member Geotechnical Engineer for Additional Assistance**

Membership in the Geotechnical Business Council of the Geoprofessional Business Association exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project. Confer with your GBC-Member geotechnical engineer for more information.



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## SECTION 011000 - SUMMARY

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Project information.
2. Work covered by Contract Documents.
3. Owner-furnished/Contractor-installed (OFICI) products.
4. Contractor's use of site and premises.
5. Work restrictions.
6. Specification and Drawing conventions.

##### B. Related Requirements:

1. Section 015000 "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.

#### 1.2 PROJECT INFORMATION

##### A. Project Identification: UTRGV/Edinburg CISD Early College High School

1. Project Location: Edinburg, Texas

##### B. Owner: UTRGV and Edinburg CISD

1. Owner's Representative: UTRGV  
Marta Salinas-Hovar, AIA LEED AP  
956-665-2782  
[marta.salinashovar@utrgv.edu](mailto:marta.salinashovar@utrgv.edu)

Edinburg CISD  
Victor Gonzalez  
1305 E. Schunior  
Edinburg, Tx 78541  
956-289-2578  
[victor.gonzalez3@ecisd.us](mailto:victor.gonzalez3@ecisd.us)

##### C. Architect: GMS Architects

1. Architect's Representative: David A. Monreal, AIA  
1150 Paredes Line Road  
Brownsville, Tx 78521  
956-546-0110  
[dmonreal@gmsarchitects.com](mailto:dmonreal@gmsarchitects.com)

D. Architect's Consultants: Architect has retained the following design professionals, who have prepared designated portions of the Contract Documents:

1. Structural Consultant: Chanin Engineering  
Miguel Chanin, P.E.  
400 W. Nolana Ave. #H2  
McAllen, Tx 78594  
956-687-9421  
[miguel@chaninengineering.com](mailto:miguel@chaninengineering.com)
2. Civil Consultant: Melden & Hunt, Inc.  
Kelley Heller-Vela, P.E.  
115 W. McIntyre  
Edinburg, Tx 78541  
956-381-0981  
[kelley@meldenandhunt.com](mailto:kelley@meldenandhunt.com)
3. MEP Consultant: Ethos Engineering  
Guillermo Quintanilla and  
Cesar Gonzalez P.E.  
1126 South Commerce St.  
Harlingen, Tx 78550  
956-230-3435  
[gquin@ethoseng.net](mailto:gquin@ethoseng.net)  
[cgonzalez@ethoseng.net](mailto:cgonzalez@ethoseng.net)
4. Landscape Consultant: SSP Design  
Scott Pajeski  
789 East Washington Street  
Brownsville Tx 78520  
956-547-9788  
[spajeski@sspdesign.com](mailto:spajeski@sspdesign.com)

E. Web-Based Project Software: Project software will be used for purposes of managing communication and documents during the construction stage.

1. See Section 013100 "Project Management and Coordination." for requirements for using web-based Project software.

### 1.3 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work of Project is defined by the Contract Documents and consists of the following:

1. A two-story building that is approximately 76,000 sf that utilizes brick veneer and metal panels over metal stud framing on a steel structure supported by concrete foundation and piers. The site will have detention ponds, parking/drive areas and Landscaping with other Work indicated in the Contract Documents.

B. Type of Contract: Competitive Sealed Proposal

1. Project will be constructed under a single prime contract.

#### 1.4 OWNER-FURNISHED/CONTRACTOR-INSTALLED (OFCI) PRODUCTS

- A. Owner's Responsibilities: Owner will furnish products indicated and perform the following, as applicable:
  1. Provide to Contractor Owner-reviewed Product Data, Shop Drawings, and Samples.
  2. Provide for delivery of Owner-furnished products to Project site.
  3. Upon delivery, inspect, with Contractor present, delivered items.
    - a. If Owner-furnished products are damaged, defective, or missing, arrange for replacement.
  4. Obtain manufacturer's inspections, service, and warranties.
  5. Inform Contractor of earliest available delivery date for Owner-furnished products.
- B. Contractor's Responsibilities: The Work includes the following, as applicable:
  1. Designate delivery dates of Owner-furnished products in Contractor's construction schedule, utilizing Owner-furnished earliest available delivery dates.
  2. Review Owner-reviewed Product Data, Shop Drawings, and Samples, noting discrepancies and other issues in providing for Owner-furnished products in the Work.
  3. Receive, unload, handle, store, protect, and install Owner-furnished products.
  4. Make building services connections for Owner-furnished products.
  5. Protect Owner-furnished products from damage during storage, handling, and installation and prior to Substantial Completion.
  6. Repair or replace Owner-furnished products damaged following receipt.
- C. Owner-Furnished/Contractor-Installed (OFCI) Products:
  1. N/A

#### 1.5 CONTRACTOR'S USE OF SITE AND PREMISES

- A. Unrestricted Use of Site: Contractor shall have full use of Project site for construction operations during construction period. Contractor's use of Project site is limited only by Owner's right to perform work or to retain other contractors on portions of Project.
- B. Restricted Use of Site: Contractor shall have limited use of Project site for construction operations as indicated on Drawings by the Contract limits and as indicated by requirements of this Section.
- C. Limits on Use of Site: Limit use of Project site to areas within the Contract limits indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.
  1. Limits on Use of Site: Confine construction operations to Project Limits.
  2. Driveways, Walkways, and Entrances: Keep driveways and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or for storage of materials.



- D. Condition of Existing Building: Maintain portions of existing building affected by construction operations in a weathertight condition throughout construction period. Repair damage caused by construction operations.
- E. Condition of Existing Grounds: Maintain portions of existing grounds, landscaping, and hardscaping affected by construction operations throughout construction period. Repair damage caused by construction operations.

## 1.6 WORK RESTRICTIONS

- A. Comply with restrictions on construction operations.
  - 1. Comply with limitations on use of public streets, work on public streets, rights of way, and other requirements of authorities having jurisdiction.
- B. Smoking and Controlled Substance Restrictions: Use of tobacco products, alcoholic beverages, and other controlled substances on Project site is not permitted.
- C. Employee Identification: Provide identification tags for Contractor personnel working on Project site. Require personnel to use identification tags at all times.
- D. Employee Screening: Comply with Owner's requirements for background screening of Contractor personnel working on Project site.
  - 1. Maintain list of approved screened personnel with Owner's representative.

## 1.7 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. Text Color: Text used in the Specifications, including units of measure, manufacturer and product names, and other text may appear in multiple colors or underlined as part of a hyperlink; no emphasis is implied by text with these characteristics.
  - 3. Hypertext: Text used in the Specifications may contain hyperlinks. Hyperlinks may allow for access to linked information that is not residing in the Specifications. Unless otherwise indicated, linked information is not part of the Contract Documents.
  - 4. Specification requirements are to be performed by Contractor unless specifically stated otherwise.
- B. Division 00 Contracting Requirements: General provisions of the Contract, including General and Supplementary Conditions, apply to all Sections of the Specifications.
- C. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.



PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011000

## SECTION 012100 - ALLOWANCES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes administrative and procedural requirements governing allowances.
- B. Types of allowances include the following:
  - 1. Lump-sum allowances.
  - 2. Unit-cost allowances.
  - 3. Quantity allowances.
  - 4. Contingency allowances.
- C. Related Requirements:
  - 1. Section 012200 "Unit Prices" for procedures for using unit prices, including adjustment of quantity allowances when applicable.

#### 1.2 SELECTION AND PURCHASE

- A. At the earliest practical date after award of the Contract, advise Architect of the date when final selection, or purchase and delivery, of each product or system described by an allowance must be completed by the Owner to avoid delaying the Work.
- B. At Architect's request, obtain proposals for each allowance for use in making final selections. Include recommendations that are relevant to performing the Work.
- C. Purchase products and systems selected by Architect from the designated supplier.

#### 1.3 ACTION SUBMITTALS

- A. Submit proposals for purchase of products or systems included in allowances in the form specified for Change Orders.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Submit invoices or delivery slips to show actual quantities of materials delivered to the site for use in fulfillment of each allowance.
- B. Submit time sheets and other documentation to show labor time and cost for installation of allowance items that include installation as part of the allowance.
- C. Coordinate and process submittals for allowance items in same manner as for other portions of the Work.

## 1.5 LUMP-SUM 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 Project site.
- B. Unless otherwise indicated, Contractor's costs for receiving and handling at Project 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.

## 1.6 UNIT-COST 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 Project site.
- B. Unless otherwise indicated, Contractor's costs for receiving and handling at Project 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.

## 1.7 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 Project site.
- B. Unless otherwise indicated, Contractor's costs for receiving and handling at Project 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.

## 1.8 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.
- D. At Project closeout, credit unused amounts remaining in the contingency allowance to Owner by Change Order.

## 1.9 ADJUSTMENT OF ALLOWANCES

- A. Allowance Adjustment: To adjust allowance amounts, prepare a Change Order 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 markups.
  - 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. **Allowance No. 1: Contingency Allowance:** Include a contingency allowance of \$400,000.00 for use according to Owner's written instructions.

- B. **Allowance No. 2:** Graphics Allowance: Include a contingency allowance of \$100,000.00 for additional building branding signage not included in contract documents according to Owner's written instructions.
- C. **Allowance No. 3:** Contingency Allowance: Include a contingency allowance of \$30,000.00 for additional Structural Steel required. (5 Tons @ \$6,000 = \$30,000.00 Total).
- D. **Allowance No. 4:** Contingency Allowance: Include a contingency allowance of \$12,000.00 for additional Steel Rebar required. (3 Tons @ \$4,000 = \$12,000.00 Total).

END OF SECTION 012100



## SECTION 012500 - SUBSTITUTION PROCEDURES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes administrative and procedural requirements for substitutions.
- B. Related Requirements:
  - 1. Document 002600 "Procurement Substitution Procedures" for requirements for substitution requests prior to award of Contract.
  - 2. Section 016000 "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.

#### 1.2 DEFINITIONS

- A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.
  - 1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
  - 2. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required in order to meet other Project requirements but may offer advantage to Contractor or Owner.

#### 1.3 ACTION SUBMITTALS

- A. Substitution Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
  - 1. Substitution Request Form: Use form acceptable to Architect.
  - 2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
    - a. Statement indicating why specified product or fabrication or installation method cannot be provided, if applicable.
    - b. Coordination of information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed substitution.
    - c. Detailed comparison of significant qualities of proposed substitutions with those of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes, such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific

features and requirements indicated. Indicate deviations, if any, from the Work specified.

- d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
  - e. Samples, where applicable or requested.
  - f. Certificates and qualification data, where applicable or requested.
  - g. List of similar installations for completed projects, with project names and addresses as well as names and addresses of architects and owners.
  - h. Material test reports from a qualified testing agency, indicating and interpreting test results for compliance with requirements indicated.
  - i. Research reports evidencing compliance with building code in effect for Project.
  - j. Detailed comparison of Contractor's construction schedule using proposed substitutions with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
  - k. Cost information, including a proposal of change, if any, in the Contract Sum.
  - l. Contractor's certification that proposed substitution complies with requirements in the Contract Documents, except as indicated in substitution request, is compatible with related materials and is appropriate for applications indicated.
  - m. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.
3. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within seven days of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
- a. Forms of Acceptance: Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the Work.
  - b. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

#### 1.4 QUALITY ASSURANCE

- A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended by manufacturers.

#### 1.5 PROCEDURES

- A. Coordination: Revise or adjust affected work as necessary to integrate work of the approved substitutions.

## 1.6 SUBSTITUTIONS

- A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than 15 days prior to time required for preparation and review of related submittals.
1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
    - a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
    - b. Substitution request is fully documented and properly submitted.
    - c. Requested substitution will not adversely affect Contractor's construction schedule.
    - d. Requested substitution has received necessary approvals of authorities having jurisdiction.
    - e. Requested substitution is compatible with other portions of the Work.
    - f. Requested substitution has been coordinated with other portions of the Work.
    - g. Requested substitution provides specified warranty.
    - h. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.
- B. Substitutions for Convenience: Architect will consider requests for substitution if received within 30 days after the Notice to Proceed. Requests received after that time may be considered or rejected at discretion of Architect.
1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
    - a. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
    - b. Requested substitution does not require extensive revisions to the Contract Documents.
    - c. Requested substitution is consistent with the Contract Documents and will produce indicated results.
    - d. Substitution request is fully documented and properly submitted.
    - e. Requested substitution will not adversely affect Contractor's construction schedule.
    - f. Requested substitution has received necessary approvals of authorities having jurisdiction.
    - g. Requested substitution is compatible with other portions of the Work.
    - h. Requested substitution has been coordinated with other portions of the Work.
    - i. Requested substitution provides specified warranty.

- j. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012500

## SECTION 012600 - CONTRACT MODIFICATION PROCEDURES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes administrative and procedural requirements for handling and processing Contract modifications.

#### 1.2 MINOR CHANGES IN THE WORK

- A. Architect will issue supplemental instructions (ASI) authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on AIA Document G710.
  - 1. Work Change Proposal Requests (PR) issued by Architect are not instructions either to stop work in progress or to execute the proposed change.

#### 1.3 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. Within 14 days after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
    - a. Include a 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 a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.



2. Include a 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 012500 "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.

#### 1.4 CHANGE ORDER PROCEDURES

- A. On Owner's approval of a Work Change Proposal Request, Architect will issue a Change Order for signatures of Owner and Contractor on AIA Document G701.

#### 1.5 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. It also designates method to be followed 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.
  1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

#### 1.6 WORK CHANGE DIRECTIVE

- A. Work Change Directive: Architect may issue a Work Change Directive on EJCDC Document C-940. Work Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.
  1. Work Change Directive contains a complete description of change in the Work. It also designates method to be followed 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 Work Change Directive.

1. 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 012600

## SECTION 012900 - PAYMENT PROCEDURES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes administrative and procedural requirements necessary to prepare and process Applications for Payment.

#### 1.2 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 items required to be indicated as separate activities in 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.
- 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. Arrange schedule of values consistent with format of AIA Document G703.
  - 2. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Provide multiple line items for principal subcontract amounts in excess of five percent of the Contract Sum.
  - 3. Provide a 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.
  - 4. 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.
  - 5. Overhead Costs: Include total cost and proportionate share of general overhead and profit for each line item.
  - 6. Overhead Costs: Show cost of temporary facilities and other major cost items that are not direct cost of actual work-in-place as separate line items.
  - 7. Closeout Costs. Include separate line items under Contractor and principal subcontracts for Project closeout requirements in an amount totaling five percent of the Contract Sum and subcontract amount.
  - 8. Schedule of Values Revisions: Revise the schedule of values when Change Orders or Construction Change Directives result in a change in the Contract Sum. Include at least one separate line item for each Change Order and Construction Change Directive.

### 1.3 APPLICATIONS FOR PAYMENT

- A. Each Application for Payment following the initial Application for Payment shall be consistent with previous applications and payments as certified by Architect and paid for by Owner.
- B. Payment Application Times: The date for each progress payment is indicated in the Agreement between Owner and Contractor. The period of construction work covered by each Application for Payment is the period indicated in the Agreement.
- C. Payment Application Times: Submit Application for Payment to Architect by the third week of the month. The period covered by each Application for Payment is one month, ending on the last day of the month.
  - 1. Submit draft copy of Application for Payment seven days prior to due date for review by Architect.
- D. Application for Payment Forms: Use AIA Document G702 and AIA Document G703 as form for Applications for Payment.
- E. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect will return incomplete applications without action.
  - 1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
  - 2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
  - 3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
- F. Transmittal: Submit three signed and notarized original copies of each Application for Payment to Architect by a method ensuring receipt within 24 hours. One copy shall include waivers of lien and similar attachments if required.
  - 1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.
- G. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien from entities lawfully entitled to file a mechanic's lien arising out of the Contract and related to the Work covered by the payment.
  - 1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
  - 2. When an application shows completion of an item, submit conditional final or full waivers.
  - 3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
  - 4. Submit final Application for Payment with or preceded by conditional final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.

5. Waiver Forms: Submit executed waivers of lien on forms acceptable to Owner.
- H. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
1. List of subcontractors.
  2. Schedule of values.
  3. Contractor's construction schedule (preliminary if not final).
  4. Products list (preliminary if not final).
  5. Sustainable design action plans, including preliminary project materials cost data.
  6. Schedule of unit prices.
  7. Submittal schedule (preliminary if not final).
  8. List of Contractor's staff assignments.
  9. List of Contractor's principal consultants.
  10. Copies of building permits.
  11. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
  12. Initial progress report.
  13. Report of preconstruction conference.
  14. Certificates of insurance and insurance policies.
  15. Performance and payment bonds.
  16. Data needed to acquire Owner's insurance.
- I. Application for Payment at Substantial Completion: After Architect issues the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.
1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
  2. This application shall reflect Certificate(s) of Substantial Completion issued previously for Owner occupancy of designated portions of the Work.
- J. Final Payment Application: After completing Project closeout requirements, submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
1. Evidence of completion of Project closeout requirements.
  2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
  3. Updated final statement, accounting for final changes to the Contract Sum.
  4. AIA Document G706.
  5. AIA Document G706A.
  6. AIA Document G707.
  7. Evidence that claims have been settled.
  8. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
  9. Final liquidated damages settlement statement.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012900



## SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION

### PART 1 - GENERAL

#### 1.1 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. RFIs.
  - 4. Digital project management procedures.
  - 5. Project meetings.
- B. Related Requirements:
  - 1. Section 017300 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
  - 2. Section 019113 "General Commissioning Requirements" for coordinating the Work with Owner's Commissioning Authority.

#### 1.2 INFORMATIONAL 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, telephone number, and email address 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.

#### 1.3 GENERAL COORDINATION PROCEDURES

- A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations included in different Sections 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. 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. Such 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.

#### 1.4 COORDINATION DRAWINGS

- A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely indicated 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. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
    - b. Indicate dimensions shown on Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternative 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 as follows:
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 plenums to accommodate layout of light fixtures and other components indicated on Drawings. Indicate areas of conflict between light fixtures 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. Review: Architect will review coordination drawings to confirm that, in general, 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 suitable modifications and resubmit.

C. Coordination Digital Data Files: Prepare coordination digital data files according to the following requirements:

1. File Preparation Format:

- a. Same digital data software program, version, and operating system as original Drawings.

2. File Submittal Format: Submit or post coordination drawing files using PDF 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. Contractor shall execute a data licensing agreement in the form of AIA Document C106 or Agreement form acceptable to Owner and Architect.

#### 1.5 REQUEST FOR INFORMATION (RFI)

A. General: Immediately on discovery of the need for additional information, clarification, or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.

1. Architect will return without response those RFIs submitted to Architect by other entities controlled by Contractor.
2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.

B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:

1. Owner name.
2. Owner's Project number.
3. Name of Architect.
4. Architect's Project number.
5. Date.
6. Name of Contractor.
7. RFI number, numbered sequentially.
8. RFI subject.
9. Specification Section number and title and related paragraphs, as appropriate.
10. Drawing number and detail references, as appropriate.
11. Field dimensions and conditions, as appropriate.

12. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
  13. Contractor's signature.
  14. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
- C. RFI Forms: AIA Document G716.
- D. Architect's Action: Architect will review each RFI, determine action required, and respond. Allow seven days for Architect's response for each RFI. RFIs received by Architect after 1:00 p.m. will be considered as received the following working day.
1. The following Contractor-generated RFIs will be returned without action:
    - a. Requests for approval of submittals.
    - b. Requests for approval of substitutions.
    - c. Requests for approval of Contractor's means and methods.
    - d. Requests for coordination information already indicated in the Contract Documents.
    - e. Requests for adjustments in the Contract Time or the Contract Sum.
    - f. Requests for interpretation of Architect's actions on submittals.
    - g. Incomplete RFIs or inaccurately prepared RFIs.
  2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt by Architect additional information.
  3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Section 012600 "Contract Modification Procedures."
    - a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within five days of receipt of the RFI response.
- E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly.
1. Project name.
  2. Name and address of Contractor.
  3. Name and address of Architect.
  4. RFI number including RFIs that were returned without action or withdrawn.
  5. RFI description.
  6. Date the RFI was submitted.
  7. Date Architect's response was received.
- F. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within three days if Contractor disagrees with response.

## 1.6 DIGITAL PROJECT MANAGEMENT PROCEDURES

- A. Use of Architect's Digital Data Files: Digital data files of Architect's **CAD drawings** will be provided by Architect for Contractor's use during construction.
1. Digital data files may be used by Contractor in preparing coordination drawings, Shop Drawings, and Project record Drawings.
  2. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Contract Drawings.
  3. Contractor shall execute a data licensing agreement in the form of AIA Document C106 or Agreement form acceptable to Owner and Architect.
    - a. Subcontractors, and other parties granted access by Contractor to Architect's digital data files shall execute a data licensing agreement in the form of AIA Document C106 or agreement acceptable to Owner and Architect.
- B. Web-Based Project Management Software Package: Provide, administer, and use web-based Project management software package for purposes of hosting and managing Project communication and documentation until Final Completion.
1. Web-based Project management software includes, at a minimum, the following features:
    - a. Compilation of Project data, including Contractor, subcontractors, Architect, architect's consultants, Owner, and other entities involved in Project. Include names of individuals and contact information.
    - b. Access control for each entity for each workflow process, to determine entity's digital rights to create, modify, view, and print documents.
    - c. Document workflow planning, allowing customization of workflow between project entities.
    - d. Creation, logging, tracking, and notification for Project communications required in other Specification Sections, including, but not limited to, RFIs, submittals, Minor Changes in the Work, Construction Change Directives, and Change Orders.
    - e. Track status of each Project communication in real time, and log time and date when responses are provided.
    - f. Procedures for handling PDFs or similar file formats, allowing markups by each entity. Provide security features to lock markups against changes once submitted.
    - g. Processing and tracking of payment applications.
    - h. Processing and tracking of contract modifications.
    - i. Creating and distributing meeting minutes.
    - j. Document management for Drawings, Specifications, and coordination drawings, including revision control.
    - k. Management of construction progress photographs.
    - l. Mobile device compatibility, including smartphones and tablets.
  2. Provide up to seven web-based Project management software user licenses for use of Owner, Architect, and Architect's consultants. Provide eight hours of software training at Architect's office for web-based Project software users.
  3. At completion of Project, provide digital archive in format that is readable by common desktop software applications in format acceptable to Architect. Provide data in locked format to prevent further changes.
  4. Provide one of the following:

- a. Newforma, Inc.
  - b. Procore Technologies, Inc.
  - c. Submittal Exchange
- C. PDF Document Preparation: Where PDFs are required to be submitted to Architect, prepare as follows:
- 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. Name file with submittal number or other unique identifier, including revision identifier.
  - 3. Certifications: Where digitally submitted certificates and certifications are required, provide a digital signature with digital certificate on where indicated.

## 1.7 PROJECT MEETINGS

- A. General: Schedule and conduct meetings and conferences at Project site unless otherwise indicated.
- B. Preconstruction Conference: Architect and Owner will schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 15 days after execution of the Agreement.
- 1. 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.
  - 2. Agenda: Discuss items of significance that could affect progress, including the following:
    - a. Responsibilities and personnel assignments.
    - b. Tentative construction schedule.
    - c. Phasing.
    - d. Critical work sequencing and long lead items.
    - e. Designation of key personnel and their duties.
    - f. Lines of communications.
    - g. Use of web-based Project software.
    - h. Procedures for processing field decisions and Change Orders.
    - i. Procedures for RFIs.
    - j. Procedures for testing and inspecting.
    - k. Procedures for processing Applications for Payment.
    - l. Distribution of the Contract Documents.
    - m. Submittal procedures.
    - n. Sustainable design requirements.
    - o. Preparation of Record Documents.
    - p. Use of the premises.
    - q. Work restrictions.
    - r. Working hours.
    - s. Owner's occupancy requirements.
    - t. Responsibility for temporary facilities and controls.
    - u. Procedures for moisture and mold control.



- v. Procedures for disruptions and shutdowns.
  - w. Construction waste management and recycling.
  - x. Parking availability.
  - y. Office, work, and storage areas.
  - z. Equipment deliveries and priorities.
  - aa. First aid.
  - bb. Security.
  - cc. Progress cleaning.
3. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.
- C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity when required by other sections and when required for coordination with other construction.
- 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 of scheduled meeting dates.
  - 2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
    - a. Contract Documents.
    - b. Options.
    - c. Related RFIs.
    - d. Related Change Orders.
    - e. Purchases.
    - f. Deliveries.
    - g. Submittals.
    - h. Sustainable design requirements.
    - i. Review of mockups.
    - j. Possible conflicts.
    - k. Compatibility requirements.
    - l. Time schedules.
    - m. Weather limitations.
    - n. Manufacturer's written instructions.
    - o. Warranty requirements.
    - p. Compatibility of materials.
    - q. Acceptability of substrates.
    - r. Temporary facilities and controls.
    - s. Space and access limitations.
    - t. Regulations of authorities having jurisdiction.
    - u. Testing and inspecting requirements.
    - v. Installation procedures.
    - w. Coordination with other work.
    - x. Required performance results.
    - y. Protection of adjacent work.
    - z. Protection of construction and personnel.

3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
4. Reporting: 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.

D. Progress Meetings: Conduct progress meetings at biweekly 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.
    - 1) Review schedule for next period.
  - b. Review present and future needs of each entity present, including the following:
    - 1) Interface requirements.
    - 2) Sequence of operations.
    - 3) Resolution of BIM component conflicts.
    - 4) Status of submittals.
    - 5) Status of sustainable design documentation.
    - 6) Deliveries.
    - 7) Off-site fabrication.
    - 8) Access.
    - 9) Site use.
    - 10) Temporary facilities and controls.
    - 11) Progress cleaning.
    - 12) Quality and work standards.
    - 13) Status of correction of deficient items.
    - 14) Field observations.
    - 15) Status of RFIs.
    - 16) Status of Proposal Requests.
    - 17) Pending changes.
    - 18) Status of Change Orders.
    - 19) Pending claims and disputes.
    - 20) Documentation of information for payment requests.

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.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013100

## SECTION 013200 - CONSTRUCTION PROGRESS DOCUMENTATION

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
  - 1. Contractor's Construction Schedule.
  - 2. Construction schedule updating reports.
  - 3. Daily construction reports.
  - 4. Site condition reports.

#### 1.2 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. 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.
- C. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.
- D. Event: The starting or ending point of an activity.
- 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.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Format for Submittals: Submit required submittals in the following format:

1. Working electronic copy of schedule file.
  2. PDF file.
  3. Two paper copies, of sufficient size to display entire period or schedule, as required.
- B. Startup Network Diagram: Of size required to display entire network for entire construction period. Show logic ties for activities.
- C. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.
1. Submit a working digital copy of schedule, using software indicated, and labeled to comply with requirements for submittals.
- 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, 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 each activity, sorted in ascending order by activity number and then by early start date, or actual start date if known.
  3. Total Float Report: List of activities sorted in ascending order of total float.
- E. Construction Schedule Updating Reports: Submit with Applications for Payment.
- F. Daily Construction Reports: Submit at weekly intervals.
- G. Site Condition Reports: Submit at time of discovery of differing conditions.

#### 1.4 COORDINATION

- A. Coordinate Contractor's Construction Schedule with the schedule of values, 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.

#### 1.5 CONTRACTOR'S CONSTRUCTION SCHEDULE

- A. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.
- B. Time Frame: Extend schedule from date established for the Notice to Proceed to date of Substantial Completion and final completion.

1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.
- C. Activities: Treat each floor or separate area as a separate numbered activity for each main element of the Work. Comply with the following:
1. Activity Duration: Define activities so no activity is longer than 20 days, unless specifically allowed by Architect.
  2. Submittal Review Time: Include review and resubmittal times indicated in Section 013300 "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's Construction Schedule with submittal schedule.
  3. Startup and Testing Time: Include no fewer than 30 days for startup and testing.
  4. Commissioning Time: Include no fewer than 30 days for commissioning.
  5. Substantial Completion: Indicate completion 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 not more than 30 days for completion of punch list items and final completion.
- D. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.
1. Phasing: Arrange list of activities on schedule by phase.
  2. Owner-Furnished Products: Include a separate activity for each product. Include delivery date indicated in Section 011000 "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
  3. 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.
- E. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and final completion and the following interim milestones:
1. Temporary enclosure and space conditioning.
  2. Commissioning
- F. Upcoming Work Summary: Prepare summary report 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 the Contract Time.
- G. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.
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.
- H. 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, equipment required to achieve compliance, and date by which recovery will be accomplished.
- I. Distribution: Distribute copies of approved schedule to Architect, Owner, separate contractors, testing and inspecting agencies, and other 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.

## 1.6 GANTT-CHART SCHEDULE REQUIREMENTS

- A. Gantt-Chart Schedule: Submit a comprehensive, fully developed, horizontal, Gantt-chart-type, Contractor's Construction Schedule within 30 days of date established for the Notice to Proceed.
- B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line.
1. For construction activities that require three months or longer to complete, indicate an estimated completion percentage in 10 percent increments within time bar.

## 1.7 CPM SCHEDULE REQUIREMENTS

- A. Prepare network diagrams using AON (activity-on-node) format.
- B. Startup Network Diagram: Submit diagram within 14 days of date established for the Notice to Proceed. Outline significant construction activities for the first 90 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.

- C. CPM Schedule Preparation: Prepare a list of all activities required to complete the Work. Using the startup network diagram, prepare a skeleton network to identify probable critical paths.
1. Activities: Indicate the estimated time duration, sequence requirements, and relationship of each activity in relation to other activities. Include estimated time frames for the following activities:
    - a. Preparation and processing of submittals.
    - b. Mobilization and demobilization.
    - c. Purchase of materials.
    - d. Delivery.
    - e. Fabrication.
    - f. Utility interruptions.
    - g. Installation.
    - h. Work by Owner that may affect or be affected by Contractor's activities.
    - i. Testing and inspection.
    - j. Commissioning.
    - k. Punch list and final completion.
    - l. Activities occurring following final completion.
  2. Critical Path Activities: Identify critical path activities, including those for interim completion dates. Scheduled start and completion dates shall be consistent with Contract milestone dates.
  3. Processing: Process data to produce output data on a computer-drawn, time-scaled network. Revise data, reorganize activity sequences, and reproduce as often as necessary to produce the CPM schedule within the limitations of the Contract Time.
  4. Format: Mark the critical path. Locate the critical path near center of network; locate paths with most float near the edges.
    - a. Subnetworks on separate sheets are permissible for activities clearly off the critical path.
- D. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis using a network fragment to demonstrate the effect of the proposed change on the overall Project schedule.
- E. Initial Issue of Schedule: Prepare initial network diagram from a sorted activity list indicating straight "early start-total float." Identify critical activities. Prepare tabulated reports showing the following:
1. Contractor or subcontractor and the Work or activity.
  2. Description of activity.
  3. Main events of activity.
  4. Immediate preceding and succeeding activities.
  5. Early and late start dates.
  6. Early and late finish dates.
  7. Activity duration in workdays.
  8. Total float or slack time.
  9. Average size of workforce.
  10. Dollar value of activity (coordinated with the schedule of values).

F. 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.

## 1.8 REPORTS

A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:

1. List of subcontractors at Project site.
2. List of separate contractors at Project site.
3. Approximate count of personnel at Project site.
4. Equipment at Project site.
5. Material deliveries.
6. High and low temperatures and general weather conditions, including presence of rain or snow.
7. Testing and inspection.
8. Accidents.
9. Meetings and significant decisions.
10. Stoppages, delays, shortages, and losses.
11. Meter readings and similar recordings.
12. Emergency procedures.
13. Orders and requests of authorities having jurisdiction.
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. Site Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013200

## SECTION 013233 - PHOTOGRAPHIC DOCUMENTATION

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes administrative and procedural requirements for the following:
  - 1. Preconstruction photographs.
  - 2. Concealed Work photographs.
  - 3. Periodic construction photographs.
  - 4. Final completion construction photographs.
- B. Related Requirements:
  - 1. Section 017700 "Closeout Procedures" for submitting photographic documentation as Project Record Documents at Project closeout.

#### 1.2 INFORMATIONAL 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. Indicate elevation or story of construction. Include same information as corresponding photographic documentation.
- B. Digital Photographs: Submit image files within five days of taking photographs.
  - 1. Submit photos thumb-drive and by uploading to web-based Project management software site. Include copy of key plan indicating each photograph's location and direction.
  - 2. Identification: Provide the following information with each image description web-based Project management software site:
    - 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 location, vantage point, and direction.
    - g. Unique sequential identifier keyed to accompanying key plan.

#### 1.3 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.

#### 1.4 FORMATS AND MEDIA

- A. Digital Photographs: Provide color images in JPG format, produced by a digital camera with minimum sensor size of 12 megapixels, and at an image resolution of not less than 3200 by 2400 pixels. Use flash in low light levels or backlit conditions.
- B. Digital Images: Submit digital media as originally recorded in the digital camera, without alteration, manipulation, editing, or modifications using image-editing software.

#### 1.5 CONSTRUCTION PHOTOGRAPHS

- A. Photographer: Engage a qualified photographer to take construction photographs.
- B. General: Take photographs with maximum depth of field and in focus.
  - 1. Maintain key plan with each set of construction photographs that identifies each photographic location.
- C. Preconstruction Photographs: Before commencement of the Work, take photographs of Project site and surrounding properties, including existing items to remain during construction, from different vantage points.
  - 1. Take 10 photographs to show existing conditions adjacent to property before starting the Work.
- D. Concealed Work Photographs: Before proceeding with installing work that will conceal other work, take photographs sufficient in number, with annotated descriptions, to record nature and location of concealed Work, including, but not limited to, the following:
  - 1. Underground utilities.
  - 2. Underslab services.
  - 3. Piping.
  - 4. Electrical conduit.
  - 5. Waterproofing and weather-resistant barriers.
  - 6. Base of wall flashing and waterproofing
  - 7. Door and Window fastening, flashing and waterproofing.
  - 8. Roofing Installation, including base fastening, roofing ply installation, and parapet waterproofing.
  - 9. Metal Wall Panel Installation, including fastening and waterproofing.
- E. Periodic Construction Photographs: Take 20 photographs weekly. Select vantage points to show status of construction and progress since last photographs were taken.
- F. Aerial Construction Photographs: Take aerial photographs (North, South, East, West) monthly and submit with each month's application for payment until the project is substantially complete
- G. Final Completion Construction Photographs: Take 20 photographs after date of Substantial Completion for submission as Project Record Documents. Architect and Owner will inform photographer of desired vantage points.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013233



## SECTION 013300 - SUBMITTAL PROCEDURES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Submittal schedule requirements.
  - 2. Administrative and procedural requirements for submittals.

#### 1.2 DEFINITIONS

- A. Action Submittals: Written and graphic information and physical samples that require Architect's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."
- B. Informational Submittals: Written and graphic information and physical samples that do not require Architect's action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."

#### 1.3 SUBMITTAL SCHEDULE

- A. Submittal Schedule: Submit, as an action submittal, a list 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.

#### 1.4 SUBMITTAL FORMATS

- A. Submittal Information: Include the following information in each submittal:
  - 1. Project name.
  - 2. Date.
  - 3. Name of Architect.
  - 4. Name of Construction Manager.
  - 5. Name of Contractor.
  - 6. Name of firm or entity that prepared submittal.
  - 7. Names of subcontractor, manufacturer, and supplier.
  - 8. Unique submittal number, including revision identifier. Include Specification Section number with sequential alphanumeric identifier; and alphanumeric suffix for resubmittals.
  - 9. Category and type of submittal.
  - 10. Submittal purpose and description.

11. Number and title of Specification Section, with paragraph number and generic name for each of multiple items.
  12. Drawing number and detail references, as appropriate.
  13. Indication of full or partial submittal.
  14. Location(s) where product is to be installed, as appropriate.
  15. Other necessary identification.
  16. Remarks.
  17. Signature of transmitter.
- B. Options: Identify options requiring selection by Architect.
- C. Deviations and Additional Information: On each submittal, clearly indicate deviations from requirements in the Contract Documents, including minor variations and limitations; include relevant additional information and revisions, other than those requested by Architect on previous submittals. Indicate by highlighting on each submittal or noting on attached separate sheet.
- D. Electronic Submittals: Prepare submittals as PDF package, incorporating complete information into each PDF file. Name PDF file with submittal number.
- E. Submittals for Utilizing Web-Based Project Management Software: Prepare submittals as PDF files, or other format indicated by Project management software.

## 1.5 SUBMITTAL PROCEDURES

- A. Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
1. Web-Based Project Management Software: Prepare submittals in PDF form, and upload to web-based Project management software website. Enter required data in web-based software site to fully identify submittal.
- 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 all 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.
- C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. 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 15 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. Resubmittal Review: Allow 15 days for review of each resubmittal.

- D. Resubmittals: Make resubmittals in same form and number of copies as initial submittal. Include all items as a complete package in Resubmittal. Incomplete submittals will be returned if only partial information is re-submitted.
- E. 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.
- F. 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 or Consultants action stamp.

## 1.6 SUBMITTAL REQUIREMENTS

- A. 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 unsuitable 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 that show 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 Shop Drawings, and before or concurrent with Samples.
- B. 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.
- C. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other materials.
- 1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
  - 2. Identification: Permanently attach label on unexposed side of Samples that includes the following:
    - a. Project name and submittal number.
    - b. Generic description of Sample.
    - c. Product name and name of manufacturer.
    - d. Sample source.
    - e. Number and title of applicable Specification Section.
    - f. Specification paragraph number and generic name of each item.
  - 3. Web-Based Project Management Software: Prepare submittals in PDF form, and upload to web-based Project software website. Enter required data in web-based software site to fully identify submittal.
  - 4. Paper Transmittal: Include paper transmittal including complete submittal information indicated.
  - 5. 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.
  - 6. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.
    - a. Number of Samples: Submit **one** full set of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected.
- D. 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:
- E. 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.
- F. Design Data: Prepare and submit written and graphic information indicating compliance with indicated performance and design criteria in individual Specification Sections. Include list of

assumptions and summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Number each page of submittal.

G. Certificates:

1. Certificates and Certifications Submittals: Submit a 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. Provide a notarized signature where indicated.
2. 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.
3. 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.
4. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
5. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
6. 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.

H. Test and Research Reports:

1. 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 substrate preparation and primers required.
2. 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.
3. 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.
4. 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.
5. 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.
6. 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:
  - a. Name of evaluation organization.
  - b. Date of evaluation.
  - c. Time period when report is in effect.

- d. Product and manufacturers' names.
- e. Description of product.
- f. Test procedures and results.
- g. Limitations of use.

#### 1.7 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 insufficient 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 other required submittals, submit digitally signed PDF 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.

#### 1.8 CONTRACTOR'S REVIEW

- A. Action Submittals 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. Contractor's Approval: Indicate Contractor's approval for each submittal with a uniform approval stamp and indication in web-based Project management software. Include 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.
  - 1. Architect will not review submittals received from Contractor that do not have Contractor's review and approval.

#### 1.9 ARCHITECT'S REVIEW

- A. Action Submittals: Architect will review each submittal, indicate corrections or revisions required, and return it.
  - 1. PDF Submittals: Architect will indicate, via markup on each submittal, the appropriate action.
    - a. Reviewed No Exceptions
    - b. Reviewed As Noted



c. Revise and Resubmit

2. Submittals by Web-Based Project Management Software: Architect will indicate, on Project management software website, the appropriate action.
- B. Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.
- C. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.
- D. Architect will discard submittals received from sources other than Contractor.
- E. Submittals not required by the Contract Documents will be returned by Architect without action.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013300

## SECTION 014000 - QUALITY REQUIREMENTS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspection 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. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and quality-control procedures that facilitate compliance with the Contract Document requirements.
  - 2. Requirements for Contractor to provide quality-assurance and quality-control services required by Architect, Owner and authorities having jurisdiction are not limited by provisions of this Section.

#### 1.2 DEFINITIONS

- A. Experienced: When used with an entity or individual, "experienced" unless otherwise further described means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.
- B. Field Quality-Control Tests and Inspections: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- C. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, assembly, and similar operations.
  - 1. Use of trade-specific terminology in referring to a Work result does not require that certain construction activities specified apply exclusively to specific trade(s).
- D. Mockups: Full-size physical assemblies that are constructed on-site either as freestanding temporary built elements or as part of permanent construction. Mockups are constructed to verify selections made under Sample submittals; to demonstrate aesthetic effects and 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 and tested at testing facility to verify performance characteristics.

2. Integrated Exterior Mockups: Mockups of the exterior envelope constructed on-site as freestanding temporary built elements consisting of multiple products, assemblies, and subassemblies, with cutaways enabling inspection of concealed portions of the Work.
    - a. Include each system, assembly, component, and part of the exterior wall to be constructed for the Project. Colors of components shall be those selected by the Architect for use in the Project.
  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.
  4. Product Mockups: Mockups that may include multiple products, materials, or systems specified in a single Section.
  5. In-Place Mockups: Mockups constructed on-site in their actual final location as part of permanent construction.
- E. 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. Unless otherwise indicated, copies of reports of tests or inspections performed for other than the Project do not meet this definition.
- F. Product Tests: Tests and inspections that are performed by a nationally recognized testing laboratory (NRTL) according to 29 CFR 1910.7, by a testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program (NVLAP), or by a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.
- G. Source Quality-Control Tests and Inspections: Tests and inspections that are performed at the source; for example, plant, mill, factory, or shop.
- H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall have the same meaning as testing agency.
- I. 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.
- J. 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. Contractor's quality-control services do not include contract administration activities performed by Architect.
- 1.3 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 Statement: Submit a statement, 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, indicating that the products and systems are in compliance with performance and design criteria indicated. Include list of codes, loads, and other factors used in performing these services.

#### 1.4 CONFLICTING REQUIREMENTS

- A. Conflicting Standards and Other Requirements: If compliance with two or more standards or requirements is specified and the standards or requirements establish different or conflicting requirements for minimum quantities or quality levels, inform the Architect regarding the conflict and obtain clarification prior to proceeding with the Work. Refer conflicting requirements that are different, but apparently equal, to Architect for clarification 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 ACTION SUBMITTALS

- A. Mockup Shop Drawings: For integrated exterior mockups.
  - 1. Include plans, sections, elevations, and details, indicating materials and size of mockup construction.
  - 2. Indicate manufacturer and model number of individual components.
  - 3. Provide axonometric drawings for conditions difficult to illustrate in two dimensions.

#### 1.6 INFORMATIONAL SUBMITTALS

- A. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility submitted to authorities having jurisdiction before starting work on the following systems:
  - 1. Seismic-force-resisting system, designated seismic system, or component listed in the Statement of Special Inspections.
  - 2. Main wind-force-resisting system or a wind-resisting component listed in the Statement of Special Inspections.
- B. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.
- C. Permits, Licenses, and Certificates: For Owner's record, 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.

## 1.7 REPORTS AND DOCUMENTS

A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:

1. Date of issue.
2. Project title and number.
3. Name, address, telephone number, and email address 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 inspection.
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. Statement on condition of substrates and their acceptability for installation of product.
2. Statement that products at Project site comply with requirements.
3. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
4. Results of operational and other tests and a statement of whether observed performance complies with requirements.
5. 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. Statement that equipment complies with requirements.
2. Results of operational and other tests and a statement of whether observed performance complies with requirements.
3. Other required items indicated in individual Specification Sections.

## 1.8 QUALITY ASSURANCE

A. Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.

- B. **Manufacturer Qualifications:** A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units. As applicable, procure products from manufacturers able to meet qualification requirements, warranty requirements, and technical or factory-authorized service representative requirements.
- C. **Fabricator Qualifications:** A firm experienced in producing products similar to those indicated for this Project and with a 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, applying, 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 jurisdiction where 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 the system, assembly, or product that are similar in material, design, and extent to those indicated for this Project.
- 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 shall supersede requirements for specialists.
- G. **Testing and Inspecting Agency Qualifications:** An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspection indicated, as documented according to ASTM E329 and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.
- 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 that are similar in material, design, and extent to those indicated for this Project.
- I. **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 in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
    - c. Build laboratory mockups at testing facility using personnel, products, and methods of construction indicated for the completed Work.
    - d. When testing is complete, remove test specimens and test assemblies, mockups, and do not reuse products on Project.

2. Testing Agency Responsibilities: Submit a 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.
- J. 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 of size indicated.
  2. Build mockups in location indicated or, if not indicated, as directed by Architect.
  3. Notify Architect seven days in advance of dates and times when mockups will be constructed.
  4. Employ supervisory personnel who will oversee mockup construction. Employ workers that will be employed to perform same tasks during the construction at Project.
  5. Demonstrate the proposed range of aesthetic effects and workmanship.
  6. Obtain Architect's approval of mockups before starting corresponding work, fabrication, or construction.
    - a. Allow seven days for initial review and each re-review of each mockup.
  7. Promptly correct unsatisfactory conditions noted by Architect's preliminary review, to the satisfaction of the Architect, before completion of final mockup.
  8. Approval of mockups by the Architect does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  9. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
  10. Demolish and remove mockups when directed unless otherwise indicated.

## 1.9 QUALITY CONTROL

- A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.
1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspection 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, whether specified or not, to verify and document that the Work complies with requirements.
1. Engage a qualified testing agency to perform quality-control services.
    - a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.



2. Notify testing agencies at least 48 hours in advance of time when Work that requires testing or inspection will be performed.
  3. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
  4. Testing and inspection requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
  5. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
- C. 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.
- D. 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 locations 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 duties of Contractor.
- E. 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 "Submittal Procedures."
- F. 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.
- G. Contractor's Associated Requirements and Services: Cooperate with agencies and representatives 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 inspection. Assist agency in obtaining samples.
  4. Facilities for storage and field curing of test samples.
  5. Preliminary design mix proposed for use for material mixes that require control by testing agency.

6. Security and protection for samples and for testing and inspection equipment at Project site.
- H. 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 inspection.
1. Schedule times for tests, inspections, obtaining samples, and similar activities.

#### 1.10 SPECIAL TESTS AND INSPECTIONS

- A. Special Tests and Inspections: Owner will engage a qualified testing agency to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner as follows:
1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviewing 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 Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's and authorities' having jurisdiction reference during normal working hours.
1. Submit log at Project closeout as part of Project Record Documents.

### 3.2 REPAIR AND PROTECTION

- A. General: On completion of testing, inspection, 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 017300 "Execution."
- 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 014000

## SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.
- B. Related Requirements:
  - 1. Section 011000 "Summary" for work restrictions and limitations on utility interruptions.

#### 1.2 USE CHARGES

- A. Installation, removal, and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities engaged in the Project to use temporary services and facilities without cost, including, but not limited to, Owner, Architect, Architects Consultants, testing agencies, and authorities having jurisdiction.
- B. Water and Sewer Service from Existing System: Provide connections and extensions of services and metering as required for construction operations.
- C. Electric Power Service from Existing System: Provide connections and extensions of services and metering as required for construction operations.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Site Utilization Plan: Show temporary facilities, temporary utility lines and connections, staging areas, construction site entrances, vehicle circulation, and parking areas for construction personnel.
- B. Project Identification and Temporary Signs: Show fabrication and installation details, including plans, elevations, details, layouts, typestyles, graphic elements, and message content.
- C. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire-prevention program.
- D. Moisture- and Mold-Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage and mold. Describe delivery, handling, storage, installation, and protection provisions for materials subject to water absorption or water damage.
  - 1. Indicate procedures for discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and requirements for replacing water-damaged Work.

2. Indicate sequencing of work that requires water, such as sprayed fire-resistive materials, plastering, and terrazzo 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.
3. Indicate methods to be used to avoid trapping water in finished work.

#### 1.4 QUALITY ASSURANCE

- A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.
- B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.
- C. Accessible Temporary Egress: Comply with applicable provisions in the United States Access Board's ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.

#### 1.5 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 TEMPORARY FACILITIES

- A. Field Offices: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.
- B. Common-Use Field Office: Of sufficient size to accommodate needs of Owner, Architect, and construction personnel office activities and to accommodate Project meetings specified in other Division 01 Sections. Keep office clean and orderly. Furnish and equip offices as follows:
  1. Furniture required for Project-site documents including file cabinets, plan tables, plan racks, and bookcases.
  2. Conference room of sufficient size to accommodate meetings of 10 individuals. Provide electrical power service and 120-V ac duplex receptacles, with no fewer than one receptacle on each wall. Furnish room with conference table, chairs, and 4-foot square tack and marker boards.
  3. Drinking water and private toilet.
  4. Heating and cooling equipment necessary to maintain a uniform indoor temperature of 68 to 72 deg F.
  5. Lighting fixtures capable of maintaining average illumination of 20 fc at desk height.

## 2.2 EQUIPMENT

- A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.
- B. 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. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
  - 2. Heating, Cooling, and Dehumidifying 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.
- C. 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 TEMPORARY FACILITIES, GENERAL

- A. Conservation: Coordinate construction and use of temporary facilities 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. See other Sections for disposition of salvaged materials that are designated as Owner's property.

### 3.2 INSTALLATION, GENERAL

- 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.
- 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.
- C. Isolation of Work Areas in Occupied Facilities: Prevent dust, fumes, and odors from entering occupied areas.

### 3.3 TEMPORARY UTILITY INSTALLATION

- A. General: Install temporary service or connect to existing service.
  - 1. 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, safety shower and eyewash 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.
- E. Temporary 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.
  - 1. Provide temporary dehumidification systems when required to reduce ambient and substrate moisture levels to level required to allow installation or application of finishes and their proper curing or drying.
- F. Electric Power Service: Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.
  - 1. Install electric power service overhead unless otherwise indicated.
- G. 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.
- H. Electronic Communication Service: Provide secure WiFi wireless connection to internet with provisions for access by Architect and Owner.
  - 1. Printer: "All-in-one" unit equipped with printer server, combining color printing, photocopying, scanning, and faxing, or separate units for each of these three functions.
  - 2. Internet Service: Broadband modem, router, and ISP, equipped with hardware firewall, providing minimum 10.0-Mbps upload and 15 -Mbps download speeds at each computer.
  - 3. Internet Security: Integrated software, providing software firewall, virus, spyware, phishing, and spam protection in a combined application.

### 3.4 SUPPORT FACILITIES INSTALLATION

- A. Comply with the following:
  - 1. Provide construction for temporary field offices, shops, and sheds located within construction area or within 30 feet of building lines that is noncombustible according to ASTM E136. Comply with NFPA 241.



2. Utilize designated area within existing building for temporary field offices.
  3. 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 Roads and Paved Areas: Construct and maintain temporary roads and paved areas adequate for construction operations. Locate temporary roads and paved areas as required for proper access onto and around the project site.
1. Provide dust-control treatment that is nonpolluting and nontracking. Reapply treatment as required to minimize dust.
- 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 on Project Site for construction personnel. Coordinate locations with construction activities.
- E. Storage and Staging: Use designated areas of Project site for storage and staging needs. Coordinate locations with construction activities.
- F. 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.
- G. 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 touch up signs so they are legible at all times.
- H. Waste Disposal Facilities: Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."
- I. 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 "Execution."
- J. 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.

- K. Temporary Elevator Use: Use of elevators is not permitted.
- L. Existing Elevator Use: Use of Owner's existing elevators will be permitted, provided elevators are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore elevators to condition existing before initial use, including replacing worn cables, guide shoes, and similar items of limited life.
  - 1. Do not load elevators beyond their rated weight capacity.
  - 2. Provide protective coverings, barriers, devices, signs, or other procedures to protect elevator car and entrance doors and frame. If, despite such protection, elevators become damaged, engage elevator Installer to restore damaged work so no evidence remains of correction work. Return items that cannot be refinished in field to the shop, make required repairs and refinish entire unit, or provide new units as required.
- M. Temporary Stairs: Until permanent stairs are available, provide temporary stairs where ladders are not adequate.
- N. Existing Stair Usage: Use of Owner's existing stairs will be permitted, provided stairs are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore stairs to condition existing before initial use.
  - 1. Provide protective coverings, barriers, devices, signs, or other procedures to protect stairs and to maintain means of egress. If stairs become damaged, restore damaged areas so no evidence remains of correction work.
- O. 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.

### 3.5 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.
  - 1. Where access to adjacent properties is required in order to affect protection of existing facilities, obtain written permission from adjacent property owner to access property for that purpose.
- 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: Comply with requirements of EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent and requirements specified in Section 311000 "Site Clearing."
- D. 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 erosion- and sedimentation-control Drawings,

requirements of EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent.

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.
- E. 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.
- F. Tree and Plant Protection: Comply with requirements specified in Section 015639 "Temporary Tree and Plant Protection."
- G. 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.
- H. 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 materials approved by authorities having jurisdiction.
- I. Site Enclosure Fence: Before construction operations begin furnish and install site enclosure fence in a manner that will prevent people 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.
  2. Maintain security by limiting number of keys and restricting distribution to authorized personnel.
- J. 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 workday.
- K. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.
- L. Temporary Egress: Provide temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction. Provide signage directing occupants to temporary egress.
- M. 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.
- N. Temporary Partitions: Provide floor-to-ceiling dustproof partitions to limit dust and dirt migration and to separate areas occupied by Owner and tenants 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. Where fire-resistance-rated temporary partitions are indicated or are required by authorities having jurisdiction, construct partitions according to the rated assemblies.
  3. Provide walk-off mats at each entrance through temporary partition.
- O. 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. Comply with additional limits on smoking specified in other Sections.
  2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.
  3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
  4. Provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

### 3.6 MOISTURE AND MOLD CONTROL

- A. Moisture and Mold Protection: Protect stored materials and installed Work in accordance with Moisture and Mold Protection Plan.
- B. Exposed Construction Period: 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 Period: 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 and replace stored or installed material that begins to grow mold.
  7. Perform work in a sequence that allows wet materials adequate time to dry before enclosing the material in gypsum board or other interior finishes.
- D. Controlled Construction Period: 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 temporary or permanent HVAC system to control humidity within ranges specified for installed and stored materials.
  3. Comply with manufacturer's written instructions for temperature, relative humidity, and exposure to water limits.

### 3.7 OPERATION, TERMINATION, AND REMOVAL

- A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.
- B. Maintenance: Maintain facilities in good operating condition until removal.
1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.
- C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.
- 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. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 017700 "Closeout Procedures."

END OF SECTION 015000

## SECTION 016000 - PRODUCT REQUIREMENTS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.
- B. Related Requirements:
  - 1. Section 012500 "Substitution Procedures" for requests for substitutions.

#### 1.2 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," 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 that is current as of date of the Contract Documents.
  - 2. New Products: Items that have not previously been incorporated into another project or facility. Salvaged items or items reused from other projects are not considered new products. Items that are manufactured or fabricated to include recycled content materials are considered new products, unless indicated otherwise.
  - 3. Comparable Product: Product by named manufacturer that is demonstrated and approved through the comparable product submittal process described in Part 2 "Comparable Products" Article, 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 single manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation. Published attributes and characteristics of basis-of-design product establish salient characteristics of products.
  - 1. Evaluation of Comparable Products: In addition to the basis-of-design product description, product attributes and characteristics may be listed to establish the significant qualities related to type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other special features and requirements for purposes of evaluating comparable products of additional manufacturers named in the specification.
- C. Subject to Compliance with Requirements: Where the phrase "Subject to compliance with requirements" introduces a product selection procedure in an individual Specification Section,

provide products qualified under the specified product procedure. In the event that a named product or product by a named manufacturer does not meet the other requirements of the specifications, select another named product or product from another named manufacturer that does meet the requirements of the specifications; submit a comparable product request or substitution request, if applicable.

- D. Comparable Product Request Submittal: An action submittal requesting consideration of a comparable product, including the following information:
  - 1. Identification of basis-of-design product or fabrication or installation method to be replaced, including Specification Section number and title and Drawing numbers and titles.
  - 2. Data indicating compliance with the requirements specified in Part 2 "Comparable Products" Article.
- E. Basis-of-Design Product Specification Submittal: An action submittal complying with requirements in Section 013300 "Submittal Procedures."
- F. Substitution: Refer to Section 012500 "Substitution Procedures" for definition and limitations on substitutions.

### 1.3 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.

### 1.4 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.

### 1.5 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 standard warranty form furnished by individual manufacturer for a particular product and issued in the name of the Owner or endorsed by manufacturer to Owner.
  - 2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner and issued in the name of the Owner or endorsed by manufacturer to Owner.



- B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.
  - 1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
  - 2. Specified Form: When specified forms are included in the Project Manual, prepare a written document, using indicated form properly executed.
  - 3. See other Sections for specific content requirements and particular requirements for submitting special warranties.

## PART 2 - PRODUCTS

### 2.1 PRODUCT SELECTION PROCEDURES

- A. General 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 other items needed for a 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 meeting 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. Sole 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.
    - a. Sole product may be indicated by the phrase "Subject to compliance with requirements, provide the following."
  - 2. Sole 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.
    - a. Sole manufacturer/source may be indicated by the phrase "Subject to compliance with requirements, provide products by the following."
  - 3. Limited List of Products: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements.

- a. Limited list of products may be indicated by the phrase "Subject to compliance with requirements, provide one of the following."
- 4. Non-Limited List of Products: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed or an unnamed product that complies with requirements.
  - a. Non-limited list of products is indicated by the phrase "Subject to compliance with requirements, available products that may be incorporated in the Work include, but are not limited to, the following."
  - b. Provision of an unnamed product is not considered a substitution, if the product complies with requirements.
- 5. Limited List of Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements.
  - a. Limited list of manufacturers is indicated by the phrase "Subject to compliance with requirements, provide products by one of the following."
- 6. Non-Limited List of Manufacturers: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed or a product by an unnamed manufacturer that complies with requirements.
  - a. Non-limited list of manufacturers is indicated by the phrase "Subject to compliance with requirements, available manufacturers whose products may be incorporated in the Work include, but are not limited to, the following."
  - b. Provision of products of an unnamed manufacturer is not considered a substitution, if the product complies with requirements.
- 7. 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 may additionally indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.
  - a. For approval of products by unnamed manufacturers, comply with requirements in Section 012500 "Substitution Procedures" for substitutions for convenience.
- C. Visual Matching Specification: Where Specifications require the phrase "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 other specified requirements, comply with requirements in Section 012500 "Substitution Procedures" for proposal of product.
- D. Visual Selection Specification: Where Specifications include the phrase "as selected by Architect from manufacturer's full range" or a 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.

- E. Sustainable Product Selection: Where Specifications require product to meet sustainable product characteristics, select products complying with indicated requirements. Comply with requirements in Division 01 sustainability requirements Section and individual Specification Sections.
  - 1. Select products for which sustainable design documentation submittals are available from manufacturer.

## 2.2 COMPARABLE PRODUCTS

- A. Conditions for Consideration of Comparable Products: 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 the following requirements:
  - 1. Evidence that proposed product does not require revisions to the Contract Documents, is consistent with the Contract Documents, will produce the indicated results, and is compatible with other portions of the Work.
  - 2. Detailed comparison of significant qualities of proposed product with those of the named basis-of-design product. Significant product qualities include attributes, such as type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other specific features and requirements.
  - 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.
- B. Architect's Action on Comparable Products Submittal: If necessary, Architect will request additional information or documentation for evaluation, as specified in Section 013300 "Submittal Procedures."
  - 1. Form of Approval of Submittal: As specified in Section 013300 "Submittal Procedures."
  - 2. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.
- C. Submittal Requirements, Two-Step Process: Approval by the Architect of Contractor's request for use of comparable product is not intended to satisfy other submittal requirements. Comply with specified submittal requirements.
- D. Submittal Requirements, Single-Step Process: When acceptable to Architect, incorporate specified submittal requirements of individual Specification Section in combined submittal for comparable products. Approval by the Architect of Contractor's request for use of comparable product and of individual submittal requirements will also satisfy other submittal requirements.

PART 3 - EXECUTION (Not Used)

END OF SECTION 016000

## SECTION 017700 - CLOSEOUT PROCEDURES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes administrative and procedural requirements for Contract closeout, including, but not limited to, the following:
  - 1. Substantial Completion procedures.
  - 2. Final completion procedures.
  - 3. Warranties.
  - 4. Final cleaning.
- B. Related Requirements:
  - 1. Section 017839 "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
  - 2. Section 017900 "Demonstration and Training" for requirements to train the Owner's maintenance personnel to adjust, operate, and maintain products, equipment, and systems.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of cleaning agent.
- B. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.
- C. Certified List of Incomplete Items: Final submittal at Final Completion.

#### 1.3 CLOSEOUT SUBMITTALS

- A. Certificates of Release: From authorities having jurisdiction.
- B. Certificate of Insurance: For continuing coverage.
- C. Field Report: For pest-control inspection.

#### 1.4 SUBSTANTIAL COMPLETION PROCEDURES

- A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's "punch list"), indicating the value of each item on the list and reasons why the Work is incomplete.
- B. Submittals Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction, permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
  2. Submit closeout submittals specified in other Division 01 Sections, including Project Record Documents, operation and maintenance manuals, damage or settlement surveys, property surveys, and similar final record information.
  3. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
  4. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Architect. Label with manufacturer's name and model number.
  5. Submit testing, adjusting, and balancing records.
  6. Submit sustainable design submittals not previously submitted.
  7. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
- C. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
1. Advise Owner of pending insurance changeover requirements.
  2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
  3. Complete startup and testing of systems and equipment.
  4. Perform preventive maintenance on equipment used prior to Substantial Completion.
  5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings specified in Section 017900 "Demonstration and Training."
  6. Advise Owner of changeover in utility services.
  7. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
  8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
  9. Complete final cleaning requirements.
  10. Touch up paint and otherwise repair and restore marred exposed finishes to eliminate visual defects.
- D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.

## 1.5 FINAL COMPLETION PROCEDURES

- A. Submittals Prior to Final Completion: Before requesting final inspection for determining Final Completion, complete the following:

1. Submit a final Application for Payment in accordance with Section 012900 "Payment Procedures."
  2. Certified List of Incomplete Items: Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
  3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
  4. Submit pest-control final inspection report.
- B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.

#### 1.6 LIST OF INCOMPLETE ITEMS

- A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.
1. Organize list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor, listed by room or space number.
  2. Organize items applying to each space by major element, including categories for ceilings, individual walls, floors, equipment, and building systems.
  3. Include the following information at the top of each page:
    - a. Project name.
    - b. Date.
    - c. Name of Architect.
    - d. Name of Contractor.
    - e. Page number.
  4. Submit list of incomplete items in the following format:
    - a. PDF Electronic File: Architect will return annotated file.

#### 1.7 SUBMITTAL OF PROJECT WARRANTIES

- A. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where warranties are indicated to commence on dates other than date of Substantial Completion, or when delay in submittal of warranties might limit Owner's rights under warranty.
- B. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.



- C. Warranty Electronic File: Provide warranties and bonds in PDF format. Assemble complete warranty and bond submittal package into a single electronic PDF file with bookmarks enabling navigation to each item. Provide bookmarked table of contents at beginning of document.
  - 1. Submit by uploading to web-based project software site and by email to Architect.
- D. Warranties in Paper Form:
  - 1. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.
- E. Provide additional copies of each warranty to include in operation and maintenance manuals.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.
  - 1. Use cleaning products that comply with Green Seal's GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.

## PART 3 - EXECUTION

### 3.1 FINAL CLEANING

- A. Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.
- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
  - 1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:
    - a. Clean Project site of rubbish, waste material, litter, and other foreign substances.
    - b. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
    - c. Remove debris and surface dust from limited-access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.

- d. Clean flooring, removing debris, dirt, and staining; clean according to manufacturer's recommendations.
  - e. Vacuum and mop concrete.
  - f. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
  - g. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.
  - h. Remove labels that are not permanent.
  - i. Wipe surfaces of mechanical and electrical equipment[, **elevator equipment,**] and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
  - j. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
  - k. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
  - l. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter on inspection.
    - 1) Clean HVAC system in compliance with NADCA ACR.
  - m. Clean luminaires, lamps, globes, and reflectors to function with full efficiency.
  - n. Clean strainers.
  - o. Leave Project clean and ready for occupancy.
- C. Pest Control: Comply with pest control requirements in Section 015000 "Temporary Facilities and Controls." Prepare written report.
- D. Construction Waste Disposal: Comply with waste-disposal requirements in Section 015000 "Temporary Facilities and Controls."

### 3.2 REPAIR OF THE WORK

- A. Complete repair and restoration operations required by Section 017300 "Execution" before requesting inspection for determination of Substantial Completion.

END OF SECTION 017700

## SECTION 017839 - PROJECT RECORD DOCUMENTS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes administrative and procedural requirements for Project Record Documents, including the following:
  - 1. Record Drawings.
  - 2. Record specifications.
  - 3. Record Product Data.
- B. Related Requirements:
  - 1. Section 017823 "Operation and Maintenance Data" for operation and maintenance manual requirements.

#### 1.2 CLOSEOUT SUBMITTALS

- A. Record Drawings: Comply with the following:
  - 1. Number of Copies: Submit one set of marked-up record prints.
  - 2. Number of Copies: Submit copies of Record Drawings as follows:
    - a. Initial Submittal:
      - 1) Submit one paper-copy set(s) of marked-up record prints.
      - 2) Submit PDF electronic files of scanned record prints and one set of file prints.
      - 3) Architect will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.
    - b. Final Submittal:
      - 1) Submit One paper-copy set of marked-up record prints.
      - 2) Submit PDF electronic files of scanned Record Prints and one set of file prints.
- B. Record Specifications: Submit annotated PDF electronic files and one paper copies of Project's Specifications, including addenda and Contract modifications.
- C. Record Product Data: Submit annotated PDF electronic files and directories and one paper copies 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.

### 1.3 RECORD DRAWINGS

- A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.
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.
    - a. Give particular attention to information on concealed elements that would be 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 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.
    - 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. Use personnel proficient at recording graphic information in production of marked-up record prints.
  4. Mark record prints with erasable, red-colored pencil. Use other 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 a full set of corrected digital data files of the Contract Drawings, as follows:
1. Format: Same digital data software program, version, and operating system as for the original Contract Drawings.
  2. Format: Annotated PDF electronic file[ **with comment function enabled**].

3. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
  4. Refer instances of uncertainty to Architect for resolution.
  5. Architect will furnish Contractor with one set of digital data files of the Contract Drawings for use in recording information.
- C. Format: Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
1. Record Prints: Organize record prints into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
  2. Format: Annotated PDF electronic file.
  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.

#### 1.4 RECORD SPECIFICATIONS

- A. Preparation: Mark Specifications to indicate the actual product installation, where installation varies from that indicated in Specifications, addenda, and Contract modifications.
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.

#### 1.5 RECORD PRODUCT DATA

- 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. 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.

- C. Format: Submit Record Product Data as annotated PDF electronic file.
  - 1. Include Record Product Data directory organized by Specification Section number and title, electronically linked to each item of Record Product Data.

1.6 MAINTENANCE OF RECORD DOCUMENTS

- A. Maintenance of Record Documents: Store Record Documents in the field office apart from the Contract Documents used for construction. Do not use Project Record Documents for construction purposes. 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.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 017839

## SECTION 017900 - DEMONSTRATION AND TRAINING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:
  - 1. Instruction in operation and maintenance of systems, subsystems, and equipment.
  - 2. Demonstration and training video recordings.

#### 1.2 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 using manufacturer-produced demonstration and training video recordings for systems, equipment, and products in lieu of video recording of live instructional module.

#### 1.3 CLOSEOUT SUBMITTALS

- A. Demonstration and Training Video Recordings: Submit two copies within seven days of end of each training module.
  - 1. At completion of training, submit complete training manual(s) for Owner's use prepared in same paper and PDF file format required for operation and maintenance manuals specified in Section 017823 "Operation and Maintenance Data."

#### 1.4 QUALITY ASSURANCE

- A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.
- B. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Section 014000 "Quality Requirements," experienced in operation and maintenance procedures and training.
- C. Preinstruction Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination."



## 1.5 COORDINATION

- A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.
- 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 have been reviewed and approved by Architect.

## 1.6 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. Systems and equipment operation manuals.
    - c. Systems and equipment maintenance manuals.
    - d. Product maintenance manuals.
    - e. Project Record Documents.
    - f. Identification systems.
    - g. Warranties and bonds.
    - h. 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.

## 1.7 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 Section 017823 "Operation and Maintenance Data."
- B. Set up instructional equipment at instruction location.

## 1.8 INSTRUCTION

- A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Owner for number of participants, instruction times, and location.
- B. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
- C. 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 with at least seven days' advance notice.
- D. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.
- E. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of a demonstration performance-based test.
- F. Cleanup: Collect used and leftover educational materials and remove from Project site. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

## 1.9 DEMONSTRATION AND TRAINING VIDEO RECORDINGS

- A. General: Engage a qualified commercial videographer to record demonstration and training video recordings. Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice.
  - 1. At beginning of each training module, record each chart containing learning objective and lesson outline.
- B. Digital Video Recordings: Provide high-resolution, digital video in MPEG format, produced by a digital camera with minimum sensor resolution of 12 megapixels and capable of recording in full HD mode.
  - 1. Submit video recordings thumb drive.
- C. Recording: Mount camera on tripod before starting recording, unless otherwise necessary to adequately cover area of demonstration and training. Display continuous running time.

- D. Light Levels: Verify light levels are adequate to properly light equipment. Verify equipment markings are clearly visible prior to recording.
- E. Preproduced Video Recordings: Provide video recordings used as a component of training modules in same format as recordings of live training.

PART 2 - PRODUCTS

PART 3 - EXECUTION

END OF SECTION 017900

## SECTION 019113 - GENERAL COMMISSIONING 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.
- B. [Basis-of-Design documentation is referenced for information only, and not included here.](#)

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. General requirements for coordinating and scheduling commissioning.
  - 2. Commissioning meetings.
  - 3. Commissioning reports.
  - 4. Equipment and systems installation, startup, and field quality-control testing indicated in the Contract Documents.
  - 5. Use of test equipment, instrumentation, and tools for commissioning.
  - 6. System readiness checklists, including, but not limited to, installation checks, startup, performance tests, and performance test demonstration.
  - 7. Commissioning tests and commissioning test demonstration.
  - 8. Work to correct commissioning issues.
  - 9. Work to repeat tests when equipment and systems fail acceptance criteria.
  - 10. Adjusting, verifying, and documenting identified systems and assemblies.
- B. Related Requirements:
  - 1. [Section 013300 "Submittal Procedures"](#) for submittal procedures requirements for commissioning.
  - 2. [Section 017700 "Closeout Procedures"](#) for certificate of Construction Phase Commissioning Completion submittal requirements.
  - 3. [Section 017823 "Operation and Maintenance Data"](#) for preliminary operation and maintenance data submittal.
  - 4. [Section 230800 "Commissioning of HVAC"](#) for technical commissioning requirements for HVAC.
  - 5. [Section 260800 "Commissioning of Electrical Systems"](#) for technical commissioning requirements for electrical systems.

#### 1.3 DEFINITIONS

- A. Acceptance Criteria: Threshold of acceptable work quality or performance specified for a commissioning activity, including, but not limited to, system readiness checklists, performance tests, performance test demonstrations, commissioning tests and commissioning test demonstrations.

## SECTION 019113 - GENERAL COMMISSIONING REQUIREMENTS

- B. Basis-of-Design Document (BoD): A document prepared by Engineer, or Commissioning Authority that records concepts, calculations, decisions, and product selections used to comply with Owner's Project Requirements and to suit applicable regulatory requirements, standards, and guidelines.
- C. Commissioning Authority (CxA): An entity engaged by Owner, and identified in Section 011000 "Summary," to evaluate Commissioning-Process Work.
- D. Commissioning Plan: A document, prepared by Commissioning Authority, that outlines the organization, schedule, allocation of resources, and documentation requirements of commissioning.
- E. Commissioning (Cx): A quality-focused process for verifying and documenting that the facility and all of its systems and assemblies are planned, designed, installed, and tested to comply with Owner's Project Requirements. The requirements specified here are limited to the construction phase commissioning activities.
- F. Construction Phase Commissioning Completion: The stage of completion and acceptance of commissioning when resolution of deficient conditions and issues discovered during commissioning and retesting until acceptable results are obtained has been accomplished. Owner will establish in writing the date Construction Phase Commissioning Completion is achieved. [See Section 017700 "Closeout Procedures" for certificate of Construction Phase Commissioning Completion submittal requirements.](#)
  - 1. Commissioning is complete when the work specified in this Section and related Sections has been completed and accepted, including, but not limited to, the following:
    - a. Completion of tests and acceptance of test results.
    - b. Resolution of issues, as verified by retests performed and documented with acceptance of retest results.
    - c. [Comply with requirements in Section 017900 "Demonstration and Training."](#)
    - d. Completion and acceptance of submittals and reports.
- G. Functional Test: Test of dynamic function of systems, as opposed to components, under full operation in various modes through all control system's sequences of operation using manual (direct observation) or monitoring methods following prescribed test procedures in sequential written form
- H. Owner's Project Requirements (OPR): A document that details the functional requirements of a project and the expectations of how it will be used and operated, including Project goals, measurable performance criteria, cost considerations, benchmarks, success criteria, and supporting information.
- I. Owner's Witness: Commissioning Authority, Owner's Project Manager, or Architect-designated witness authorized to authenticate test demonstration data and to sign completed test data forms.
- J. Construction or System readiness Checklist: List, provided by Commissioning Authority to installer, of items to inspect and elementary component tests to conduct to verify proper installation of equipment prior to functional testing.

## SECTION 019113 - GENERAL COMMISSIONING REQUIREMENTS

- K. Sampling: Functionally testing only a fraction of total number of identical or near identical pieces of equipment.
- L. Seasonal Commissioning: Testing of equipment that can be done only during periods of peak heating or cooling, when HVAC equipment is operating at full-load or heavy-load conditions.
- M. Simulated Condition: Condition created for purpose of testing response of system.
- N. "Systems," "Assemblies," "Subsystems," "Equipment," and "Components": Where these terms are used together or separately, they shall mean "as-built" systems, assemblies, subsystems, equipment, and components.
- O. Test: Performance tests, performance test demonstrations, commissioning tests, and commissioning test demonstrations.
- P. Trending: Monitoring using building control system.

### 1.4 COMPENSATION

- A. Should Architect, Commissioning Authority, other Owner's witness, or Owner's staff perform additional services or incur additional expenses due to actions of Contractor listed below, compensate Owner for such additional services and expenses.
  - 1. Failure to provide timely notice of commissioning activities schedule changes.
  - 2. Failure to meet acceptance criteria for test demonstrations.
- B. Contractor shall compensate Owner for such additional services and expenses at the rate of \$150.00 per labor hour plus \$100.00 per round trip plus per diem allowances for meals and lodging according to current U.S. General Services Administration (GSA) Per Diem Rates.

### 1.5 COMMISSIONING TEAM

- A. Members Appointed by Contractor(s):
  - 1. Commissioning Coordinator: A person or entity employed by Contractor to manage, schedule, and coordinate commissioning.
  - 2. Project superintendent and other employees that Contractor may deem appropriate for a particular portion of the commissioning.
  - 3. Subcontractors, installers, suppliers, and specialists that Contractor may deem appropriate for a particular portion of the commissioning.
  - 4. Appointed team members shall have the authority to act on behalf of the entity they represent.
- B. Members Appointed by Owner:
  - 1. Commissioning Authority (CxA), plus consultants that CxA may deem appropriate for a particular portion of the commissioning.
    - a. CxA: Coordinate with Owner.

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2. Owner representative(s), facility operations and maintenance personnel, plus other employees, separate contractors, and consultants that Owner may deem appropriate for a particular portion of the commissioning.
  - a. Owner's Rep: To be designated
3. Architect, plus employees and consultants that Architect may deem appropriate for a particular portion of the commissioning.
  - a. Architect: See Specifications for Contact Information.
4. MEP Engineer, plus employees and consultants that Architect may deem appropriate for a particular portion of the commissioning.
  - a. MEP: Ethos Engineering, Guillermo Quintanilla. Cell (956) 564-2811.

### 1.6 INFORMATIONAL SUBMITTALS

- A. Comply with requirements in Section 013300 "Submittal Procedures" for submittal procedures general requirements for commissioning.
- B. Commissioning Plan Information:
  1. List of Contractor-appointed commissioning team members to include specific personnel and subcontractors to the performance of the various commissioning requirements.
  2. Schedule of commissioning activities, integrated with the construction schedule. Comply with requirements in Section 013200 "Construction Progress Documentation" for construction schedule general requirements for commissioning.
  3. Contractor personnel and subcontractors to participate in each test.
  4. List of instrumentation required for each test to include identification of parties that will provide instrumentation for each test.
- C. Commissioning schedule.
- D. Two-week look-ahead schedules.
- E. Test Reports:
  1. Pre-Startup Report: Prior to startup of equipment or a system, submit signed, completed system readiness checklists.
  2. Test Data Reports: At the end of each day in which tests are conducted, submit test data for tests performed.
  3. Commissioning Issues Reports: Daily, at the end of each day in which tests are conducted, submit commissioning issue reports for tests for which acceptable results were not achieved.
  4. Weekly Progress Report: Weekly, at the end of each week in which tests are conducted, submit a progress report.
  5. Data Trend Logs: Submit data trend logs at the end of the trend log period.



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6. System Alarm Logs: Daily, at the start of days following a day in which tests were performed, submit print-out of log of alarms that occurred since the last log was printed.

### F. System readiness checklists:

1. Material checks.
2. Installation checks.
3. Startup procedures, where required.

## 1.7 CLOSEOUT SUBMITTALS

### A. Commissioning Report:

1. At Construction Phase Commissioning Completion, include the following:
  - a. Pre-startup reports.
  - b. Test data forms, completed and signed.
  - c. Commissioning issues report log.
  - d. Commissioning issues reports showing resolution of issues.
  - e. Correspondence or other documents related to resolution of issues.
  - f. Other reports required by commissioning.
  - g. List unresolved issues and reasons they remain unresolved and should be exempted from the requirements for Construction Phase Commissioning Completion.
  - h. Report shall include commissioning work of Contractor.

### B. Request for Certificate of Construction Phase Commissioning Completion.

### C. Operation and Maintenance Data: For proprietary test equipment, instrumentation, and tools to include in operation and maintenance manuals.

## 1.8 COMMISSIONING TEAM RESPONSIBILITIES

### A. COMMISSIONING AUTHORITY: Responsibilities of the CxA during the Construction Phase include the following:

1. Coordinate and direct steps of the total Commissioning Process for systems being installed as part of this contract. Coordinate commissioning work schedule with Owner and Contractor.
2. Provide Commissioning Plan.
3. Attend planning and construction-site meetings as required to obtain information relating to Commissioning Process. Convene commissioning team meetings as required.
4. Plan and conduct commissioning scoping and coordination meetings. Provide notice to all Team members to attend scheduled commissioning meetings.
5. Request all information required for Commissioning Process from manufacturers, Contractor, and Design Professionals.
6. Review Design Professionals' design documents to gain clear understanding of design intent and provide a report showing discrepancies.
7. Review submittals for compliance with commissioning needs.

## SECTION 019113 - GENERAL COMMISSIONING REQUIREMENTS

8. Verify that systems and equipment have been installed and started in accordance with manufacturer's recommendations and with generally recognized construction standards, and that documentation of such has been provided.
9. Assist in resolving discrepancies.
10. Prepare System readiness checklists to ensure systems have been installed according to project specifications. Verify that System readiness checklists have been addressed by Contractor and are accurate. Deliver final System readiness checklists to Owner.
11. Prepare Functional Test procedures to demonstrate performance of systems according to project specifications. Observe and document performance of systems, as per process detailed in Functional Test procedures.
12. Verify the execution of commissioning process activities using random sampling. The sampling rate may vary from 1 to 100 percent. Verification will include, but is not limited to, equipment submittals, system readiness checklists, training, operating and maintenance data, tests, and test reports to verify compliance with the OPR. When a random sample does not meet the requirement, the CxA will report the failure in the Issues Log.
13. Prepare and maintain an Issues Log.
14. Compile test data, inspection reports, and certificates; include them in the systems manual and commissioning process report.
15. Review testing and balancing (TAB) reports; notify Owner of deficiencies.
16. Recommend acceptance or non-acceptance of systems to Owner.
17. Verify that Operations and Maintenance (O&M) documentation is acceptable. Operations and Maintenance manuals shall be submitted simultaneously to CxA and to Design Professionals for review.
18. Verify that training has taken place by collecting training documentation from Contractor.
19. Compile and maintain commissioning record.
20. Provide pre-final and final commissioning reports to all commissioning team members. The report shall include:
  - a. Communications between Owner, CxA, Design Professionals, Vendors, and/or Contractor and Subcontractors related to Commissioning Process.
  - b. Minutes of commissioning meetings.
  - c. Findings and pertinent observations.
  - d. A listing of any deficiencies, unresolved issues, and compromises in the environmentally responsive features.
  - e. Manufacturer's start-up reports.
  - f. An Issues Log which:
    - 1) Describes design, installation, and performance issues which are at variance with the Owner's project requirements and Contract Documents.
    - 2) Identifies and tracks issues as they are encountered, documenting the status of unresolved and resolved issues.
    - 3) Documents corrective modifications made.
  - g. System readiness checklists.
  - h. Testing plans and Functional Test reports.
  - i. Listing of off-season test(s) not performed and a schedule for their completion.
21. Conduct an inspection of the building and its systems within 10 months after substantial completion and prior to the expiration of warranties. Prepare a report documenting findings that should be addressed prior to expiration of warranties.

- B. **CONTRACTOR:** Responsibilities of the General Contractor (GC) as related to Commissioning Process include, but are not limited to the following:

## SECTION 019113 - GENERAL COMMISSIONING REQUIREMENTS

1. Facilitate coordination of Commissioning work by CxA.
2. Attend Commissioning meetings or other meetings called by CxA to facilitate the Commissioning Process.
3. Integrate and coordinate commissioning process activities with construction schedule.
4. Review CxA's Functional Test procedures for feasibility, safety, and impact on warranty, and provide CxA with written comment on same.
5. Provide all documentation relating to manufacturer's recommended performance testing of equipment and systems.
6. Provide Operations and Maintenance Data to CxA for preparation of checklists and training manuals.
7. Provide testing and balancing report.
8. Provide As-built drawings and documentation to facilitate Functional Testing.
9. Assure and facilitate participation and cooperation of specialty subcontractors (electrical, mechanical, Building Automation, etc.), and equipment suppliers as required for the Commissioning Process.
10. Require subcontractors to inspect systems installed and fill-out System readiness checklists (provided by CxA) to verify installation has taken place in accordance with manufacturer's instructions, and in a workmanlike manner in accordance with project documents and generally accepted construction practices. Certify to CxA that installation work listed in System readiness checklists has been completed and accompany CxA during verification of completed System readiness checklists.
11. Install systems and equipment in strict conformance with project specifications, manufacturer's recommended installation procedures, and System readiness checklists, as prepared by CxA.
12. Provide data concerning performance, installation, and start-up of systems.
13. Provide copy of manufacturer's filled-out start-up forms for equipment and systems.
14. Ensure systems have been started and fully checked for proper operation prior to arranging for Functional Testing with CxA. Prepare and submit to CxA written certification that each piece of equipment and/or system has been started according to manufacturer's recommended procedure, and that system has been tested for compliance with operational requirements.
  - a. GC shall carry out manufacturer's recommended start-up and testing procedures, regardless of whether or not they are specifically listed in CxA's Functional Test procedures.
  - b. GC is not relieved of obligation for systems / equipment demonstration where performance testing is required by specifications, but a Functional Performance Test is not specifically designated by CxA.
15. Coordinate with CxA to determine mutually acceptable date of Functional Performance Tests.
16. Review and accept construction checklists provided by the CxA.
17. Direct and coordinate commissioning testing among subcontractors, suppliers, and vendors.
18. Complete commissioning process test procedures.
19. Provide qualified personnel to assist and participate in Commissioning.
20. Provide test instruments and communications devices, as prescribed by CxA and where identified in this specifications manual, as required for carrying out Functional Testing of systems.
21. Evaluate performance deficiencies identified in test reports and, in collaboration with entity responsible for system and equipment installation, recommend corrective action.
22. Cooperate with the CxA for resolution of issues recorded in the Issues Log.

## SECTION 019113 - GENERAL COMMISSIONING REQUIREMENTS

23. Ensure deficiencies found in the Commissioning Process are corrected within the time schedule shown in the CA report.
  24. Provide CxA with all submittals, start-up instructions manuals, operating parameters, and other pertinent information related to Commissioning Process. This information shall be provided directly to the CxA as a digital PDF file at the same time that the submittals are made to the architect and/or engineer.
  25. Prepare and submit to CxA proposed Training Program outline for each system.
  26. Coordinate and provide training of Owner's personnel. Provide CxA with proposed training agenda no less than 14 days prior to scheduled training sessions. Provide documentation that training took place (including system being trained on, trainer's name and contact information, sign-in sheet verifying who attended training, length of training, and signature of owner's authorized person certifying training took place satisfactorily).
  27. Prepare Operation and Maintenance manuals and As-Built drawings in accordance with specifications; submit copy to CxA in addition to other contractually required submissions. Revise and resubmit manuals in accordance with Design Professionals and CxA's comments.
  28. All costs associated with the participation of GC, Sub-Contractors, Design Professionals, and Equipment Vendors in the Commissioning Process shall be included as part of the Construction Contract.
- C. Subcontractors and vendors shall prepare and submit to Commissioning Authority Manufacturer's installation and performance test procedures to demonstrate performance of systems according to these specifications and checklists prepared by Commissioning Authority.
- D. Owner's Representative: Responsibilities of the Owner's Representative as related to Commissioning Process include, but are not limited to the following:
1. Provide the OPR documentation to the CxA and GC for information and use.
  2. Assign operation and maintenance personnel and schedule them to participate in commissioning team activities.
  3. Provide the BoD documentation, prepared by Architect and approved by Owner, to the CxA and GC for use in developing the commissioning plan, systems manual, and operation and maintenance training plan.
  4. Manage contracts of Architect and GC.
  5. Arrange for facility operating and maintenance personnel to attend various field commissioning activities and field training sessions.
  6. Provide final approval for completion of Commissioning Work.
  7. Warranty Period: Ensure that seasonal or deferred testing and deficiency issues are addressed.
- E. Architect: Responsibilities of the Architect as related to Commissioning Process include, but are not limited to the following:
1. Attend commissioning scoping meeting and other commissioning team meetings as requested by Commissioning Authority and as selected by Architect.
  2. Perform normal submittal review, construction observation, record drawing preparation, and operations and maintenance data preparation, as required by Contract Documents.
  3. Coordinate resolution of system deficiencies identified during commissioning, as required by Contract Documents. Review Commissioning Issues Logs and issue directives to GC and/or Design Professionals as applicable.

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4. Prepare and submit final as-built design intent documentation for inclusion in Operation and Maintenance Data Manual, and review and approve Operation and Maintenance Data Manual.
  5. Review Commissioning Report and issue directive to resolve all outstanding deficiencies prior to project close-out.
  6. Warranty Period: Coordinate resolution of design non-conformance and design deficiencies identified during warranty period commissioning.
- F. Design Professionals Responsible for Design of Each Portion of Work Being Commissioned:
1. Perform normal submittal review, construction observations, and record drawing preparation, as required by Contract Documents. Perform site observation immediately preceding system startup.
  2. Respond to deficiencies identified by Commissioning Authority as directed by Architect.
  3. Provide design narrative and sequence documentation requested by Commissioning Authority. Assist, along with GC, in clarifying operation and control of commissioned equipment in areas where specifications, control drawings, or equipment documentation are not sufficient for writing detailed testing procedures.
  4. Attend commissioning scoping meetings and other commissioning team meetings as requested by Commissioning Authority and as selected by Architect or responsible design professional.
  5. Participate in resolution of system deficiencies identified during commissioning, as required by Contract Documents.
  6. Prepare and submit final as-built design intent and operating parameters documentation for inclusion in Operation and Maintenance Manual, and review and approve Operation and Maintenance Manual.

## PART 2 - PRODUCTS

### 2.1 TEST EQUIPMENT, INSTRUMENTATION, AND TOOLS

- A. Test equipment and instrumentation required to perform the commissioning shall remain the property of Contractor unless otherwise indicated.

### 2.2 REPORT FORMAT AND ORGANIZATION

A. General Format and Organization:

1. Bind report in three-ring binders.
2. Label the front cover and spine of each binder with the report title, volume number, project name, Contractor's name, and date of report.
3. Record report on compact disk.
4. Electronic Data: Portable document format (PDF); a single file with outline-organized bookmarks for major and minor tabs and tab contents itemized for specific reports.

B. Commissioning Report:

1. Include a table of contents and an index to each test.

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2. Include major tabs for each Specification Section.
3. Include minor tabs for each test.
4. Within each minor tab, include the following:
  - a. Test specification.
  - b. Pre-startup reports.
  - c. Test data forms, completed and signed.
  - d. Commissioning issue reports, showing resolution of issues, and documentation related to resolution of issues pertaining to a single test. Group data forms, commissioning issue reports showing resolution of issues, and documentation related to resolution of issues for each test repetition together within the minor tab, in reverse chronological order (most recent on top).

### PART 3 - EXECUTION

#### 3.1 PREPARATION

- A. Review preliminary system readiness checklists and preliminary test procedures and data forms.

#### 3.2 GENERAL

- A. Authority
  1. The Commissioning Authority carries out the Cx responsibilities as the Owner's authorized agent in accordance with plans, specifications, and contractual requirements.
  2. CxA reports deficiencies found to the GC, Architect and Owner.
  3. The Architect evaluates deficiencies and issues directive to GC to remedy CxA's deficiencies lists, in accordance with contract documents.
  4. No change in scope work is to take place without express written consent of Owner. Any deficiencies identified by CxA that are deemed by Architect to be outside of the scope of work shall be discussed with Owner for consideration.
  5. GC and CxA are to copy Architect on all correspondence related to the commissioning process.
- B. Participation In The Commissioning Process
  1. GC shall attend meetings related to Commissioning process and arrange for attendance by subcontractors and vendors prior to commissioning of their systems, at the discretion of CxA.
  2. Provide skilled technicians to start and test all systems, and place systems in complete and fully functioning service in accordance with contract documents and design intent.
  3. Provide skilled technicians, experienced and familiar with systems being commissioned, to assist CxA in commissioning process.
  4. Attend initial commissioning team scoping meeting, pre-commissioning meetings specific to each system, and other meetings requested by CxA as required to discuss resolution of deficiencies.
  5. Coordinate with sub-Contractors and equipment vendors/representatives to set aside adequate time to address System readiness Checklists, Functional Testing, Operations and Maintenance Training, and associated coordination meetings.

## SECTION 019113 - GENERAL COMMISSIONING REQUIREMENTS

### C. Work Prior To Testing

1. A commissioning team scoping meeting shall be held at a time and place designated by Commissioning Authority. Owner, Architect, Commissioning Authority, Contractor, and Mechanical, Electrical, and Controls Contractors, shall be present at this meeting. The main objectives of the meeting are to familiarize all parties with the requirements of the commissioning process; to ensure that the responsibilities of each party are clearly understood; and obtain information to develop the preliminary commissioning plan, including:
  - a. Personnel representing the various entities participating in the process (GC, subcontractors, Owner, Architect, Engineer, CxA)
  - b. Lines of communications;
  - c. Assignment of responsibilities;
  - d. Review system readiness checklists;
  - e. Submittal schedule;
  - f. Preliminary construction schedule
2. Following the initial commissioning team scoping meeting, and upon reviewing submittals, CxA shall prepare a preliminary Commissioning Plan outlining procedures and responsibilities, including names and contact information of responsible parties, tentative dates for commissioning activities, and system readiness checklists. Preliminary Commissioning Plan shall be distributed to GC and Owner electronically for review and comment. CxA shall modify the Commissioning Plan based on feedback from GC and Owner and will generate a final Cx Plan.
3. Prior to system readiness and functional testing, CxA will conduct site inspections at critical times and issue Cx Field Reports with observations on installation deficiencies so that they may be issued by Architect as deemed appropriate
4. GC shall complete all phases of the work so the systems can be started, tested, adjusted, balanced, and otherwise commissioned.
5. GC shall verify requirements of Divisions 22, 23 and 26 outlining responsibilities for start-up of equipment with obligations to complete systems, including all sub-systems so that they are fully functional.
6. A minimum of fourteen (14) days prior to date of system readiness performance test, submit to Commissioning Authority for review, detailed description of equipment start-up procedures which GC proposes to perform to demonstrate conformance of systems to specifications and commissioning checklists.
7. Convene system-specific pre-commissioning meetings prior to start of system readiness testing of each system. The GC shall hold a pre-commissioning meeting with all Team members in attendance. The purpose of the meeting is to review the system readiness checklists, and equipment start-up procedures for each system to be commissioned, confirm that systems are ready for testing, and define a schedule for testing activities.

### D. System readiness checks and functional performance tests

1. The GC shall provide all materials, services, and labor required to operate equipment and/or system in order to perform the system readiness checks and functional performance tests. A system readiness check or functional performance test shall be aborted if any system deficiency prevents the successful completion of the test or if any participating commissioning team member of which participation is specified is not present for the test. The GC shall reimburse the Owner and A/E for all costs associated with effort lost due to tests that are aborted. These costs shall include salary, travel costs and per diem (where applicable).
2. Functional performance tests may sometimes duplicate the checking, testing, and inspection methods established in related Sections. Where checking, testing, and

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inspection methods are not specified in other Sections, methods shall be established which will provide required information. Testing and verification required by this section shall be performed during the Commissioning phase. Requirements in related Sections are independent from the requirements of this Section and shall not be used to satisfy any of the requirements specified in this Section without the approval of CxA.

3. Follow start-up and initial checkout procedures listed in article titled "RESPONSIBILITIES" in Part 1, and additional requirements specified in this Section. Divisions 22, 23 and 26 have startup responsibilities and are required to complete systems and sub-systems so systems are fully functional, meeting design requirements of Contract Documents. Commissioning procedures and functional testing do not relieve or lessen this responsibility or shift this responsibility, in whole or in part, to Commissioning Agent or Owner.

### E. Work To Resolve Deficiencies

1. Complete corrective work in a timely manner to allow expeditious completion of commissioning process. If deadlines pass without resolution of identified problems, Owner reserves the right to obtain supplementary services and/or equipment to resolve the problem. Costs thus incurred will be GC's responsibility.

## 3.3 SUSTAINABILITY REQUIREMENTS

- A. Comply with requirements listed in specifications and drawings as it relates to sustainability features that will be verified during the Commissioning process.

## 3.4 SYSTEM READINESS CHECKLISTS

### A. General

1. System readiness checklists are important to ensure that equipment and systems are properly connected and operational, and installed in accordance with specifications, drawings, manufacturer's requirements, and all applicable codes.
2. Checklists ensure that functional performance testing (in-depth checkout) may proceed without unnecessary delays.
3. Performance of system readiness checklists, startup, and checkout shall be directed and executed by subcontractor or vendor. Only individuals that have direct knowledge and who witnessed that line item task on system readiness checklist was performed shall initial or check item off.
4. Each piece of equipment and major distribution system receive full system readiness checkout. No sampling strategies are used.
5. System readiness checkout for given system must be successfully completed prior to formal functional performance testing of equipment or subsystems of given system.

### B. System readiness Checklist

1. System readiness performance tests shall be documented in a checklist format, as prepared and provided by CxA, for each piece of equipment. Each checklist shall be initialed by GC, verifying that all items on checklist have been addressed and completed.
2. Commissioning System readiness checklists are not to preclude GC from applying his own construction inspection checklists.
3. All system elements shall be checked to verify that they have been installed, adjusted, and calibrated properly, that all connections have been made correctly, and that it is ready



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to function as specified. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, control sequence, and other conditions which may cause damage.

4. Verify that tests, meter readings and specific electrical characteristics agree with those required by equipment or system manufacturer.
5. All discrete elements and sub-systems shall be adjusted and shall be checked for proper operation. Verify wiring and support components for equipment are complete and tested.
6. Do not conduct start-up procedure recommended by equipment/system manufacturer at prior to system readiness testing.
7. Subcontractors shall clearly list outstanding items of initial start-up and system readiness procedures that were not completed successfully at bottom of procedures form or on separate sheet attached to form. Completed forms and attached sheets shall be provided to Commissioning Authority within 2 days of test completion. Installing subcontractor or vendor shall correct deficient or incomplete areas in timely manner and shall submit updated system readiness checklist and startup report with statement of correction on original non-compliance report.
8. When system readiness checklists for a particular system or subsystems are completed, GC will request verification by CxA. GC and subcontractors shall accompany CxA during system readiness checklist verification.
9. If during system readiness checklist verification, CxA finds a significant number of deficiencies, GC shall have all the checklists associated with similar system redone.

### 3.5 SYSTEM START-UP

- A. GC will arrange for start-up of operating equipment and systems after (or at the same time as) system readiness testing and prior to scheduling Functional Testing.
- B. Start-up of equipment and systems shall be performed only by a manufacturer's representative, or person(s) who are specifically manufacturer-approved. All start-up personnel shall be trained and authorized, experienced and knowledgeable in the operations of such equipment and systems.
- C. Coordinate schedule for start-up of various equipment and systems so that subsystems required for major systems operation are tested first.
- D. Manufacturer's start-up reports must be submitted to CxA prior to scheduling Functional Testing.

### 3.6 FUNCTIONAL TESTING

- A. The objective of Functional Testing is to demonstrate that each system is operating according to documented design intent and Contract Documents, through all possible modes of operation.
- B. GC and sub-Contractors shall include in his bid proposal all costs associated with preparation and execution of Testing Procedures for all systems to be commissioned.
- C. Functional testing is intended to begin upon completion of each system and after system readiness checklists have been completed. Functional testing may proceed prior to completion of systems or sub-systems at discretion of Commissioning Authority. Beginning system testing

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before completion does not relieve GC from fully completing system, including system readiness checklists as early as possible.

- D. GC and sub-Contractors shall provide detailed Testing Procedures that will allow all items on checklists to be verified.
- E. Testing shall be conducted under specified operating conditions as recommended or approved by Commissioning Authority.
- F. A Functional Performance Test shall be performed on each complete system. Each function shall be demonstrated to the satisfaction of Commissioning Authority in accordance with proposed test procedures developed to demonstrate compliance with specifications.
- G. Each Functional Test shall be witnessed and signed off by Commissioning Authority upon satisfactory completion. Functional Test is not to be considered complete until Owner accepts Commissioning Authority's recommendation for completion.
- H. All elements of system shall be tested to demonstrate that total systems satisfy all requirements of these specifications. Testing shall be accomplished on hierarchical basis. Test each piece of equipment for proper operation, followed by each subsystem, followed by the entire system, followed by any inter-ties to other major systems.
- I. Notification, Scheduling Of Functional Testing and Re-Testing
  - 1. Notify CxA and Owner, in writing, of request for scheduling Functional Testing. Submit request no fewer than five days prior to desired date for beginning functional testing.
    - a. GC must certify that systems and equipment are functioning satisfactorily, according to specifications and design intent, prior to requesting Functional Testing. Upon receipt of such certification, CxA will schedule with GC a time for the particular system test.
      - 1) CxA will attempt to schedule Functional Testing when convenient for GC and his vendors, and to minimize lost time to GC.
    - b. GC will resolve all deficiencies identified during initial test prior to submitting request, in writing, for re-testing. Such request for re-testing shall certify that GC has resolved all deficiencies, or list reason why any deficiencies remain which cannot be resolved.
    - c. CxA will re-test to ensure that all deficiencies have been resolved.
      - 1) Deficiencies that were not detected in first Functional Test, but are discovered in subsequent re-testing, are to be resolved by GC as if they had been discovered in initial testing.
- J. Functional Testing Requirements And Procedures
  - 1. GC and sub-Contractors shall perform tests in the presence of CxA. Tests not witnessed by CxA shall not be considered complete.
  - 2. To facilitate Functional Testing, when requested by CxA, GC shall provide services of personnel to accompany CxA for the duration of Functional Testing, including any follow-up testing. Such personnel must be experienced, qualified, and intimately familiar with the system being tested.
    - a. Participation by representative(s) of direct digital controls (DDC) systems is of particular importance in Functional Testing. All systems which are controlled and/or monitored by DDC are to be thoroughly tested, point by point, through all modes of operation, with the assistance of manufacturer's representative. DDC

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- graphics, setpoints, and programming are to be included as a part of Functional Testing as well.
- b. GC must provide services of personnel to accompany CxA for equipment and systems which may pose particular health and safety concerns, such as boilers.
  - c. Should he fail to provide representative to accompany CxA during Functional Testing, GC continues to bear full responsibility for equipment warranty. Owner and CxA will not be held responsible for damage to equipment, or other actions which might impact warranty, when performing Functional Testing of systems where GC has not provided authorized accompanying representative to operate equipment.
3. Each system shall be operated through all modes of operation including, but not limited to seasonal, occupied, unoccupied, warm-up, cool-down, part-load, and full-load, where system response is specified.
    - a. For multiple units, sampling strategy established by Commissioning Authority and subject to approval of Owner may be used.
    - b. Verification of each sequence in sequences of operation is required.
    - c. Proper responses to such modes and conditions as power failure, freeze condition, low oil pressure, no flow, equipment failure, and the like, shall also be tested.
  4. Where possible, inspections carried out on systems by local Authorities Having Jurisdiction (AHJ) may serve as Functional Testing for purposes of Commissioning.
    - a. CxA will accompany AHJ during testing procedures required by AHJ.
    - b. It is responsibility of GC to arrange for testing by AHJ and to coordinate with CxA to find mutually convenient times for testing. Provide CxA a minimum of four days in advance of intent to schedule testing by AHJ.
    - c. CxA will issue a separate report on results of testing.
    - d. CxA reserves the right to require additional testing, should testing by AHJ not adequately cover all system components in all modes of operation.
  5. Functional Testing is to be dedicated solely to testing of equipment and systems, and not to resolution of deficiencies. Deficiencies identified during testing process must be corrected by GC at a time other than during Functional Testing.
  6. Within six days of performing functional test, CxA will issue test report with findings a list of deficiencies that must be addressed by GC or sub-Contractors.
  7. Commissioning Authority shall submit a Final Report to Owner recommending acceptance or non-acceptance of individual system components as well as the systems as a whole.

### K. Re-Testing And Failure To Remedy Deficiencies

1. Despite GC's best efforts to ensure systems are problem-free, it is expected that some deficiencies will be found during initial inspection of System readiness Checklist, and during initial Functional Testing; such deficiencies are expected to be minimal.
2. It is GC's responsibility to remedy identified deficiencies, both in System readiness Checklist and in Functional Testing phases of work, in a timely and thorough manner.
3. It is GC's responsibility to ensure that all deficiencies are corrected prior to requesting a re-inspection or re-test of systems and equipment. Do not request re-inspection or re-test until deficiencies are corrected.
  - a. At his discretion, CxA may agree to re-testing systems or equipment where deficiencies remain which are beyond GC's control to resolve expeditiously.
  - b. Typically such re-testing of incomplete systems and equipment will take place only if remaining deficiencies are minor in scope and nature, and are of such nature that they cannot be resolved in a timely manner (such as those due to

## SECTION 019113 - GENERAL COMMISSIONING REQUIREMENTS

difficulties in obtaining parts, or where Owner has requested a change that has delayed work, etc.)

4. CxA will carry out a second re-inspection or re-test of systems and equipment subsequent to receiving GC's request.
  - a. If CxA finds deficiencies identified in initial inspection or test have not been remedied (with exception of un-resolvable deficiencies noted above), and such remaining deficiencies are significant enough to require additional inspection or re-testing, GC will be back-charged for CxA's expenses, per Article 1.5.

### 3.7 DEFERRED TESTING

- A. "Seasonal Commissioning" pertains to testing during peak heating or cooling seasons when HVAC equipment is operating at full-load or heavy-load conditions. Initial commissioning will be done as soon as contract work is completed, regardless of season. Seasonal Commissioning under full- or heavy-load conditions other than the current season will be handled at later time by GC and CxA.
  1. If adequate load may be artificially placed upon heating or cooling equipment, CxA, at his discretion, may perform functional testing during non-peak load periods.
  2. GC is to provide services of personnel and participate in seasonal testing process in the same manner as he would in non-seasonal testing.
  3. Until off-season commissioning can be accomplished, Owner may retain an amount from GC's payment sufficient to cover the cost of off-season testing.
- B. Unforeseen Deferred Tests: If any check or test cannot be completed due to building structure, required occupancy condition, or other reason, execution of checklists and functional testing may be delayed upon approval of Owner. Tests shall be conducted in same manner as seasonal tests, as soon as possible. Services of required parties will be negotiated. Make final adjustments to Operation and Maintenance Manuals and record drawings due to unforeseen deferred tests.
  1. GC is to provide services of personnel and participate in deferred testing in the same manner as he would for normal commissioning.
  2. Until deferred testing can be accomplished, Owner may retain an amount from GC's payment sufficient to cover the cost of deferred testing.

### 3.8 TRAINING

- A. The following requirements are in addition to operation and maintenance requirements specified elsewhere in this specifications manual. GC shall be responsible for training coordination and scheduling, and ultimately to ensure that training is completed.
- B. Scheduling
  1. Organize training to fit Owner's schedule and to optimize the learning experience. Limit continuous sessions to no more than four hours, or otherwise only as approved by Owner and/or Architect.
  2. Provide an outline of the proposed training agenda for review by Owner and CxA a minimum of 10 days prior to proposed date for training session.
  3. Provide CxA a minimum 5 days advance notice of intent to carry out a training session.
  4. The CxA will not be required to attend all training sessions for building personnel, but will attend selected sessions and monitor progress and content.

## SECTION 019113 - GENERAL COMMISSIONING REQUIREMENTS

5. No training will take place prior to successful completion of Functional Testing.

### C. Training Materials

1. Develop Training Manuals to meet requirements of individual equipment specification sections.
2. Operating and Maintenance Manuals alone are NOT considered training manuals. O&M Manuals may be used as reference, but shall not be considered to meet requirements for training materials.
3. Develop a detailed outline showing how training program will be organized, including classroom and hands-on training as required by individual specifications sections.
4. Provide with training materials, a quick-reference "how-to" index which will allow operators to easily access information included in Training Manuals and/or O&M Manuals. This reference will include, as a minimum; routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions.
5. Refer to individual equipment or system specifications for minimum material to be covered as part of the training program.

### D. Documentation

1. All training sessions are to be fully documented. Document:
  - a. Basic information on training session (name of system, time, date, and location of training, name of presenter, length of training session, etc.).
  - b. Names of persons who attended the training session (provide a sign-in sheet).
  - c. Signature from authorized Owner's representative indicating that training took place and was satisfactory.
2. Provide CxA copy of sign-in sheet with training session documentation.

## 3.9 O&M MANUALS

- A. Provide operation and maintenance manuals as specified in section 017700 Closeout Submittals, and as outlined in individual sections of Divisions 22, 23 and 26.
- B. Provide CxA with a single copy of Operation and Maintenance Manuals for review. CxA's copy of O&M manuals shall be submitted through Architect.
- C. CxA shall review O&M Manuals and submit comments through the Architect.

## 3.10 SYSTEMS TO BE COMMISSIONED

- A. Refer to commissioning specifications sections in Related Sections, including the following:
  1. 230100 - COMMISSIONING OF MECHANICAL SYSTEMS: HVAC and Controls.
  2. 260100 - COMMISSIONING OF ELECTRICAL SYSTEMS: Lighting and Lighting Controls.

END OF SECTION 019113

## SECTION 024440 VINYL COATED CHAIN LINK FENCES AND GATES

### PART 1 GENERAL

#### RELATED DOCUMENTS

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

#### DESCRIPTION OF WORK:

Extent of vinyl coated chain link fences and gates is shown on drawings.

#### QUALITY ASSURANCE

Provide chain link fences and gates as complete units controlled by a single source including necessary erection accessories, fittings, and fastenings.

#### SUBMITTALS

Submit Product data in the form of manufacturer's technical data, specifications, and installation instructions for metal fencing and gates.

### PART 2 PRODUCT

#### GENERAL

Exterior Chain Link Fence 6ft High Black Vinyl, and Black Vinyl Posts

Dimensions shown form pipe, roll formed, and H sections are outside dimensions.

#### MANUFACTURERS

##### Vinyl Coated Steel Fencing and Fabric:

Allied Tube and Conduit Corp.

Anchor Fence, Inc.

Colorguard Corp.

Davis Walker Corp.

Dominion Fence and Wire Prod.

United States Steel.

Merchants Metals

#### STEEL FENCING (STFN):

Fabric: No. 9 ga. (0.148") core finished steel wires, 2" mesh, with top selvages knuckled for fabric 60" high and under, and both top and bottom selvages twisted and barbed for fabric over 60" high. Furnish one-piece fabric widths for fencing up to 12' high.

Fabric coating: The zinc coating of the fabric shall be minimum .30 oz./sq. ft. of uncoated wire surface. The weight of zinc coating on the fabric shall be determined in accordance with ASTM A-90.

PVC: Wire shall be coated with a minimum of 8 gauge finish of poly-vinyl chloride permanently bonded to the galvanized wire by the thermal fusion bonded method. Chain link fabric shall conform to the requirements of ASTM F-668, class 2b.

**HARDWARE AND ACCESSORIES:**

Framework: Galvanized steel, ASTM A 120 or A 123, with not less than 2.0 oz. zinc per sq. ft. of surface. All framework and components shall be coated with 10 to 15 mils of PVC.

End, Corner, and Pull Posts: Minimum sizes and weights as follows:

Up to 6 feet fabric height: 2.375 inch OD steel pipe, 3.65 lbs. per lin. ft., or 3.5 inch by 3.5 inch roll formed sections weighing 4.85 lb. per lin. ft.

Over 6 feet fabric height: 2.875 inch OD steel pipe, 5.79 lbs. per lin. ft., or 3.5 inch by 3.5 inch roll formed sections weighing 4.85 lbs. per lin. ft.

Line posts Space 10' o.c. maximum, unless otherwise indicated, of following minimum sizes and weights.

Up to 6 feet fabric height: 1.90 inch OD steel pipe, 2.70 lbs. per lin. ft. or 1.875" x 1.625" C sections, 228 lbs. per lin. ft.

6' to 8' fabric height, 2.375" OD steel pipe, 3.65 lbs. per lin. ft. or 2.25" x 1.875" H sections, 2.64 lbs. per lin. ft.

Over 8 feet fabric height: 2.875 inch OD steel pipe, 5.79 lbs. per lin. ft. or 2.25" x 1.875" H sections, 3.26 lbs. per lin. ft.

Gate Posts: Furnish posts for supporting single gate leaf, or one leaf of a double gate installation, for nominal gate widths as follows:

<u>Leaf Width</u>	<u>Gate Post</u>	<u>Lbs./Lin. Ft.</u>
Up to 6'	3.5" x 3.5" roll formed section or 2.875" OD pipe	4.85 5.79
Over 6' to 13'	4.000" OD pipe	9.11
Over 13' to 18'	6.625" OD pipe	18.97
Over 18'	8.625" OD pipe	28.55

Tension Wire: 7 gage, coated coil spring wire, metal finish to match fabric. Locate wire at bottom of fabric.

Top Rail: Provide 1 -5/8" diameter galvanized steel.

Post Brace Assembly: Manufacturer's standard adjustable brace at end and gate posts and at both sides of corner and pull posts, with horizontal brace located at mid height of fabric. Use same material as top rail for brace, and truss to line posts with 0.375" diameter rod and adjustable tightener.

Post Tops: Weathertight closure cap for tubular posts. Provide one cap for each post.

Stretcher Bars: One piece lengths equal to full height of fabric, with minimum cross section of 3/16" x 3/4". Provide one stretcher bar for each gate and end post, and two for each corner and pull post, except where fabric is integrally woven into post.

Corner Bracing: Install diagonal cross bracing consisting of 3/8" diameter adjustable length truss rods on corner posts to ensure frame rigidity without sag or twist, if required.

Stretcher Bar Bands: Space not over 15" oc., to secure stretcher bars to end, corner, pull and gate posts.

## GATES

Fabrication: Fabricate gate perimeter frames of 1.90" OD pipe. Metal and finish to match fence framework. Provide horizontal and vertical members to ensure proper gate operation and attachment of fabric, hardware, and accessories. Space frame member's maximum of 8 feet apart.

Assemble gate frames by welding or with special fittings and rivets, for rigid connections. Use same fabric as for fence, unless otherwise indicated. Install fabric with stretcher bars at vertical edges. Bars may also be used at top and bottom edges. Attach stretchers to gate frame at not more than 15" o.c. Attach hardware to provide security against removal or breakage.

Install diagonal cross bracing consisting of 3/8" diameter adjustable length truss rods on gates to ensure frame rigidity without sag or twist, if required.

Gate Hardware: Furnish the following hardware and accessories for each gate.

Hinges: Size and material to suite gate size, non lift off type, offset to permit 180 deg gate opening. Provide 1 1/2 pair of hinges for each leaf over 6 foot nominal height.

Latch: Forked type or plunger bar type to permit operation from either side of gate, with padlock eye as integral part of latch.

Keeper: Provide keeper for vehicle gates, which automatically engages gate leaf and holds it in open position until manually released.

Sliding Gates: Provide manufacturer's standard heavy duty track, ball bearing hanger sheaves, overhead framing and supports, guides, stays, bracing, hardware, and accessories as required.

Wire Ties: For tying fabric to line posts, use wire ties spaced 12" o.c. For tying fabric to rails and braces, use wire ties spaced 24" o.c. For tying fabric to tension wire, use hog rings spaced 24" o.c.

Manufacturer's standard procedure will be accepted if of equal strength and durability.

Concrete: Provide concrete consisting of Portland cement, ASTM C150, aggregates, ASTM C33, and clean water. Mix materials to obtain concrete with a minimum 28 day compressive strength of 2500 psi using at least 4 sacks of cement per cu. yd., 1" maximum size aggregate, maximum 3" slump, and 2% to 4% entrained air.

## PART 3 EXECUTION

### INSTALLATION

Do not begin installation and erection before final grading is completed, unless otherwise



permitted.

Excavation: Drill holes for posts to diameters and spacings shown, in firm, undisturbed or compacted soil.

If not shown on drawings, excavate holes for each post to minimum diameter recommended by fence manufacturer.

Unless otherwise indicated, excavate hole depths approximately 3 inches lower than post bottom, with bottom of posts set not less than 36 inches below finish grade surface.

Setting Posts: Center and align posts in holes 3 inches above bottom of excavation.

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.

Center Rails: Provide center rails where shown. Install in one piece between posts and flush with post on fabric side, using special offset fittings where necessary.

Brace Assemblies: Install braces so posts are plumb when diagonal rod is under proper tension.

Tension Wire: Install tension wires before stretching fabric and tie to each post with not less than 6 ga. galvanized wire. Fasten fabric to tension wire using 11 gage galvanized steel hog rings of spaced 24 inches o.c.

Fabric: Leave approximately 2 inches between finish grade and bottom selvage unless otherwise indicated. Pull fabric taut and tie to posts, rails, and tension wires. Install fabric on security side of fence, and anchor to framework so that fabric remains in tension after pulling force is released.

Stretcher Bars: Thread through or clamp to fabric 4 inches o.c., and secure to posts with metal bands spaced 15 inches o.c.

Gates: Install gates plumb, level, and secure for full opening without interference. Install ground set items in concrete for anchorage as recommended by manufacturer. Adjust hardware for smooth operation and lubricate where necessary.

Tie Wires: Use U shaped wire, conforming to diameter of pipe to which attached, clasping pipe and fabric firmly with ends twisted at least 2 full turns. Bend wire to minimize hazard to persons or clothing.

Fasteners: Install nuts for tension bands and hardware bolts on side of fence opposite fabric side. Peen ends of bolts or score threads to prevent removal of nuts.

END OF SECTION 02444

## SECTION 02780 – UNIT PAVERS

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Concrete paver units
- B. Bedding and joint sand.

#### 1.03 REFERENCES

- A. American Society of Testing and Materials (ASTM):

1. C 33, Specification for Concrete Aggregates.
2. C 136, Method for Sieve Analysis for Fine and Coarse Aggregate.
3. C 140, Sampling and Testing Concrete Masonry Units.
4. C 144, Standard Specification for Aggregate for Masonry Mortar.
5. C 936, Specification for Solid Interlocking Concrete Paving Units.
6. C 979, Specification for Pigments for Integrally Colored Concrete.
7. D 698, Test Methods for Moisture Density Relations of Soil and Soil Aggregate Mixtures Using a 5.5-lb (2.49 kg) Rammer and 12 in. (305 mm) drop.
8. D 1557, Test Methods for Moisture Density Relations of Soil and Soil Aggregate Mixtures Using a 10-lb (4.54 kg) Rammer and 18 in. (457 mm) drop.

#### 1.04 QUALITY ASSURANCE

- A. Manufacturer: Company specializing in the manufacture of concrete interlocking pavers for a minimum of five (5) years.
- B. Installation shall be by a contractor and crew with at least five (5) years of experience in placing interlocking concrete pavers on projects of similar nature or dollar cost.
- C. Installation Contractor shall conform to all local, state/provincial licensing and bonding requirements.

#### 1.05 SUBMITTALS

- A. Submit product drawings and data.
- B. Submit full size sample sets of concrete paving units to indicate color and shape selections. Color will be selected by SSP from manufacturer's available colors.
- C. Submit sealer tech specs
- D. Submit sieve analysis for grading of bedding and joint sand.
- E. Indicate layout, pattern, and relationship of paving joints to fixtures per plans and details.
- F. Substitutions: Substitutions shall be submitted 7 days prior to bid opening for acceptance.

#### 1.06 MOCK-UPS

- A. Install a 12 ft. x 12 ft. paver area as described in Article 3.02. This area will be used to determine surcharge of the bedding sand layer, joint sizes, lines, laying pattern(s), color(s), and texture of the job. This area shall be the standard from which the work will be judged. Consideration shall be given to differences in age of materials from time of mock-up erection to time of actual product delivery.

## SECTION 02780 – UNIT PAVERS

### 1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver concrete pavers to the site in steel banded, plastic banded, or plastic wrapped cubes capable of transfer by fork lift or clamp lift. Unload pavers at job site in such a manner that no damage occurs to the product.
- B. Sand shall be covered with waterproof covering to prevent exposure to rainfall or removal by wind. The covering shall be secured in place.
- C. Coordinate delivery and paving schedule to minimize interference with normal use of buildings adjacent to paving.

### 1.08 MAINTENANCE/WARRANTY

- A. Maintenance Requirements: Maintain the work of this Section for one year after ‘substantial completion’ and until final written acceptance by Owner. Notify the owner in writing of ‘substantial completion’. Maintenance period begins after owner’s written acceptance of ‘substantial completion’.
- B. Maintenance Service: Perform the following maintenance operations:
  - 1. Re-sand all joints and gaps in pavers as required or requested by owner. Use polymeric sand to fill all joints.
  - 2. Re-level pavers as required or requested by owner.
  - 3. Control/eradicate any weed or vegetative growth within paver areas.

## PART 2 PRODUCTS

### 2.01 CONCRETE PAVERS

- A. Concrete pavers shall be supplied by Belgard or approved equal.  
Jewell Concrete Products Inc  
400 Jewell Dr, Waco, TX 76712 · (254) 772-3440
- B. Pavers shall be Belgard - “Lafitt Gran Slab” – 3 Piece Modular, Pattern to be ‘Random’, Desert Sand Color and Hollandstone Fossil Beige Color and overall dimensions shall be:

**Field:**

- 1. Paver I – 14-7/8” x 7-3/8” x 2” thickness
- 2. Paver II – 14-7/8” x 14-7/8” x 2” thickness
- 3. Paver III – 14-7/8” x 22-7/16” x 2” thickness

**Banding:**

- 1. Hollandstone – 4” x 8” x 2 3/8” thickness

- C. Paver colors shall be: *Desert Sand for field and Fossil Beige for Banding*

## SECTION 02780 – UNIT PAVERS

- D. Pavers shall meet the following requirements set forth in ASTM C 936, Standard Specification for Interlocking Concrete Paving Units:
  - 1. Average compressive strength of 8,000 psi (55 MPa) with no individual unit under 7,200 psi (50 MPa).
  - 2. Average absorption of 5% with no unit greater than 7% when tested in accordance with ASTM C 140.
  - 3. Resistance to 50 freeze-thaw cycles when tested in accordance with ASTM C 67.
- E. Pigment in concrete pavers shall conform to ASTM C 979.
- F. Material shall be manufactured in individual layers on production pallets.
- G. Materials shall be manufactured to produce a solid homogeneous matrix in the produced unit.
- H. Seal all paver surfaces when thoroughly dry. Use Techniseal ‘Natural Look (iN)’, matte finish, penetrating paver sealer, product code 60304120.

### 2.02 VISUAL INSPECTION

- A. All units shall be sound and free of defects that would interfere with the proper placing of unit or impair the strength or permanence of the construction.

### 2.03 SAMPLING AND TESTING

- A. Manufacturer shall provide access to lots ready for delivery to the Owner or his authorized representative for testing in accordance with ASTM 936-82 for sampling of material prior to commencement of paver placement.
- B. Manufacturer shall provide a minimum of three (3) years testing backup data showing manufactured products that meet and exceed ASTM 936-82 when tested in compliance with ASTM C-140.
- C. Sampling shall be random with a minimum of nine (9) specimens per 20,000 sq. ft. per product shape and size with repeated samples taken every additional 20,000 sq. ft. or a fraction thereof.
- D. Test units in accordance with ASTM for compressive strength, absorption and dimensional tolerance. A minimum of three (3) specimens per test required for an average value. Testing of full units is preferred.

### 2.04 REJECTION

- A. In the event the shipment fails to conform to the specified requirements, the manufacturer may sort it, and new test units shall be selected at random by the Owner from the retained lot and tested at the expense of the manufacturer. If the second set of test units fails to conform to the specified requirements, the entire lot shall be rejected.

### 2.05 EXPENSE OF TESTS

- A. The expense of inspection and testing shall be borne by the Owner.

### 2.06 BEDDING AND JOINT SAND

- A. Bedding and joint sand shall be clean, non-plastic, free from deleterious or foreign matter. The sand shall be natural or manufactured from crushed rock. Limestone screenings or stone dust shall not be used.

**SECTION 02780 – UNIT PAVERS**

- B. Grading of sand samples for the bedding course and joints shall be done according to ASTM C 136. The bedding sand shall conform to the grading requirements of ASTM C 33 as shown in Table 1 below.

<b>Table 1</b>	
<b>Grading Requirements for Bedding Sand</b>	
<i>ASTM C 136</i>	
Sieve Size	Percent Passing
3/8 in. (9.5 mm)	100
No. 4 (4.75 mm)	95 to 100
No. 8 (2.36 mm)	85 to 100
No. 16 (1.18 mm)	50 to 85
No. 30 (600 μm)	25 to 60
No. 50 (300 μm)	10 to 30
No. 100 (150 μm)	2 to 10

Bedding sand may be used for joint sand for the initial filling of joints but must be supplemented with polymeric sand or gel to completely fill the joints. If joint sand other than bedding sand is used, the gradations shown in Table 2 are recommended. Joint sand should never be used for bedding sand.

- C. The joint sand shall conform to the grading requirements of ASTM C 144 as shown in Table 2 below:

<b>Table 2</b>	
<b>Grading Requirements for Joint Sand</b>	
<i>ASTM C 144 Natural Sand</i>	
Sieve Size	Percent Passing
No. 4 (4.75 mm)	100

## SECTION 02780 – UNIT PAVERS

No. 8 (2.36 mm)	95 to 100
No. 16 (1.18 mm)	70 to 100
No. 30 (600 µm)	40 to 75
No. 50 (300 µm)	10 to 35
No. 100 (150 µm)	2 to 15
No. 200 (75 µm)	0

### PART 3 EXECUTION

#### 3.01 EXAMINATION

- A. Verify that subgrade preparation, compacted density and elevations conform to the specifications. Compaction of the soil subgrade to at least 95% Standard Proctor Density per ASTM D 698 is recommended. Stabilization of the subgrade and/or base material may be necessary with weak or saturated subgrade soils. Owner/SSP Design will inspect subgrade preparation, elevations, and conformance to specifications.
- B. Verify that aggregate base materials, thickness, compaction, surface tolerances, and elevations conform to the civil engineers grading plans and specifications.
- C. Verify location, type, installation and elevations of edge restraints around the perimeter area to be paved.
- D. Verify that base is dry, uniform, even, and ready to support sand, pavers, and imposed loads.
- E. Beginning of bedding sand and paver installation means acceptance of base and edge restraints.

#### 3.02 INSTALLATION

- A. Refer to Engineer's plans for sub-base preparation, concrete work and final grades/elevations.
- B. Apply herbicide on any vegetative matter within paver areas.
- C. Apply pre-emergent herbicide to base course prior to installing leveling sand.
- D. Spread sand evenly over the base course and screed to a nominal 1 in. thickness, not exceeding 1-1/2 in. thickness. The screeded sand should not be disturbed. Place sufficient sand to stay ahead of the laid pavers. Do not use the bedding sand to fill depressions in the base surface.
- E. Ensure that pavers are free of foreign materials before installation.
- F. Lay the pavers in pattern as indicated on plans using specified paver types. Maintain straight pattern lines as indicated on plans or details. Paving banding pattern shall be installed as indicated on plans or details.
- G. Joints between pavers shall not exceed 3/16" in width. Miter cut pavers shall be used to minimize gaps and joints.
- H. Fill gaps at the edges of the paved area with cut pavers or edge units.
- I. Cut pavers to be cut/sawn using a masonry saw. Paver splitters shall not be used.
- J. Use a low amplitude, high frequency plate vibrator to vibrate the pavers into the sand. Use Table 3 below to select size of compaction equipment:

**SECTION 02780 – UNIT PAVERS**

Paver Thickness	Minimum Centrifugal Compaction Force
60 mm	3000 lbs. (13 kN)
80 mm	500 lbs (22 kN)

- K. Vibrate the pavers, sweeping polymeric sand or gel into the joints and vibrating until they are fully compacted. This will require at least two or three passes with the vibrator. Do not vibrate within 3 ft. (1 m) of the unrestrained edges of the paving units.
- L. Install ‘hidden’ concrete edge restraints as shown on details using Min. 2500 PSI concrete with fibre-mesh reinforcement and rebar.
- M. All work to within 3 ft. (1 m) of the laying face must be left fully compacted with sand-filled joints at the completion of each day.
- N. Sweep off excess sand when the job is complete.
- O. The final surface elevations shall not deviate more than 3/8 in. (10 mm) under a 10 ft. (3 m) long straightedge.
- P. The surface elevation of pavers shall be 1/8 in. to 1/4 in. (3 to 6 mm) above adjacent drainage inlets, concrete collars or channels.
- I. Apply penetrating sealer when pavers are completely dry and clean. Matte finish, (Techniseal ‘Natural Look (iN)’, matte finish, penetrating paver sealer, product code 60304120) or approved equal.
- Q. The re-sanding of paver joints using polymeric sand shall be accomplished by contractor for a period of one (1) year after completion of work.

**3.03 FIELD QUALITY CONTROL**

- A. After removal of excess sand, check and adjust final elevations for conformance to the grading and drainage plans.
- B. Clean

**END OF SECTION**

## SECTION 02810 – IRRIGATION

### PART 1 – GENERAL

#### 1.01 SCOPE

- A. An automatic underground irrigation system for exterior landscaped areas including, but not limited to, supply an installation of water meter, backflow device and controller, boring and sleeving, rotary heads and spray heads in lawn areas and spray heads and drip lines in shrub, ground cover, and flower bed areas.

#### 1.02 SYSTEM DESCRIPTION

- A. Design Requirements:
  - 1. Provide connection to water source and new water meter(s) as specified and in accordance with local code requirements.
  - 2. Provide for an electro-mechanical controller as specified.
- B. Performance Requirements: Provide for irrigation at a rate of 1 in. per week applied at 2 or 3 day intervals.

#### 1.03 QUALIFICATIONS

- A. Irrigation work to be performed by a Texas licensed irrigation company specializing in commercial irrigation installation with a minimum of five (5) years experience on similar projects. Owner/SSP Design to review qualifications and approve subcontractor prior to commencing work.

#### 1.03 SCHEDULE OF VALUES

- A. Landscape/Irrigation subcontractor shall submit costs for GC schedule of values as follows:
  - 1. Irrigation Sleeving
  - 2. Irrigation Water Meter, Backflow, Permits, Testing
  - 3. Irrigation System
  - 4. Landscape Grading and Soil Mix
  - 5. Landscape Planting, Materials, Installation, Warranty
  - 6. Landscape / Irrigation 90 Day Maintenance

#### 1.04 SUBMITTALS

- A. Submittals shall be formatted electronically in a PDF file with a table of contents and tabs identifying each section. The following submittals are required for this section:
  - 1. Product Data: Manufacturers' technical data (Cut Sheets) and installation information for all components including: Backflow Assembly (Pressure Vacuum Breaker PVB or Reduced Pressure, Backflow Preventer RPZ (as specified), Y strainer (if required), Ball valves, PVC pipe, PVC fittings, PVC primers, solvents, cement, glue, etc., Control wire / tracking wire, Wire connectors, Pump stations, booster pumps (if specified), Pump enclosures (if specified), Controller (incl. communications modules, etc.), Rain/freeze sensors, Valves, Valve boxes, Decoders (if specified), Rotors, Sprays, Nozzles, Bubblers, Drip line, Drip filters, Drip indicators (operind), Air relief valves



## SECTION 02810 – IRRIGATION

### 1.05 QUALITY CONTROL

- A. Submit verification of water pressure at meter or point of connection.

### 1.06 MAINTENANCE/WARRANTY

- A. Provide the following extra materials to the Owner:
  - 1. Two (2) quick coupler hose bib keys.
  - 2. Four (4) keys for the controller door lock.
- B. Maintenance Requirements: Maintain the work of this Section during construction and for ninety days after ‘substantial completion’ and until final acceptance by Owner. Notify the owner in writing of ‘substantial completion’. Maintenance period begins after owner’s acceptance of ‘substantial completion’.
- C. Maintenance Service: Perform the following maintenance operations at least once a week:
  - 1. Test entire system and adjust timer as necessary and as directed by landscape contractor, landscape designer or owner.
  - 2. Replace or repair any broken parts or equipment.
  - 3. Report any significant problems in writing to landscape contractor, owner and landscape designer.
- D. Warranty: Warranty shall cover all parts and equipment for a period of one year from the date of final acceptance. Repairs and replacements shall be completed within two weeks of notification from owner.

## PART 2- PRODUCTS

### 2.1 MATERIALS

- A. PVC Plastic Pipe: ASTM D 2241-83, SDR21, class 160 lateral piping; ASTM D1785, class 200 mainline piping.
- B. Pipe Fittings:
  - 1. Pipe under 3 in., id: Socket type, ASTM D 2466-78, with solvent Cement, ASTM D 2564-80.
  - 2. Pipe 3 in. id and Larger: Gasketed fittings of epoxy coated steel with non-hardening pipe dope or Teflon tape for threads.
- C. Concrete: 2500 psi min. compressive strength.

### 2.2 MANUFACTURED UNITS

- A. Controller: Electro-mechanical, 24 hr./14-day clock with manual operation capacity, with adequate number of stations for system operating requirements (two wire) (see irrigation equipment table). Provide both freeze-protection and rain-sensor devices with controller. Provide ground-fault interrupt and lightning protection. Provide flow control, flow

## SECTION 02810 – IRRIGATION

management, flow sensor, ET Management, and IQ System cellular cartridge. Contractor to coordinate setup and connection to IQ4 cellular software including training.

- B. Water Meters: Water meters in locations shown on plans. Contractor to coordinate application, permit and installation with local utility company. Contractor responsible for water meters and all associated installation costs.
- C. Booster Pump: If required contractor shall furnish and install booster pump with enclosure as specified in plans/details. Contractor shall also provide a concrete pad and any and all fittings, adaptors, connections, enclosure, etc. for the complete installation and proper operation of booster pump.
- D. Backflow Preventers: Provide and install backflow devices per local codes, specifications and requirements. Provide steel mesh enclosure per plans/schedule.
- E. Electric Valves: PEB-IVF Smart Valves Normally closed, 24v AC, 60 cycle, solenoid actuated, globe pattern, diaphragm type. Cast brass or plastic body and nylon reinforced nitrile rubber diaphragm.
- F. Quick coupling Valves: Cast brass body with self-closing cover. Provide (2) brass keys with 1 in. female threaded outlet.
- G. Sprinkler Heads: Heavy-duty plastic sprinkler case, high density plastic sprinkler body, corrosion-resistant internal parts, plastic spray nozzles with adjustable flow and direction features.
- H. Control Wire: 2-wire cable – Rainbird Maxi Cable 14/2.
- I. Tracking Wire: 18 gauge copper (only where mainline and wiring bundle are separated)
- J. Valve Boxes: Heavy-duty commercial grade, fiberglass reinforced, plastic with locking covers. Rainbird VB series, 10” Round or Standard Rectangular.
- K. Swing Joints: 3 high density polyethylene street ells with 8 in. Schedule 80 PVC nipple; sized the same as inlet to sprinkler head.
- L. Sleeves: Schedule 40 PVC. Boring as required under all existing pavement, walls or curbs.
- M. Flow Sensor: Rainbird FS200B (installed with a Two-Wire Decoder Sensor Decoder (SD210TURF) connected to the two wire path (no pulse transmitter required)

## SECTION 02810 – IRRIGATION

### PART 3 – EXECUTION

#### 3.01 EXAMINATION

- A. Verification of Conditions: Examine the site and conditions under which irrigation work is to be performed. Irrigation contractor shall notify the landscape contractor in writing, with a copy to Construction Manager, if the site is unsatisfactory. Do not begin the work until unsatisfactory conditions have been corrected in a manner acceptable to irrigation contractor. Beginning of work indicates acceptance of the site as satisfactory by the irrigation contractor.

#### 3.02 INSTALLATION

- A. General: Install tracking wire along mainline pipe if separate from valve wiring bundle.
- B. Excavating and Filling:
1. Cover for Piping:
    - a) Mains: 18 in. min.
    - b) Laterals: 12 in. min.
  2. Use clean backfill material without stones larger than 1/2 in., debris or extraneous material that may damage pipe assembly.
  3. Compact all trenches to a minimum 95% Standard Proctor Density.
- C. Pipe:
1. Install in existing sleeves under pavement or provide boring and sleeves under pavement as required.
  2. Clean pipe and joints before making connections. Purple primer to be used on all joints before applying solvent. Per TCEQ Regulations.
  3. Attach joints according to manufacturer's instructions. Threaded joints to be coated with "Teflon" tape. Allow joints to set for at least 24 hrs. before applying water pressure to the system.
  4. Thoroughly flush piping before sprinkler heads are installed and test under pressure for leaks in each line separated by valves.
- D. Water Meters: Provide and install water meters per local codes, specifications and requirements. Coordinate permit and application with owner and local utility company. Adjust locations as necessary to coordinate with existing water line locations.
- E. Back Flow Protection: Provide and install backflow devices per local codes, specifications and requirements including enclosure.
- F. Valves:
1. Provide isolation valve on inlet side of every electric control valve (if specified).
  2. Install electric and gate valves with at least 10 in. of cover over the valve and at least 6 in. of cover over the stem.
  3. Install valve box centered over the flow control handle. Provide 1 cu. ft. of clean pea gravel in the bottom of each valve box with filter fabric below.
  4. In lawn areas, valve boxes to be set flush with existing grade; in planting bed areas valve boxes shall be set 2" above grade.

## SECTION 02810 – IRRIGATION

- G. Controllers: Hard wire to nearest power source. Coordinate with general contractor. Install on exterior wall in location as shown on plans or as directed/approved by Owner / SSP. Must be hard wired to an electrical J-Box. Plug in connection not acceptable.
- H. Sprinkler Heads: Install all heads on swing joint assemblies and flush with finish grade.
- I. Wiring:
  - 1. Bundle and tape wires at 10 ft. o.c., max.
  - 2. Snake wire in trenches to allow for expansion. Provide expansion coils at 100 ft. o.c. max., and at the entry to each valve box.
  - 3. Splice wires using mechanical sealant connector for a waterproof connection. Make all wire splices within valve boxes. Use RB WPCONN N90300 or approved equal.

### 3.03 FIELD QUALITY WORK

- A. General: Notify the Construction Manager at least 48 hours before testing is begun.
- B. Hydrostatic Test: Test mainline piping to a hydrostatic pressure of not less than 100 psi for a minimum of 24 hours. Piping may be tested in sections to expedite work. Remove and repair piping and connections which do not pass hydrostatic testing.
- C. Operational Testing: Perform operational testing after hydrostatic testing is completed, backfill is in place, and sprinkler heads adjusted to final position.

### 3.04 ADJUSTING

- A. Check sprinkler heads for arc of spray. Adjust as necessary to provide 100% coverage of all landscaped areas.
- B. Adjust layout to conform to actual layout of landscape plantings.

### 3.05 DEMONSTRATION

- A. Demonstrate operation of the system to Owner's personnel and staff. Install and setup communications cartridge in controller and run flow calculations and setup irrigation schedule.

### 3.06 CLOSE-OUT DOCUMENTS

- A. As-Built Drawings: Submit 'As-Built' drawings before project close-out showing the irrigation system layout, including line locations and sizes, spray heads and types, points of connection, booster pump, location of backflow device(s), controller, and other installation information.
- B. Warranty Letters: Submit warranty letters for all irrigation items including labor for the specified warranty period.
- C. Operation and Maintenance Data: Submit Manufacturers' operation and maintenance instructions and laminated colored (11x17) valve Zoning Diagram.

**END OF SECTION**

## SECTION 028250 - ORNAMENTAL FENCES AND GATES

### 2.01 MANUFACTURER:

The fencing system shall be Industrial Aluminum Fence #202 Series as manufactured by Jerith Manufacturing Co., Inc., 14400 McNulty Road, Philadelphia, PA 19154. (Telephone: 800-344-2242; Fax: 215-676-9756; email: sales@jerith.com.)

Elite Fence Products, Inc., 835 Scott St, Murfreesboro, TN 37129; (615) 849-1886, Industrial EFF-20 is an approved manufacturer.

Ameristar Fence Products, 1555 N. Mingo Rd., Tulsa, OK 74116; (888) 333-3422, Echelon II 3-Rail Profile is an approved manufacturer.

### 2.02 MATERIALS:

A. Aluminum Extrusions: All posts and rails used in the fence system shall be extruded from HS-35™ aluminum alloy having minimum yield strength of 35,000 psi. All pickets shall have minimum yield strength of 25,000 psi. 6063-T5 Alloy is not acceptable for any components.

B. Fasteners: All fasteners shall be stainless steel. Square drive screws shall be used to connect the pickets to the horizontal rails. Rail to post connections shall be made using self-drilling hex-head screws.

C. Accessories: Aluminum sand and die castings shall be used for all scrolls, post caps, finials, and miscellaneous hardware. Die castings shall be made from Alloy 360.0 for superior corrosion resistance. Alloy 380.0 is not acceptable.

### 2.03 FINISH:

A. Pretreatment: A three stage non-chrome pretreatment shall be applied. The first step shall be a chemical cleaning, followed by a water rinse. The final stage shall be a dry-in-place activator which produces a uniform chemical conversion coating for superior adhesion.

B. Coating: Fence materials shall be coated with FencCoat™, a Super-Durable TGIC polyester powder-coat finish system applied by Jerith Manufacturing Company. Epoxy powder coatings, baked enamel or acrylic paint finishes are not acceptable. The FencCoat finish shall have a cured film thickness of at least 2.0 mils. In addition, the screw heads shall be painted to match the color of the fence. The color of the fence system shall be selected from standard colors.

C. Tests: The cured FencCoat finish shall meet AAMA 2604 "Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels", which includes the following requirements:

1. Humidity resistance of 3,000 hours using ASTM D2247.
2. Salt-spray resistance of 3,000 hours using ASTM B117.
3. Outdoor weathering shall show no adhesion loss, checking or crazing, with only slight fade and chalk when exposed for 5 years in Florida facing south at a 45 degree angle.

Finishes which only meet AAMA 2603 (or the previous version - AAMA 603) are not acceptable.

### 2.04 CONSTRUCTION:

A. Horizontal rails shall be 1 5/8" x 1 5/8" channels formed in a modified "U" shape. Pickets shall pass through holes punched in the top of the rail. The top wall shall be

.072" thick and the side walls .082" thick for superior vertical load strength. There shall be 3 horizontal rails in each section.

B. Pickets shall be fastened to the rails using painted stainless steel screws. Screws shall be used on only one side of the rail, leaving the other side with a clean appearance. Pickets shall be 1" square and have a wall thickness of .062". Welding the pickets to the rails is not permitted.

C. Posts shall be 2 1/2" square extrusions with pre-punched holes which allow the fence section rails to slide in. Posts shall be spaced 72" on center and have .075 walls. Gate posts shall be 4" square with .125" walls and used on both sides of a gate. Die cast aluminum caps shall be provided with all posts.

D. Gates shall have welded frames and shall support a 250 lb. vertical load on the latch side of the gate without collapsing. Walk gates shall be self-closing and self-latching.

E. Assembled sections shall support a 1,000 lb. vertical load at the midpoint of any horizontal rail.

#### 2.05 ADDITIONAL PEDESTRIAN GATE HARDWARE:

Provide at all pedestrian swing gates Samson-2 Locinox hydraulic gate closer. Provide for push button lockset, exit devise, stainless steel mounting plates, closer and all necessary accessories required for a complete installation. Provide 10" stainless steel kickplate.

#### 2.06 GATE OPERATORS

A. Gate Operators:

Elite SL 3000 1/2 Horsepower

Liftmaster CSL 24VDC

B. Provide factory-assembled automatic operating system designed for gate size, type, weight, and operation frequency. Provide operation control system with characteristics suitable for Project conditions, with remote-control stations, safety devices, and weatherproof enclosures; coordinate electrical requirements with building electrical system.

1. Provide operator with UL approved components.

C. Provide gate operators w/ two reversing loops saw cut into concrete asphalt and sealed, as indicated.

D. Provide/ install a standard vehicle height pedestal with one card reader, custom reader box and an over-ride key switch by the motor/operator, saw cut and seal low voltage wiring from reader to operator, include one photo eye as required and indicated on plans.

E. Provide/ install (1) 2" and (2) 1 1/2" electrical conduits and pull strings from pedestals to operators and to nearest electrical service as indicated on plans,

F. Refer to Electrical Drawings for keypads, airphone and interface equipment need for gate access.

#### 2.06 WARRANTY:

The entire fence system shall have a written Limited Lifetime Warranty against rust and defects in workmanship and materials. In addition, the FencCoat finish shall be warranted not to crack, chip, peel, or blister for the same period.

At pedestrian gates, all closers, exit devices and locksets to have a (2) year warranty.

### PART 3 - EXECUTION

Installation: All material must be checked upon receipt at the job site prior to installation to check for any damage that may have occurred during transport. The fence system must be stored in a safe and dry environment so as to protect it from any potential damage. This aluminum Ornamental Fence system must be installed in accordance with manufacturer's standard procedures.

END OF SECTION 02825

## SECTION 02900 – PLANTING

### PART 1 - GENERAL

#### 1.01 SCOPE

- A. Supply and installation of all approved materials, labor, equipment, transportation and services required and incidental thereto, in conformity with the plans and specifications, including but not limited to; vegetation protection/pruning, fine grading, earth mounding, bed excavation and preparation, bed edging, planting soil/compost mixes, fertilizer, mulch, trees, palms, shrubs, ground covers, staking, paving, site furniture, clean-up, maintenance, and warranty.
- B. Related Sections:
  - 1. Irrigation – 02810
  - 2. Lawns – 02930

#### 1.02 REFERENCE STANDARDS

- A. General: "Hortus Third," 1976.
- B. Texas Association of Nurserymen, Grades and Standards for Nursery Stock.
- C. Plant Material: "American Standard for Nursery Stock," ANSI Z60.1-1990.
- D. National Arborist Association Standards

#### 1.03 DEFINITIONS

- A. Specimen Plants: Plants having exceptional character, superiority in form and branching, and the best attributes of the species; all as determined by the Architect, Landscape Designer or Owner.

#### 1.04 QUALIFICATIONS

- A. Landscape work to be performed by a single firm specializing in commercial landscape work with a minimum of five (5) years experience on similar type projects. Owner/SSP Design to review qualifications and approve subcontractor prior to commencing work.

#### 1.03 SCHEDULE OF VALUES

- A. Landscape subcontractor shall submit costs for GC schedule of values as follows:
  - 1. Irrigation Sleeving
  - 2. Irrigation Water Meter, Backflow, Permits, Testing
  - 3. Irrigation System
  - 4. Landscape Grading and Soil Mix
  - 5. Landscape Planting, Materials, Installation, Warranty
  - 6. Landscape / Irrigation 90 Day Maintenance

#### 1.04 SUBMITTALS

- A. Submittals shall be formatted electronically in a pdf file with a table of contents and tabs



## SECTION 02900 – PLANTING

identifying each section. The following submittals are required for this section:

1. Landscape Construction Sequence
2. Edging Materials
3. Post emergent Herbicides
4. Pre emergent Herbicides
5. Soils, Compost and Mulch
6. Sources of all Plant Materials (including address and telephone numbers)
7. Product Data Material Safety Data Sheets
8. Paving Materials
9. Root Barrier Info/Cut Sheets
10. Staking Materials
11. Samples: One foot sections of edging and root barrier (as specified on plans), one pound bag sample of each; topsoil, premium compost, mulch, decomposed granite, river rock, washed gravel, example boulder/rocks, and seatwall blocks and caps.
12. Photographs of all plant material prior to ordering/installation
13. Name and License Number of Subcontractor for pruning trees (Certified I.S.A. Arborist required)

### 1.05 PROTECTION

- A. Before commencing work, contractor shall place orange construction fencing around all vegetation labeled “to remain” on landscape plans. Fencing shall be placed squarely around each tree 6’ x 6’ and at least 60” in height or continuously around groups of vegetation as shown on plans. No work may begin until this requirement is fulfilled. All other vegetation not labeled “to remain” shall be cleared and grubbed including root systems.
- B. In order to avoid damage to roots, bark or lower branches, no truck or other equipment shall be driven or parked within the drip line of any tree, unless the tree overspreads a paved way.
- C. The contractor shall use any and all precautionary measure when performing work around trees, walks, pavements, utilities, and any other features either existing or previously installed under this Contract.
- D. The Contractor shall adjust depth of earthwork and loaming when working immediately adjacent to any of the aforementioned features in order to prevent disturbing tree roots, undermining walks and pavements, and damage in general to any existing or newly incorporated item.
- E. Where excavating, fill or grading is required within the branch spread of trees that are to remain, the work shall be performed as follows:
  - a. TRENCHING: When trenching occurs around trees to remain, the tree roots shall not be cut but the trench shall be tunneled under or around the roots by careful hand digging and without injury to the roots.
  - b. RAISING GRADES: When the existing grade at tree is below the now finished grade, and fill not exceeding 16 inches (16") is required, clean, washed gravel graded from one to two inches (1" - 2") in size shall be placed directly around the tree trunk. The gravel shall extend out from trunk on all sides a minimum of 18 inches (18") and finish approximately two inches

## SECTION 02900 – PLANTING

(2") above the finished grade at tree. Install gravel before any earth fill is placed. New earth fill shall not be left in contact with the trunks of any trees requiring fill. Where fill exceeding 16 inches (16") is required, a dry laid tree well shall be constructed around the trunk of the tree. The tree well shall extend out from the trunk on all sides a minimum of three feet (3') and to three inches (3") above finish grade. Coarse grade rock shall be placed directly around the tree well extending out the drip line of the tree. Clean, washed gravel graded from one to two inches (1" - 2") in size shall be placed directly over the coarse rock to a depth of three inches (3"). Approved backfill material shall be placed directly over the washed gravel to desired finished grade.

- c. LOWERING GRADES: Existing trees in areas where the now finished grade is to be lowered shall have regarding work done by hand to elevation as indicated. Roots as required shall be cut cleanly three inches (3") below finished grade and scars covered with tree paint.
  - d. Trees marked for preservation that are located more than six inches (6") above proposed grades shall stand on broad rounded mounds and be graded smoothly into the lower level. Trees located more than 16 inches (16") above proposed grades shall have a dry laid stonewall, or other retaining structure as detailed on the plans, constructed a minimum of five feet (5') from the trunk. Exposed or broken roots shall be cut clean and covered with topsoil.
- F. Contractor is responsible for all protection measures listed above. If these procedures are not followed, contractor is responsible for replacement of existing trees with approved trees of equal caliper and height.

### 1.06 DELIVERY, STORAGE, AND HANDLING

- A. Packing and Shipping: Transport plant materials covered or in closed vehicles to protect from exposure to heat and wind. Spray trees and in full leaf with anti-desiccant - as recommended by the manufacturer - before shipping. Take precautions to protect plant materials from desiccation and from damage to bark, branches and roots. Do not allow root balls to crack. Schedule shipments to coincide with planting work schedule.
- B. Storage and Protection: If planting is delayed after delivery, keep plants in a shaded area, cover roots with mulch or topsoil, and keep plants constantly watered until planted.

### 1.07 MAINTENANCE/WARRANTY

- A. Maintenance Requirements: Maintain the work of this Section throughout construction and for ninety days after 'substantial completion' and until final written acceptance by Owner. Notify the owner in writing of 'substantial completion'. Maintenance period begins after owner's written acceptance of 'substantial completion'.
- B. Maintenance Service: Perform the following maintenance operations at least once a week:
  - 1. Remove and replace dead plant material. Prune plants to remove dead wood and to maintain health of plants.
  - 2. Maintain all mulched areas at a 2 in. depth. Remove weeds and grass from shrub and ground cover areas and from watering basins.
  - 3. Provide insect and disease control to maintain health of plants.
  - 4. Irrigation:

## SECTION 02900 – PLANTING

- a) If the irrigation system is operating, program and monitor the system to provide adequate water for plants.
  - b) If the irrigation system is not operating, hand water plants. Deep water trees each week.
  5. Dispose of all maintenance debris/clippings off-site. Owner’s dumpsters shall not be used.
  6. Keep all site areas tidy and free of weeds, grass, grass clippings, mulch or other foreign materials.
  7. Submit dates, descriptions and receipts of all maintenance operations to SSP Design for approval.
- C. Warranty: Warranty shall cover all shrubs/groundcovers for a period of three months and trees/palms for a period of one year from the date of final acceptance. Any plant material deemed dead or unrecoverable by the owner shall be replaced with similar species and size within two weeks of notification from owner.

### 1.08 RIGHT OF REJECTION

- A. The Owner/SSP Design reserve the right to inspect and reject plants at any time and at any place.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Fertilizer: 13-13-13 Osmocote slow release fertilizer granules or approved equal.
- B. Planting tablets: Agraform 21 gram slow release fertilizer tablets or approved equal.
- C. Compost: Premium grade compost (‘9 Kids Compost’ or approved equal).
- D. Topsoil: Fertile, agricultural soil, typical for locality, capable of sustaining vigorous plant growth, taken from drained site; free of subsoil, clay or impurities, plants, weeds and roots; minimum pH value of 5.4 and maximum 7.0; organic matter to exceed 1.5%, magnesium to exceed 100 units; phosphorus to exceed 150 units; potassium to exceed 120 units; soluble salts/conductivity not to exceed 900 ppm/0.9 mmhos/GC in soil.
- E. Sand: Clean, screened inorganic masonry sand. Silica sand only. River sand not acceptable. Mathis sand, Wright Materials, Plant 3 masonry sand (361) 387-0293 or approved equal
- F. Mulch:
  1. Shrub and Ground Cover Planting Areas: Grade A Shredded Hardwood; long, fibrous bark strands free from wood chips. Texas Natives or Approved Equal.
  2. Watering basins: Grade A Shredded Hardwood; long, fibrous bark strands free from wood chips. Texas Natives or Approved Equal.
- G. Plants:
  1. General: Provide plant materials that are healthy and free from disease, insects, and larvae and without damage to bark, branches, and roots.
  2. Approval: All plants must be approved by Owner/SSP Design prior to installation. Any plants not approved by Owner/SSP Design shall be subject to rejection. All trees/palms must be

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inspected, approved and tagged by Owner/SSP Design at their place of origin or as directed in writing by Owner/SSP Design. Container grown trees shall be obtained by Glen Flora Farms, Inc. or approved equal.

3. Sizes: Measured after pruning and in accordance with the plant schedule.
4. Root Treatment: As follows in accordance with the Reference Standards:
  - a) Palms: Balled and burlapped or containerized if they have been in the container for at least one growing season.
  - b) Trees, Shrubs, Ground Cover Plants: Container grown with a well-established fibrous root system.
5. Palms: All new palms shall be field dug or containerized material in specified sizes shown in plant schedule. All palms shall have good form (straight trunks) consistent of its species, free of scares/abrasions/burn marks and disease and insects, with large healthy root systems. Rootballs sizes for B/B material must meet the following minimum specifications:
  - a) Sabal Palms - 44” diameter, 36” height
  - b) Washingtonia Palms - 44” diameter, 36” height
  - c) Cuban Royal Palms, Mediterranean Fan Palms, Cocos Palms - 30” diameter, 30” height

### H. Staking material:

1. Tree stakes shall be commercial grade T-Posts, 1.25 Gauge, 8’ Ht., Green with orange safety caps on tops. Note: Do not drive through stakes through root balls.
2. Tree ties shall be Poly Chain Lock – 1” width, black, ProLock or approved equal
3. Palm stakes shall be treated timber braces, stakes, and battens including burlap protection and steel straps sized per palm planting detail. Ground stakes must be at least 48” in length with at least 42” securely embedded in undisturbed soil.

### I. Edging:

1. Concrete Edging: Extruded, colored, fibermesh reinforced concrete edging (per details) *Curb Appeal (or approved equal)*
2. Tree Rings: 4” Ht., 30” Dia., Black Anodized Aluminum tree rings. *Dreamscapes (or approved equal)*
3. Aluminum edging: 4” Ht., Black Anodized Aluminum Edging. *Dreamscapes (or approved equal)*

## 2.2 PLANTING SOILS

- A. Planting Mix: 75 percent sandy-loam topsoil; 25 percent premium compost; (3:1 ratio by volume); and specified fertilizer or planting tablets.
- B. Shrub and Ground Cover Areas:
  1. Where no topsoil has been installed: Remove twelve inches of existing soil and replace with ten inches of ‘Planting Mix’ as described in Item A above.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verification of Conditions: Examine the site and conditions under which landscape work is to be performed. Have the installer notify the Contractor in writing, with a copy to SSP

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Design if the site is unsatisfactory. Do not begin the work until unsatisfactory conditions have been corrected in a manner acceptable to installer. Beginning of work indicates acceptance of the site as satisfactory by the installer.

### 3.02 EXECUTION

- A. Site Preparation: Contractors must visit and review site prior to bidding. Compacted soils and sub-soils from construction activities must be ripped and tilled until a loose, friable and free-draining condition is met. All existing weeds, grass, stabilized sub-base material, rubble, excavated soil and other material shall be removed from the site and disposed of by the contractor prior to starting any new landscape work. Soil conditions around entire site must be approved by Owner/SSP Design prior to rough and finished grading operations. Contractor shall not install any fill or topsoil in landscape areas prior to site condition approval by Owner/SSP Design.
- B. Drainage: Landscape contractor shall follow grading as shown and specified on Civil Engineer's grading plans. Landscape contractor shall coordinate grading operations with site contractor. Landscape contractor shall ensure final grades conform to the Civil Engineer's grading plan including grades around building, swales, sidewalk under-drains/swales, roof drains, splash blocks and rock swales through planting beds.
- C. Vegetation Protection: Contractors are responsible for protection of existing vegetation labeled on plans "to remain". Protection of existing vegetation includes supply and installation of protective fencing around all existing planting areas.
- D. Bed Preparation and herbicide: All planting areas shall be free of weeds, grass, insects, or any other deleterious material prior to bed preparation. Contractor shall apply herbicide to all planting and lawn areas at least two times prior to installation of any new plants to eradicate all existing weeds and grass. Pre-emergent herbicide shall be applied after planting and before placement of mulch.
- E. Planting Beds: Excavate 12" of existing soil within planting beds and replace with 8" of imported topsoil and 2" of premium compost. Mechanically till into top six inches of bed until a loose, friable soil condition is met. Final grades within all planting beds shall be 2-3" below adjacent curbs to allow for mulch. Contractor to ensure positive drainage throughout all landscape areas. Adjust grades as necessary to direct water away from planting beds. Report any discrepancies on all drainage issues in writing to Construction Manager or the Civil Engineer. Owner or SSP Design to approve planting beds prior to planting operations.
- F. Edging: Edging shall be installed as shown on plans. Edging shall allow for tapered drainage points to ensure free drainage away from all structures and walkways. Edging shall be set flush with adjacent paving, sidewalks or driveways.
- G. Grass Areas: Scarify, float and fine grade all areas to receive sod or hydromulch for approval by SSP prior to placement of sod or application of hydromulch. Supply additional topsoil as necessary to fill any/all low areas and ensure positive drainage away building / planting beds. (see specification on lawns for further requirements).

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- H. Berms and Mounding: Supply topsoil and construct berms as indicated on plans. Berms shall have a maximum slope of 1:4. Owner or Construction manager to approve berming and mounding prior to planting operations.
- I. Planting:
1. Installation:
    - a) Excavate planting pit and french drains to depth and width indicated on details in drawings.
    - b) Set root ball on undisturbed or compacted soil in planting pit. Remove burlap, rope, wire, and all other wrapping material from top of ball. Remove any binding rope which is not biodegradable completely. Top of root ball shall be set 1” above adjacent finished grade.
    - c) Fill planting pit 2/3 full with planting mix, soak with water and allow settling, and adding fertilizer tablets as detailed. Finish filling pit with planting mix and tamp lightly.
    - d) Construct a watering basin as detailed (or install aluminum edge tree ring) and install 2 in. layer of mulch. Water-in to completely saturate the root ball and planting mix. Add planting mix where any settling or air pockets occur.
    - e) Stake all trees/palms immediately after planting as detailed.
  2. Palms: New Washingtonia palms shall be cleaned (skinned) completely of their leafstem bases and fibers to a height 4 feet below the crown. Sabal palms shall be planted with their leafstem bases remaining but cleaned and trimmed evenly. All palms shall be planted with several petioles or fronds tied up straight with natural twine. Remaining fronds shall be trimmed or ‘hurricane cut’ to lighten wind load on terminal bud. Contractor is responsible for removing or cutting the twine supporting the fronds at the appropriate time. All palms must be inspected and approved on site by SSP Design prior to installation.
  3. Shrubs: All plants shall be of species denoted on plans and shall be container-grown material at specified sizes. All plants shall be of size equal or greater than T.A.N. standards for their respective container size. All material shall be vigorous, well established, of good form consistent of species, free of disease and insects, with large healthy root systems and with no evidence of being restricted or damaged. All plants shall be inspected and approved on site by SSP Design prior to installation.
  4. Planting Holes: All tree/palm holes shall be excavated with a diameter at least two times the rootball size and to a depth equal to the height of the rootball. The bottoms and sides of each hole shall be scarified with a pick to allow for free drainage and maximum root penetration. After tree/palm placement, the hole shall be backfilled with a mixture of excavated soil and premium compost mixture (9 Kids Compost or approved equal). All holes shall be tested/inspected by SSP Design for free drainage prior to installation of trees.
  5. Tree Rings: Tree rings shall be installed on trees within grass areas as indicated on plans. Tree rings are to be aluminum edge or extruded concrete per plans and details. A minimum of 2 inches of specified mulch shall be placed within the tree rings. Tree rings must be maintained and kept free of weeds during the entire maintenance period.

## **SECTION 02900 – PLANTING**

- 6. Watering Basins: Watering basins for all trees/palms that do not include an aluminum edge tree ring shall be constructed in a ring shape around each tree or palm trunk. This earthen berm shall be constructed 6” in height and 36” in diameter so as to hold water and allow infiltration around root ball. A minimum of 2 inches of specified mulch shall be placed within the watering basin. Watering basins must be maintained and kept free of weeds during the entire maintenance period.
  
- J. Insect and Disease Control: Apply treatment as frequently as required during construction and 90-day maintenance period to prevent damage to plant material. Use only chemicals specifically approved by TNRCC.
  
- K. Pruning: All existing and new vegetation shall be pruned/trimmed by a Certified I.S.A. Arborist as directed on site by SSP Design.

### **3.03 CLEANUP AND PROTECTION**

- A. Remove debris from landscaped areas daily and sweep clean adjacent pavements, if soiled by landscape activities.
- B. Provide temporary barriers or fences as required to protect landscaping and lawns from any type of damage or theft until final acceptance.

### **3.04 CLOSE-OUT DOCUMENTS**

- A. As-Built Drawings: Submit ‘As-Built’ drawings before project close-out showing the landscape layout, including revised plant material, and other installation information.
- B. Warranty Letters: Submit warranty letters for trees / palms / lawns / shrubs / pavers / stone / amenities.

**END OF SECTION**

## SECTION 02930 – LAWNS

### PART 1 - GENERAL

#### 1.01 SUMMARY

- A. Section Includes: The establishment of a complete and uniform lawn by sodding and/or hydromulching.
- B. Related Sections:
  - 1. Section 02810-Irrigation
  - 2. Section 02900-Planting

#### 1.02 QUALIFICATIONS

- A. Lawn work to be performed by a single firm specializing in commercial landscape work with a minimum of five (5) years experience on similar type projects. Owner/SSP Design to review qualifications and approve subcontractor prior to commencing work.

#### 1.03 SCHEDULE OF VALUES

- A. Landscape subcontractor shall submit costs for GC schedule of values as follows:
  - 1. Irrigation Sleeving
  - 2. Irrigation Water Meter, Backflow, Permits, Testing
  - 3. Irrigation System
  - 4. Landscape Grading and Soil Mix
  - 5. Landscape Planting, Materials, Installation, Warranty
  - 6. Landscape / Irrigation 90 Day Maintenance

#### 1.03 SUBMITTALS

- A. Submittals shall be formatted electronically in a pdf file with a table of contents and tabs identifying each section. The following submittals are required for this section:
  - 1. Product Data: Manufacturer's specifications and application instructions for fertilizer.
  - 2. Hydromulch mixes, percentages, lbs per acre, etc. for SSP review and approval before application.
  - 3. Samples: Topsoil, compost, silica/masonry sand for SSP review and approval before installation.
  - 4. Certificates: Inspection certificate from Texas Department of Agriculture indicating sod has been found free of diseases, insects and larvae.
  - 5. Certificates: Breakdown of seed types, percentages, and mixture composition.
  - 6. Sod Delivery Tickets: One per truckload indicating sod species, nursery certification, date and time of cutting.

#### 1.04 DELIVERY, STORAGE AND HANDLING

- A. Sod Delivery: Have sod delivered within forty-eight hours of cutting. Stack sod with roots to roots, protected from exposure to elements during shipment.



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- B. Storage: Lay sod as soon as practicable after delivery. If installation is delayed more than four hours, store sod under shade and keep constantly moist. Sod must be laid within forty-eight hours of cutting. Do not pile more than two foot depth of sod. Do not tear, stretch or drop sod. Do not allow soil to break free of turf roots.

### 1.05 PROJECT CONDITIONS

- A. Utility Construction: Do not lay sod or begin hydro-mulching until all underlying utility work is complete, trenches backfilled, compacted and graded, and topsoil placed and fine graded and sports fields laser leveled and approved by Owner/SSP.

### 1.06 MAINTENANCE/WARRANTY

- A. Maintenance Service: Maintain the work of this Section throughout construction until the Date of Substantial Completion and ninety (90) days thereafter until a complete and uniform lawn has been established and accepted by the Owner / SSP.
1. Establish hydro-mulched or sodded lawns per planting plans. Reapply hydro-mulch or re-sod as necessary until **full and uniform** coverage is obtained.
  2. Mow general lawn areas **at least once per week** to maintain height of grass at 2 inches or as directed by Owner/SSP. Mowing of general lawn areas may be carried out using standard rotary type mowing equipment.
  3. If included in plans, mow Sports Fields **at least twice per week** to maintain an initial height of 2” for the establishment period then begin lowering the height over the next 90-days to achieve a final height of one inch. Mowing of Sports Field areas shall be carried out using reel type mowers only. Rotary mowers will not be accepted for Sports Field maintenance.
  4. Trim/edge all lawn areas adjacent to watering basins, pavements, driveways, walls, structures, curbs, planting beds, edges and islands.
  5. Provide insect and disease control to maintain health of grass.
  6. Apply pre and post emergent herbicides as required or directed to control weed growth throughout the establishment and maintenance periods.
  7. Fertilize general lawn areas (minimum two applications) with balanced commercial grade lawn fertilizer until complete and uniform coverage is obtained.
  8. If included in plans, fertilize Sports Field areas (minimum four applications) using a high nitrogen formula such as HJ 25-0-0 with Wolfrax or Scotts Sierrablen 27+5+5+Fe or Scotts Fairwaymaster 20+5+8 or approved equal.

***Note: Submit fertilizer type for SSP review and approval prior to application. Depending on time of year, SSP may require a fertilizer that includes pre or post emergent herbicide.***

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9. Verti-cut or de-thatch Sports Field turf at least one time during the maintenance period.
10. Apply top dressing (Mathis Sand per materials schedule) to level any divots, depressions or low spots during the maintenance period. Application of top dressing sand shall be accomplished utilizing a mechanical top dresser (Lely or approved equal). Utilize entire amount of sand mix as specified.
11. Irrigation:
  - a) If the irrigation system is operating, program and monitor the system to provide adequate water for grass.
  - b) If the irrigation system is not operating, hand water grass.
12. Submit receipts/dates of all maintenance operations to SSP Design for approval.
  - B. Warranty: Warranty shall cover all lawn grasses for a period of three months from the date of final acceptance. Final acceptance will not be approved until full and uniform lawns are completely established and proof of all fertilizations including receipts have been reviewed and accepted.

## PART 2 PRODUCTS

### 2.01 MATERIALS

- A. Topsoil: Fertile, agricultural soil, typical for locality, capable of sustaining vigorous plant growth, taken from drained site; free of subsoil, clay or impurities, plants, weeds and roots; minimum pH value of 5.4 and maximum 7.0; organic matter to exceed 1.5%, magnesium to exceed 100 units; phosphorus to exceed 150 units; potassium to exceed 120 units; soluble salts/conductivity not to exceed 900 ppm/0.9 mmhos/cm in soil.

***NOTE: Any use of existing soil from the site must be tested by Texas Plant & Soil Lab in Edinburg, Texas and reviewed / approved by SSP and Owner before any use on site.***

- B. Sand: For athletic/sports fields. Silica sand, clean, screened and free of debris. (Mathis Sand, Wright Materials Plant-3, Tel. (361) 387-0293 or approved equal).
- C. Sod: (See schedule for type). Provide premium #1 certified sod grown in a sod nursery on sandy soil, at least 1 yr. old with a heavy top and a strong, well-knit root system, and not more than five percent weeds or foreign grasses.
- D. Hydromulch Material. Material for hydraulic mulching shall consist of virgin wood fibers manufactured expressly from clean whole wood chips. The chips shall be processed in such a manner as to contain no growth or germination inhibiting factors. Fiber shall not be produced from recycled materials such as sawdust, paper, cardboard, or residue from pulp and pure plants. The wood cellulose fiber mulch shall be dyed green to aid in visual metering during application. The dye shall be biodegradable and not inhibit plant growth. The wood cellulose fibers of the mulch must maintain uniform suspension in water under agitation. Upon application, the moist material shall form a blotter-like mat covering the ground. This mat shall have the characteristics of moisture absorption, percolation, and shall cover and hold seed in contact with the soil. The Contractor shall obtain certifications from suppliers that laboratory, field-testing of their product has been accomplished, and that it meets all of the foregoing requirements pertaining to wood cellulose fiber mulch. Terra-Mulch Terra-Blend with UltraGro or approved equal.

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- E. Fertilizer: Starter fertilizer (BCF 15-15-15) shall be used in hydro-mulch mix. The Contractor shall provide a Soil Analysis Report and shall use report to determine quantity and ratio of fertilizer for sustained growth of grass.
- F. Soil and Mulch Tackifier: Tackifier used with mulch shall be organic. Tackifier shall be mixed and applied with the hydromulch at an appropriate rate to stabilize soils and minimize erosion. Tackifier shall be pH stable with fertilizer and shall hydrate and disperse in mixing tank with water and other materials to form homogeneous slurry. Tackifier shall leave loose, chain-like stabilizing film on surface of soil, allow moisture to percolate into soil during seed germination and seedling growth, and break itself down through microbial action. Tackifier shall not inhibit plant germination or growth.
  - 1. Organic Tackifier. Organic tackifier shall be, starch-based tackifier formulated for use with conventional mulches. Active ingredient in tackifier shall be 100 percent derived from plant starch.
  - 2. Dry powder tackifier shall be blended with insolubilizer. After blending and mixing with water, tackifier shall swell, become sticky, and be suitable for use during heavy rain. Tackifier shall be applied at rate of 80 pounds per acre. Emulsion shall cure on surface of soil and become insoluble. Tackifier shall not inhibit plant germination or growth.
- G. Fertilizer: 12-4-8 (N-P-K), formulated for slow-release Nitrogen.

### PART 3 EXECUTION

#### 3.01 EXAMINATION

- A. Verification of Conditions: Examine the site and conditions under which this work is to be performed. Have the installer notify the Contractor in writing, with a copy to SSP Design, if the site is unsatisfactory. Do not begin the work until unsatisfactory conditions have been corrected in a manner acceptable to installer. Beginning of work indicates acceptance of the site as satisfactory by the installer.

#### 3.02 PREPARATION

- A. Topsoil: Refer to Section 02900 'Landscaping' for topsoil amendment.
- B. Site Preparation: Contractors must visit and review site prior to bidding. Compacted soils and sub-soils from construction activities must be ripped and tilled until a loose, friable and free-draining condition is met. All existing weeds, grass, stabilized sub-base material, rubble, excavated soil and other material shall be removed from the site and disposed of by the contractor prior to starting any new landscape work. Soil conditions around entire site must be approved by SSP Design prior to rough and finished grading operations. Contractor shall not install any fill or topsoil in landscape areas prior to site condition approval by SSP Design.

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### 3.03 INSTALLATION – HYDROMULCH / SOD

- A. All exterior ground within the limit of contract or any damaged adjacent areas, except surfaces occupied by structures and paving, except areas indicated to be undisturbed, shall be seeded, hydromulched, sodded or planted as shown on drawings. Furnish topsoil (if required or specified in plans/schedules), provide finish grading, prepare seed bed, seed, hydromulch, sod and maintain areas as indicated on the drawings.
- B. Lawn Area Preparations - Grade areas to finish grades, filling as needed or removing surplus material. Float all lawn areas to a smooth, uniform grade as indicated on engineers grading plans. All lawn areas shall slope to drain away from structures and planting beds. Where no grades are shown, areas shall have a smooth and continual grade between existing or fixed controls (such as walks, curbs, catch basin, elevational steps or structures) and elevations shown on plans. Contractor to ensure proper drainage around all structures. Adjust grades as necessary to direct water away from structures and planting beds. Report any discrepancies on all drainage issues in writing to SSP Design or the project engineer.
- C. Roll, scarify, rake and level as necessary to obtain true, even lawn surfaces. All finish grades shall meet approval of the SSP, before seeding/hydromulching operations. Loosen soil to a depth of six inches (3") in lawn areas by approved method of scarification and grade to remove edges and depressions. Remove stones or foreign matter over one half inch (1/2") in diameter from the top two inches (2") of soil. Float lawn areas to finish grades as shown on civil plans. Install topsoil over prepared subbase if included in materials schedules or as required to allow for a proper seed bed for germination and strong healthy growth of sod.
- D. Lawn areas should be permitted to settle or should be firmed by rolling before hydromulching or sodding.
- E. Hydromulching shall not be performed in windy weather.
- F. Lawn areas shall be seeded by hydro-mulching evenly with an approved mechanical hydro-mulcher at the rate of a minimum of three (5) pounds per 1,000 square feet. In areas inaccessible to hydro-mulching equipment, the seeded ground shall be lightly raked with flexible rakes and rolled with a water ballast roller. After rolling, seeded areas are to be lightly mulched with wheat straw or approved material.
- G. Lawns shall be maintained by the Contractor for at least 90 days after substantial completion or as long as necessary to establish a uniform stand of the specified grasses, or until final acceptance of lawns, whichever is later.
- H. Water hydromulched / sodded areas to a minimum depth of six inches (6") with a fine spray as necessary to the equivalent of one inch (1") per week. Increase or decrease watering based on season and weather / rainfall amounts.
- I. The surface layer of soil for hydromulched areas must be kept moist during the germination period. Set irrigation controller to short (5 minute) cycles, multiple times per day to keep hydromulch moist but prevent runoff and erosion. Any eroded areas of

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hydromulch must be regraded and re-hydromulched.

- J. Sod shall be installed to all areas as indicated on plans.
- K. Sod Bed Preparation – See A, B, C, D above All lawn areas are to slope to drain.
- L. Sod shall be laid within 48hrs of being cut or 24 hours after delivery to the project site. Only healthy vigorous growing sod is to be laid. Any stressed or yellowing sod shall be rejected.
- M. Always lay sod across slope and tightly together so as to make a solid area. All rolls or pieces of sod must be butt-jointed with no open joints. Any open joints will require clean sand or topsoil fill and re-leveling and rolling.
- N. Roll all new sod sufficiently to set or press sod into underlying soil and provide a smooth and even finished surface. Mechanical 2 ton roller is required.
- O. After sodding has been completed, clean up and thoroughly moisten by sprinkler newly sodded areas.
- P. Make weekly inspections to determine the moisture content of the soil and adjust the watering schedule established by the irrigation system installer to fit conditions
- Q. After grass growth has started, all areas or parts of areas, which fail to show a uniform stand of grass for any reason whatsoever shall be re-hydromulched or sodded in accordance with the plans and as specified herein. Such areas and parts of areas shall be hydromulched or sodded repeatedly until all areas are covered with a full and uniform stand of grass at no additional cost to the Owner.
- R. Watering shall be done in such a manner and as frequently as is deemed necessary by SSP to assure continued growth of healthy grass. All areas of the site shall be watered in such a way as to prevent erosion due to excessive quantities applied over small areas and to avoid damage to the finished surface due to the watering equipment.
- S. Water for the execution and maintenance of this work shall be provided by the Owner at no expense to the Contractor. The Contractor shall, however, furnish his own portable tanks, pumps, hose, pipe, connections, nozzles, and any other equipment required to transport the water from the available outlets and apply it to the seeded area in an approved manner.
- T. Mowing of the seeded, hydromulched or sodded areas shall be initiated when the grass has attained a height of one and one-half to two inches (1-1/2" to 2"). Grass height shall be maintained between one and one and one-half inches (1 to 1½") at subsequent cutting depending on the time of year. Not more than one third (1/3) of the grass leaf shall be removed at any cutting and cutting shall not occur more than seven (7) days apart.
- U. When the amount of grass is heavy, it shall be removed to prevent destruction of the underlying turf. If weeds or other undesirable vegetation threaten to smother or takeover the planted species, such vegetation shall be mowed or, in the case of rank growths, shall be uprooted, raked and removed from the area by methods approved by the SSP.

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- V. Protect hydromulched / sodded areas against trespassing while the grass is germinating and/or growing in. Furnish and install fences, signs, barriers or any other necessary temporary protective devices. Damage resulting from trespass, erosion, washout, settlement or other causes shall be repaired by the Contractor at his expense.
- W. Remove all fences, signs, barriers or other temporary protective devices after final acceptable.

### 3.04 FERTILIZING – GRASS

Fertilizer shall be included in the hydromulch mixture. After full germination and or sodding, all site lawn areas shall have fertilizer applied in two (2) applications and sports field turf shall have four (4) applications with a thorough watering immediately following application. The first application shall be one (1) week after sodding or full germination at the rate of 5 pounds per 1,000 square feet. The second application shall be done after 30 days at the rate of 3 pounds per 1,000 square feet. Sports field fertilization shall continue with a third app after 60 days and fourth app at the 90 day mark. Soil analysis and time of year shall be considered with SSP to determine fertilizer type, composition and final application rates . Submit fertilizer type and analysis to SSP for approval before any application. Document fertilizer application with photos and receipts of fertilizer purchases.

### 3.05 CLEANUP AND PROTECTION

- A. Remove debris from landscaped areas daily and sweep clean adjacent pavements, if soiled by landscape activities.
- B. Protect lawns from damage, theft or vandalism until final acceptance. Install stakes and flagging or temporary fencing if required to keep traffic off newly established lawn areas

**END OF SECTION**

## SECTION 03 10 00

### CONCRETE FORMS AND ACCESSORIES

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Formwork for cast-in place concrete.
  - 2. Shoring, bracing, and anchorage.
  - 3. Architectural form liners.
  - 4. Form accessories.
  - 5. Form stripping.
- B. Related Sections:
  - 1. Section 032000 - Concrete Reinforcement.
  - 2. Section 033000 - Cast-in-Place Concrete.

##### 1.2 REFERENCES

- A. American Concrete Institute:
  - 1. ACI 117 - Standard Specifications for Tolerances for Concrete Construction and Materials.
  - 2. ACI 301 - Specifications for Structural Concrete.
  - 3. ACI 318 - Building Code Requirements for Structural Concrete.
  - 4. ACI 347 - Guide to Formwork for Concrete.
- B. American Forest and Paper Association:
  - 1. AF&PA - National Design Specifications for Wood Construction.
- C. The Engineered Wood Association:
  - 1. APA/EWA PS 1 - Voluntary Product Standard for Construction and Industrial Plywood.
- D. ASTM International:
  - 1. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
  - 2. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.
- E. West Coast Lumber Inspection Bureau:
  - 1. WCLIB - Standard Grading Rules for West Coast Lumber.

### 1.3 DESIGN REQUIREMENTS

- A. Design, engineer and construct formwork, shoring and bracing in accordance with ACI 318 to conform to design and applicable code requirements to achieve concrete shape, line and dimension as indicated on Drawings.

### 1.4 PERFORMANCE REQUIREMENTS

- A. Vapor Retarder Permeance: Maximum .03 perms when tested in accordance with ASTM E96, Procedure A.

### 1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with ACI 347 ACI 301 ACI 318.
- B. For wood products furnished for work of this Section, comply with AF&PA.
- C. Perform Work in accordance with State Municipality of Highways Public Work's standard.

### 1.6 COORDINATION

- A. Section 013000 - Administrative Requirements: Coordination and project conditions.
- B. Coordinate this Section with other sections of work, requiring attachment of components to formwork.

## PART 2 PRODUCTS

### 2.1 WOOD FORM MATERIALS

- A. Form Materials: At discretion of Contractor.

### 2.2 FORMWORK ACCESSORIES

- A. Vapor Retarder: Where indicated on Drawings, 10 mil thick polyethylene sheet manufacture by:
  - 1. Stego Wrap Class A: by Stego Industries LLC (887) 464-7834
  - 2. Griffolyn by Reef Industries (800) 231-6074
  - 3. VaporBlock 10 by Raven Industries (800) 635-3456
  - 4. Perminator Vapor – May by W.R. Meadows (800) 342-5976
  - 5. Xtreme by Tex-Trude (281) 452-5961
  - 6. Or Equivalent
- B. Bituminous Joint Filler: ASTM D1751.



- C. Nails, Spikes, Lag Bolts, Through Bolts, Anchorages: Size, strength and character to maintain formwork in place while placing concrete.
- D. Water Stops: Rubber Polyvinyl chloride, minimum 1,750 psi tensile strength, minimum 50 degrees F to plus 175 degrees F working temperature range, inch wide, maximum possible lengths, ribbed profile, preformed corner sections, heat welded jointing.

\*\*\*\*\* OR \*\*\*\*\*

- E. Waterstop: Flexible strip of bentonite waterproofing compound in coil form for joints in concrete construction.
  - 1. Colloid Environmental Technologies Company Model.
  - 2. TC MiraDRi Model.
  - 3. Paramount Technical Products Model.
  - 4. Substitutions: Section 016000 - Product Requirements Not Permitted.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Section 013000 - Administrative Requirements: Coordination and project conditions.
- B. Verify lines, levels, and centers before proceeding with formwork. Verify dimensions agree with Drawings.
- C. When formwork is placed after reinforcement resulting in insufficient concrete cover over reinforcement before proceeding, request instructions from Architect/Engineer.

### 3.2 INSTALLATION

- A. Earth Forms:
  - 1. Earth forms are not permitted.
- B. Formwork - General:
  - 1. Provide top form for sloped surfaces steeper than 1.5 horizontal to 1 vertical to hold shape of concrete during placement, unless it can be demonstrated that top forms can be omitted.
  - 2. Construct forms to correct shape and dimensions, mortar-tight, braced, and of sufficient strength to maintain shape and position under imposed loads from construction operations.
  - 3. Camber forms where necessary to produce level finished soffits unless otherwise shown on Drawings.
  - 4. Carefully verify horizontal and vertical positions of forms. Correct misaligned or misplaced forms before placing concrete.
  - 5. Complete wedging and bracing before placing concrete.
- C. Forms for Smooth Finish Concrete:
  - 1. Use steel, plywood or lined board forms.

2. Use clean and smooth plywood and form liners, uniform in size, and free from surface and edge damage capable of affecting resulting concrete finish.
  3. Install form lining with close-fitting square joints between separate sheets without springing into place.
  4. Use full size sheets of form lines and plywood wherever possible.
  5. Tape joints to prevent protrusions in concrete.
  6. Use care in forming and stripping wood forms to protect corners and edges.
  7. Level and continue horizontal joints.
  8. Keep wood forms wet until stripped.
- D. Erect formwork, shoring, and bracing to achieve design requirements, in accordance with requirements of ACI 301 ACI 318.
- E. Arrange and assemble formwork to permit dismantling and stripping. Do not damage concrete during stripping. Permit removal of remaining principal shores.
- F. Obtain Architect/Engineer's approval before framing openings in structural members not indicated on Drawings.
- G. Install fillet and chamfer strips on external corners of beams joists columns and.
- H. Install void forms in accordance with manufacturer's recommendations.
1. SureVoid Products, Inc., Englewood, CO (800) 458-5444.
- I. Do not reuse wood formwork more than times for concrete surfaces to be exposed to view. Do not patch formwork.

### 3.3 APPLICATION - FORM RELEASE AGENT

- A. Apply form release agent on formwork in accordance with manufacturer's recommendations.
- B. Apply prior to placement of reinforcing steel, anchoring devices, and embedded items.
- C. Do not apply form release agent where concrete surfaces are indicated to receive special finishes or applied coverings that are affected by agent. Soak inside surfaces of untreated forms with clean water. Keep surfaces coated prior to placement of concrete.
- D. Reuse and Coating of Forms: Thoroughly clean forms and reapply form coating before each reuse. For exposed work, do not reuse forms with damaged faces or edges. Apply form coating to forms in accordance with manufacturer's specifications. Do not coat forms for concrete indicated to receive "scored finish". Apply form coatings before placing reinforcing steel.

### 3.4 INSTALLATION - INSERTS, EMBEDDED PARTS, AND OPENINGS

- A. Install formed openings for items to be embedded in or passing through concrete work.
- B. Locate and set in place items required to be cast directly into concrete.

- C. Coordinate with Work of other sections in forming and placing openings, slots, reglets, recesses, sleeves, bolts, anchors, other inserts, and components of other Work.
- D. Install accessories straight, level, and plumb. Ensure items are not disturbed during concrete placement.
- E. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection. Locate openings at bottom of forms to allow flushing water to drain.
- F. Close temporary openings with tight fitting panels, flush with inside face of forms, and neatly fitted so joints will not be apparent in exposed concrete surfaces.
- G. Form Ties:
  - 1. Use sufficient strength and sufficient quantity to prevent spreading of forms.
  - 2. Place ties at least 1 inch away from finished surface of concrete.
  - 3. Leave inner rods in concrete when forms are stripped.
  - 4. Space form ties equidistant, symmetrical and aligned vertically and horizontally unless otherwise shown on Drawings.
- H. Arrangement: Arrange formwork to allow proper erection sequence and to permit form removal without damage to concrete.
- I. Construction Joints:
  - 1. Install surfaced pouring strip where construction joints intersect exposed surfaces to provide straight line at joints.
  - 2. Just prior to subsequent concrete placement, remove strip and tighten forms to conceal shrinkage.
  - 3. Show no overlapping of construction joints. Construct joints to present same appearance as butted plywood joints.
  - 4. Arrange joints in continuous line straight, true and sharp.
- J. Openings for Items Passing Through Concrete:
  - 1. Frame openings in concrete where indicated on Drawings. Establish exact locations, sizes, and other conditions required for openings and attachment of work specified under other sections.
  - 2. Coordinate work to avoid cutting and patching of concrete after placement.
  - 3. Perform cutting and repairing of concrete required as result of failure to provide required openings.
- K. Screeds:
  - 1. Set screeds and establish levels for tops of concrete slabs and levels for finish on slabs.
  - 2. Slope slabs to drain where required or as shown on Drawings.
  - 3. Before depositing concrete, remove debris from space to be occupied by concrete and thoroughly wet forms. Remove freestanding water.
- L. Screed Supports:
  - 1. For concrete over waterproof membranes and vapor retarder membranes, use cradle, pad or base type screed supports which will not puncture membrane.

2. Staking through membrane is not be permitted.

M. Cleanouts and Access Panels:

1. Provide removable cleanout sections or access panels at bottoms of forms to permit inspection and effective cleaning of loose dirt, debris and waste material.
2. Clean forms and surfaces against which concrete is to be placed. Remove chips, saw dust and other debris. Thoroughly blow out forms with compressed air just before concrete is placed.

3.5 FORM CLEANING

- A. Clean forms as erection proceeds, to remove foreign matter within forms.
- B. Clean formed cavities of debris prior to placing concrete.
- C. Flush with water or use compressed air to remove remaining foreign matter. Ensure that water and debris drain to exterior through clean-out ports.

3.6 FORM REMOVAL

- A. Do not remove forms or bracing until concrete has gained sufficient strength to carry its own weight and imposed loads and removal has been approved by Architect/Engineer.
- B. Loosen forms carefully. Do not wedge pry bars, hammers, or tools against finish concrete surfaces scheduled for exposure to view.
- C. Store removed forms in manner that surfaces to be in contact with fresh concrete will not be damaged. Discard damaged forms.
- D. Leave forms in place for minimum number of days as specified in ACI 347.

3.7 ERECTION TOLERANCES

- A. Construct formwork to maintain tolerances required by ACI 301 ACI 318.

\*\*\*\*\* OR \*\*\*\*\*

- B. Camber slabs and beams 1/4 inch per 10 feet in accordance with ACI 301 ACI 318.

3.8 FIELD QUALITY CONTROL

- A. Section 014000 - Quality Requirements 017000 - Execution Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Inspect erected formwork, shoring, and bracing to ensure that work is in accordance with formwork design, and that supports, fastenings, wedges, ties, and items are secure.
- C. Notify Architect/Engineer after placement of reinforcing steel in forms, but prior to placing concrete.

- D. Schedule concrete placement to permit formwork inspection before placing concrete.

END OF SECTION

## SECTION 03 20 00

### CONCRETE REINFORCING

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Reinforcing bars.
  - 2. Welded wire fabric.
  - 3. Reinforcement accessories.
- B. Related Sections:
  - 1. Section 031000 - Concrete Forms and Accessories.
  - 2. Section 033000 - Cast-in-Place Concrete.
  - 3. Section 033500 - Concrete: Reinforcement for concrete floor toppings.

##### 1.2 REFERENCES

- A. American Concrete Institute:
  - 1. ACI 301 - Specifications for Structural Concrete.
  - 2. ACI 318 - Building Code Requirements for Structural Concrete.
  - 3. ACI 530.1 - Specifications for Masonry Structures.
  - 4. ACI SP-66 - ACI Detailing Manual.
- B. ASTM International:
  - 1. ASTM A82 - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
  - 2. ASTM A184/A184M - Standard Specification for Fabricated Deformed Steel Bar Mats for Concrete Reinforcement.
  - 3. ASTM A496 - Standard Specification for Steel Wire, Deformed, for Concrete Reinforcement.
  - 4. ASTM A497 - Standard Specification for Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement.
  - 5. ASTM A615/A615M - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
  - 6. ASTM A704/A704M - Standard Specification for Welded Steel Plain Bar or Rod Mats for Concrete Reinforcement.
  - 7. ASTM A706/A706M - Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.
  - 8. ASTM A767/A767M - Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement.
  - 9. ASTM A775/A775M - Standard Specification for Epoxy-Coated Reinforcing Steel Bars.
  - 10. ASTM A884/A884M - Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Fabric for Reinforcement.

11. ASTM A934/A934M - Standard Specification for Epoxy-Coated Prefabricated Steel Reinforcing Bars.
  12. ASTM A996/A996M - Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement.
  13. ASTM D3963/D3963M - Standard Specification for Fabrication and Jobsite Handling of Epoxy-Coated Reinforcing Steel Bars.
- C. American Welding Society:
1. AWS D1.4 - Structural Welding Code - Reinforcing Steel.
- D. Concrete Reinforcing Steel Institute:
1. CRSI - Manual of Standard Practice.
  2. CRSI - Placing Reinforcing Bars.

### 1.3 SUBMITTALS

- A. Section 013300 - Submittal Procedures: Submittal procedures.
- B. Shop Drawings: Indicate bar sizes, spacings, locations, and quantities of reinforcing steel and welded wire fabric, bending and cutting schedules, and supporting and spacing devices.
- C. Certificates: Submit AWS qualification certificate for welders employed on the Work.
- D. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.
  1. Submit certified copies of mill test report of reinforcement materials analysis.

### 1.4 QUALITY ASSURANCE

- A. Perform Work in accordance with CRSI - Manual of Standard Practice, ACI 301, and ACI 318.
- B. Prepare shop drawings in accordance with ACI SP-66.

### 1.5 QUALIFICATIONS

- A. Welders: AWS qualified within previous 12 months.

### 1.6 COORDINATION

- A. Section 013000 - Administrative Requirements: Coordination and project conditions.
- B. Coordinate with placement of formwork, formed openings and other Work.

## PART 2 PRODUCTS

### 2.1 REINFORCEMENT

- A. Deformed and Plain Reinforcement: ASTM A615/A615M; 60 ksi yield strength, steel bars, unfinished.

### 2.2 ACCESSORY MATERIALS

- A. Tie Wire: Minimum 16 gage annealed.
- B. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for strength and support of reinforcement during concrete placement conditions including load bearing pad on bottom to prevent vapor retarder puncture.
- C. Special Chairs, Bolsters, Bar Supports, Spacers Adjacent to Weather Exposed Concrete Surfaces: Plastic tipped steel; size and shape to meet Project conditions.
- D. Reinforcing Splicing Devices: Mechanical type; full tension and compression; sized to fit joined reinforcing.
- E. Epoxy Coating Patching Material: Type as recommended by coating manufacturer.

### 2.3 FABRICATION

- A. Fabricate concrete reinforcement in accordance with CRSI Manual of Practice, and ACI 318, on and all applicable codes.
- B. Form standard hooks for 180 degree bends, 90 degree bend, stirrup and tie hooks, and seismic hooks as indicated on Drawings.
- C. Form reinforcement bends with minimum diameters in accordance with ACI 318 and all applicable codes.
- D. Fabricate column reinforcement with offset bends at reinforcement splices.
- E. Form spiral column reinforcement from minimum 3/8 inch diameter continuous deformed bar or wire.
- F. Form ties and stirrups from the following:
  - 1. For bars No. 10 and Smaller: No. 3 deformed bars.
  - 2. For bars No. 11 and Larger: No. 4 deformed bars.
- G. Weld reinforcement in accordance with AWS D1.4.
- H. Galvanized Epoxy-Coated Reinforcement: Clean surfaces, weld and re-protect welded joint in accordance with CRSI.



- I. Locate reinforcement splices not indicated on Drawings, at point of minimum stress. Review location of splices with Architect/Engineer.

2.4 SOURCE QUALITY CONTROL

- A. Section 014000 - Quality Requirements: Testing, inspection and analysis requirements.
- B. Make completed reinforcement available for inspection at manufacturer's factory prior to packaging for shipment. Notify Architect/Engineer at least seven days before inspection is allowed.
- C. When fabricator is approved by authority having jurisdiction, submit certificate of compliance indicating Work performed at fabricator's facility conforms to Contract Documents.
  - 1. Specified shop tests are not required for Work performed by approved fabricator.

PART 3 EXECUTION

3.1 PLACEMENT

- A. Place, support and secure reinforcement against displacement. Do not deviate from required position beyond specified tolerance.
  - 1. Do not weld crossing reinforcement bars for assembly.
- B. Do not displace or damage vapor retarder.
- C. Accommodate placement of formed openings.
- D. Space reinforcement bars with minimum clear spacing in accordance with ACI 318 of one bar diameter, but not less than 1 inch.
  - 1. Where bars are indicated in multiple layers, place upper bars directly above lower bars.
- E. Maintain concrete cover around reinforcement in accordance with ACI 318 applicable code as follows:

Footings and Concrete Formed Against Earth		3 inches
Concrete exposed to earth or weather	No. 6 bars and larger	2 inches
	No. 5 bars and smaller	1-1/2 inches
Supported Slabs, Walls, and Joists	No. 14 bars and larger	1-1/2 inches
	No. 11 bars and smaller	3/4 inches
Beams and Columns		1-1/2 inches
Shell and Folded	No. 6 bars and larger	3/4 inches

Plate Members	No. 5 bars and smaller	1/2 inches
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### 3.2 ERECTION TOLERANCES

- A. Section 014000 - Quality Requirements: Tolerances.
- B. Install reinforcement within the following tolerances for flexural members, walls, and compression members:

Reinforcement Depth	Depth Tolerance	Concrete Cover Tolerance
Greater than 8 inches	plus or minus 3/8 inch	minus 3/8 inch
Less than 8 inches	plus or minus 1/2 inch	minus 1/2 inch

- C. Install reinforcement within the tolerances specified in ACI 530.1 for foundation walls.

### 3.3 FIELD QUALITY CONTROL

- A. Section 014000 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Field inspection and testing will be performed by Owner's testing laboratory in accordance with ACI 318 and IBC 2018.
- C. Provide free access to Work and cooperate with appointed firm.
- D. Reinforcement Inspection:
  1. Placement Acceptance: Specified and ACI 318 material requirements and specified placement tolerances.
  2. Welding: Inspect welds in accordance with AWS D1.1.
  3. Periodic Placement Inspection: Inspect for correct materials, fabrication, sizes, locations, spacing, concrete cover, and splicing.
  4. Weldability Inspection: Inspect for reinforcement weldability when formed from steel other than ASTM A706/A706M.
  5. Continuous Weld Inspection: Inspect reinforcement as required by ACI 318.
  6. Periodic Weld Inspection: Other welded connections.

### 3.4 SCHEDULES

- A. Reinforcement For Superstructure Framing Members: Deformed bars, unfinished.
- B. Reinforcement For Foundation Wall Framing Members and Slab-on-Grade: Deformed bars and wire fabric, galvanized finish.
- C. Reinforcement For Parking Structure Framing Members: Deformed bars, epoxy-coated finish.

END OF SECTION

## SECTION 03 30 00

### CAST-IN-PLACE CONCRETE

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section includes cast-in-place concrete for the following:
  - 1. Foundation walls.
  - 2. Supported slabs.
  - 3. Slabs on grade.
  - 4. Control, expansion and contraction joint devices.
  - 5. Equipment pads.
  - 6. Light pole base.
  - 7. Flagpole base.
  
- B. Related Sections:
  - 1. Section 031000 - Concrete Forms and Accessories: Formwork and accessories. Placement of joint device joint device anchors in formwork.
  - 2. Section 032000 - Concrete Reinforcement.
  - 3. Section 033500 - Concrete Finishing.
  - 4. Section 033900 - Concrete Curing.

##### 1.2 REFERENCES

- A. American Concrete Institute:
  - 1. ACI 301 - Specifications for Structural Concrete.
  - 2. ACI 305 - Hot Weather Concreting.
  - 3. ACI 306.1 - Standard Specification for Cold Weather Concreting.
  - 4. ACI 308.1 - Standard Specification for Curing Concrete.
  - 5. ACI 318 - Building Code Requirements for Structural Concrete.
  
- B. ASTM International:
  - 1. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
  - 2. ASTM C31/C31M - Standard Practice for Making and Curing Concrete Test Specimens in the Field.
  - 3. ASTM C33 - Standard Specification for Concrete Aggregates.
  - 4. ASTM C39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
  - 5. ASTM C42/C42M - Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
  - 6. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete.
  - 7. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic Cement Concrete.
  - 8. ASTM C150 - Standard Specification for Portland Cement.
  - 9. ASTM C172 - Standard Practice for Sampling Freshly Mixed Concrete.

10. ASTM C173/C173M - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.
11. ASTM C231 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
12. ASTM C260 - Standard Specification for Air-Entraining Admixtures for Concrete.
13. ASTM C330 - Standard Specification for Lightweight Aggregates for Structural Concrete.
14. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete.
15. ASTM C595 - Standard Specification for Blended Hydraulic Cements.
16. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete.
17. ASTM C685/C685M - Standard Specification for Concrete Made By Volumetric Batching and Continuous Mixing.
18. ASTM C845 - Standard Specification for Expansive Hydraulic Cement.
19. ASTM C989 - Standard Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars.
20. ASTM C1017/C1017M - Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.
21. ASTM C1064/C1064M - Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete.
22. ASTM C1107 - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
23. ASTM C1116 - Standard Specification for Fiber-Reinforced Concrete and Shotcrete.
24. ASTM C1157 - Standard Performance Specification for Hydraulic Cement.
25. ASTM C1218 - Standard Test Method for Water-Soluble Chloride in Mortar and Concrete.
26. ASTM C1240 - Standard Specification for Silica Fume Used in Cementitious Mixtures.
27. ASTM D994 - Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type).
28. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
29. ASTM D1752 - Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.
30. ASTM D6690 - Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements.
31. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.
32. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
33. ASTM E1643 - Standard Practice for Installation of Water Vapor Retarders Used in Contact with Earth or Granular Fill under Concrete Slabs.
34. ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs.

### 1.3 PERFORMANCE REQUIREMENTS

- A. Vapor Retarder Permeance: Maximum .03 perm when tested in accordance with ASTM E96.

### 1.4 SUBMITTALS

- A. Section 013300 - Submittal Procedures: Submittal procedures.
- B. Product Data: Submit data on joint devices, attachment accessories, admixtures.
- C. Design Data:
  - 1. Submit concrete mix design for each concrete strength. Submit separate mix designs when admixtures are required for the following:
    - a. Hot and cold weather concrete work.
    - b. Air entrained concrete work.
  - 2. Identify mix ingredients and proportions, including admixtures.
  - 3. Identify chloride content of admixtures and whether or not chloride was added during manufacture.
- D. Manufacturer's Installation Instructions: Submit installation procedures and interface required with adjacent Work.

### 1.5 CLOSEOUT SUBMITTALS

- A. Section 017000 - Execution Requirements: Closeout procedures.
- B. Project Record Documents: Accurately record actual locations of embedded utilities and components concealed from view in finished construction.

### 1.6 QUALITY ASSURANCE

- A. Perform Work in accordance with ACI 301 and ACI 318.
- B. Conform to ACI 305 when concreting during hot weather.
- C. Conform to ACI 306.1 when concreting during cold weather.
- D. Acquire cement and aggregate from one source for Work.

### 1.7 COORDINATION

- A. Section 013000 - Administrative Requirements: Coordination and project conditions.

- B. Coordinate placement of joint devices with erection of concrete formwork and placement of form accessories.

## 1.8 ENVIRONMENTAL REQUIREMENTS

- A. Section 016000 - Product Requirements: Environmental conditions affecting products on site.
- B. Maintain concrete temperature after installation at minimum 50 degrees F for minimum 7 days.

## 1.9 COORDINATION

- A. Section 013000 - Administrative Requirements: Coordination and project conditions.
- B. Coordinate placement of joint devices with erection of concrete formwork and placement of form accessories.

## PART 2 PRODUCTS

### 2.1 CONCRETE MATERIALS

- A. Cement: ASTM C150, Type I - Normal
- B. Normal Weight Aggregates: ASTM C33.
  - 1. Coarse Aggregate Maximum Size: 1.5
- C. Water: ACI 318; potable, without deleterious amounts of chloride ions.

### 2.2 ADMIXTURES

- A. Air Entrainment: ASTM C260.
- B. Fly Ash: ASTM C618 type C or F.
- C. Silica Fume: ASTM C1240.

### 2.3 ACCESSORIES

- A. Vapor Retarder: ASTM E1745 Class A; 10 mil thick; type recommended for below grade application. Furnish joint tape recommended by manufacturer.
- B. Non-Shrink Grout: ASTM C1107, premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents; capable of developing minimum compressive strength of 2,400 psi in 48 hours and 7,000 psi in 28 days.

2.4 JOINT DEVICES AND FILLER MATERIALS

A. Joint Filler; Asphalt impregnated fiberboard or felt, tongue and groove profile.

\*\*\*\*\* OR \*\*\*\*\*

B. Joint Filler: ASTM D1752; Closed cell, resiliency of 95 percent if not compressed more than 50 percent of original thickness.

C. Sealant: ASTM C309, Type I approved by Asphalt and Vinyl composition Tile Institute, 30% minimum solids content.

2.5 CONCRETE MIX

A. Select proportions for normal weight concrete in accordance with ACI 301 Method 1

B. Provide concrete for the following criteria:

Foundation

Material and Property	Measurement
Compressive Strength (7 day)	2100 psi
Compressive Strength (28 day)	3000 psi
Cement Type	ASTM C150
Aggregate Size (maximum)	1.5 inch
Air Content	Do not use air entrainment for concrete mixes.
Slump	4-6 inches

2<sup>nd</sup> Floor Slab / Piers

Material and Property	Measurement
Compressive Strength (7 day)	2800 psi
Compressive Strength (28 day)	4000 psi
Cement Type	ASTM C150
Aggregate Size (maximum)	1.5 inch
Air Content	Do not use air entrainment for concrete mixes.
Slump	4-6 inches



- C. Admixtures: Include admixture types and quantities indicated in concrete mix designs only when approved by Architect/Engineer.
  - 1. Use accelerating admixtures in cold weather. Use of admixtures will not relax cold weather placement requirements.
  - 2. Do not use calcium chloride nor admixtures containing calcium chloride.
  - 3. Use set retarding admixtures during hot weather.
- D. Site Mixed Concrete: No site mixed concrete is allowed.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Section 013000 - Administrative Requirements: Coordination and project conditions.
- B. Verify requirements for concrete cover over reinforcement.
- C. Verify anchors, seats, plates, reinforcement and other items to be cast into concrete are accurately placed, positioned securely, and will not interfere with placing concrete.

### 3.2 PREPARATION

- A. Prepare previously placed concrete by cleaning with steel brush and applying bonding agent. Remove laitance, coatings, and unsound materials.
- B. In locations where new concrete is doweled to existing work, drill holes in existing concrete, insert steel dowels and pack solid with non-shrink grout.
- C. Remove debris and ice from formwork, reinforcement, and concrete substrates.
- D. Remove water from areas receiving concrete before concrete is placed.

### 3.3 PLACING CONCRETE

- A. Place concrete in accordance with ACI 301.
- B. Notify testing laboratory and Architect/Engineer minimum 24 hours prior to commencement of operations.
- C. Ensure reinforcement, inserts, embedded parts, formed expansion and contraction joints, and are not disturbed during concrete placement.
- D. Install vapor retarder under interior slabs on grade in accordance with ASTM E1643. Lap joints minimum 6 inches and seal watertight by adhesive applied between overlapping edges and ends as per manufacturer recommendations.
- E. Repair vapor retarder damaged during placement of concrete reinforcing. Repair with vapor retarder material; lap over damaged areas minimum 6 inches and seal watertight.

- F. Install construction joint devices in coordination with floor slab pattern placement sequence. Set top to required elevations. Secure to resist movement by wet concrete.
- G. Install joint device anchors. Maintain correct position to allow joint cover to be flush with floor finish.
- H. Install joint covers in one piece longest practical length, when adjacent construction activity is complete.
- I. Deposit concrete at final position. Prevent segregation of mix.
- J. Place concrete in continuous operation for each panel or section determined by predetermined joints.
- K. Consolidate concrete.
- L. Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken.
- M. Place concrete continuously between predetermined expansion, control, and construction joints.
- N. Do not interrupt successive placement; do not permit cold joints to occur.
- O. Saw cut joints within 12 hours after placing. Use 3/16 inch thick blade, cut into 1/4 depth of slab thickness.
- P. Screed floors and slabs on grade level, maintaining surface flatness of  $F_f$  of 35.

#### 3.4 CONCRETE FINISHING

- A. Finish concrete floor surfaces to requirements of Section 03350.
- B. In areas with floor drains, maintain floor elevation at walls; pitch surfaces uniformly to drains.

#### 3.5 CURING AND PROTECTION

- A. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.
  - 1. Protect concrete footings from freezing for minimum 5 days.
- B. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.
- C. Cure floor surfaces as specified in Section 03390.
- D. Ponding: Maintain 100 percent coverage of water over floor slab areas continuously for 7 days.

E. Spraying: Spray water over floor slab areas and maintain wet for 7 days.

### 3.6 FIELD QUALITY CONTROL

A. Section 014000 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.

B. Field inspection and testing will be performed by Owner's testing laboratory in accordance with ACI 318

C. Provide free access to Work and cooperate with appointed firm.

D. Submit proposed mix design of each class of concrete to inspection and testing firm for review prior to commencement of Work.

E. Concrete Inspections:

1. Continuous Placement Inspection: Inspect for proper installation procedures.
2. Periodic Curing Inspection: Inspect for specified curing temperature and procedures.

F. Strength Test Samples:

1. Sampling Procedures: ASTM C172.
2. Cylinder Molding and Curing Procedures: ASTM C31/C31M, cylinder specimens, standard cured field cured.
3. Sample concrete and make one set of three cylinders for every 150 cu yds or less of each class of concrete placed each day and for every 5,000 sf of surface area for slabs and walls.
4. When volume of concrete for any class of concrete would provide less than 3 sets of cylinders, take samples from three randomly selected batches, or from every batch when less than 3 batches are used.
5. Make one additional cylinder during cold weather concreting, and field cure.

G. Field Testing:

1. Slump Test Method: ASTM C143/C143M.
2. Air Content Test Method: ASTM C173/C173M.
3. Temperature Test Method: ASTM C1064/C1064M.
4. Measure slump and temperature for each compressive strength concrete sample.
5. Measure air content in air entrained concrete for each compressive strength concrete sample.

H. Cylinder Compressive Strength Testing:

1. Test Method: ASTM C39.
2. Test Acceptance: In accordance with ACI 318 .
3. Test one cylinder at 7 days.
4. Test two cylinders at 28 days.
5. Dispose remaining cylinders when testing is not required.

I. Core Compressive Strength Testing:

1. Sampling and Testing Procedures: ASTM C42/C42M.

2. Test Acceptance: In accordance with ACI 318.
  3. Drill three cores for each failed strength test from concrete represented by failed strength test.
- J. Water Soluble Chloride Ion Concentration Test Method: ASTM C1218; tested at 28 days.
1. Maximum Concentration: As permitted by applicable code.
- K. Maintain records of concrete placement. Record date, location, quantity, air temperature and test samples taken.

### 3.7 PATCHING

- A. Allow Architect/Engineer to inspect concrete surfaces immediately upon removal of forms.
- B. Excessive honeycomb or embedded debris in concrete is not acceptable. Notify Architect/Engineer upon discovery.
- C. Patch imperfections as directed by Architect/Engineer

### 3.8 DEFECTIVE CONCRETE

- A. Defective Concrete: Concrete not conforming to required lines, details, dimensions, tolerances or specified requirements.
- B. Repair or replacement of defective concrete will be determined by Architect/Engineer.
- C. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of Architect/Engineer for each individual area.

### 3.9 SCHEDULE - CONCRETE TYPES AND FINISHES

- A. Foundation Walls: 3,000 psi 28 day concrete, form finish with honeycomb filled surface.
- B. Underside of Supported Floors and Structure Exposed to View: 4,000 psi 28 day concrete, sack rubbed finish.
- C. Exposed Portico Structure: 4,000 psi 28 day concrete, air entrained, smooth stone rubbed finish.

### 3.10 SCHEDULE - JOINT FILLERS

- A. Basement Floor Slab Perimeter: Joint filler Type A set 1/8 inch below floor slab elevation.
- B. Exterior Retaining Wall at Loading Dock: Joint filler Type F recessed 3/8 inch with sealant cover.

END OF SECTION

## SECTION 03 35 00

### CONCRETE FINISHING

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Finishing concrete floors and floor toppings.
  - 2. Floor surface treatment.
- B. Related Sections:
  - 1. Section 033000 - Cast-in-Place Concrete: Prepared concrete floors ready to receive finish; control and formed expansion and contraction joints and joint devices.
  - 2. Section 03360 - Concrete Finishes: Exposed aggregate finish.
  - 3. Section 033900 - Concrete Curing.
  - 4. Section 079513 - Expansion Joint Cover Assemblies.
  - 5. Section 079200 - Joint Sealers.

##### 1.2 REFERENCES

- A. American Concrete Institute:
  - 1. ACI 301 - Specifications for Structural Concrete.
  - 2. ACI 302.1 - Guide for Concrete Floor and Slab Construction.
- B. ASTM International:
  - 1. ASTM E1155 - Standard Test Method for Determining Floor Flatness and of Levelness Using the F-number System.

##### 1.3 SUBMITTALS

- A. Section 013300 - Submittal Procedures: Submittal procedures.
- B. Product Data: Submit data on concrete hardener, sealer, curing compounds curing papers and slip resistant treatment, compatibilities, and limitations.

##### 1.4 CLOSEOUT SUBMITTALS

- A. Section 017000 - Execution Requirements: Closeout procedures.
- B. Operation and Maintenance Data: Submit data on maintenance renewal of applied coatings.

##### 1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with ACI 301 and ACI 302.1.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Section 016000 - Product Requirements: Product storage and handling requirements.
- B. Deliver materials in manufacturer's packaging including application instructions.

## 1.7 ENVIRONMENTAL REQUIREMENTS

- A. Section 016000 - Product Requirements: Environmental conditions affecting products on site.

## 1.8 COMPOUNDS - HARDENERS AND SEALERS

- A. Chemical Hardener: Magnesium fluorosilicate and zinc fluorosilicate blend

## PART 2 EXECUTION

### 2.1 EXAMINATION

- A. Section 013000 - Administrative Requirements: Coordination and project conditions.
- B. Verify floor surfaces are acceptable to receive the Work of this section.

### 2.2 FLOOR FINISHING

- A. Finish concrete floor surfaces in accordance with ACI 301 and ACI 302.1.
- B. Wood float surfaces receiving quarry tile, ceramic tile, and cementitious terrazzo with full bed setting system.
- C. Steel trowel surfaces receiving carpeting, resilient flooring, seamless flooring, thin set terrazzo, thin set quarry tile, and thin set ceramic tile.
- D. Steel trowel surfaces which are scheduled to be exposed.

### 2.3 TOLERANCES

- A. Section 014000 - Quality Requirements: Tolerances.
- B. Measure for F(F) and F(L) tolerances for floors in accordance with ASTM E1155, within 48 hours after slab installation.
- C. Finish concrete to achieve the following tolerances:
  - 1. Under Glazed Tile on Setting Bed: F(F) 35 and F(L) 20.
  - 2. Under Resilient Finishes: F(F) 75 and F(L) 50.
  - 3. Exposed to View and Foot Traffic: F(F) 75 and F(L) 40.
  - 4. Correct slab surface when actual F(F) or F(L) number for floor installation measures less than required.

- D. Correct defects in defined traffic floor by grinding or removal and replacement of defective Work. Areas requiring corrective Work will be identified. Re-measure corrected areas by same process.

END OF SECTION



SECTION 03 39 00  
CONCRETE CURING

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes initial and final curing of horizontal and vertical concrete surfaces.
- B. Related Sections:
  - 1. Section 033000 - Cast-In-Place Concrete.
  - 2. Section 033500 - Concrete Finishing.

1.2 REFERENCES

- A. American Concrete Institute:
  - 1. ACI 301 - Specifications for Structural Concrete.
  - 2. ACI 302.1 - Guide for Concrete Floor and Slab Construction.
  - 3. ACI 308.1 - Standard Specification for Curing Concrete.
  - 4. ACI 318 - Building Code Requirements for Structural Concrete.
- B. ASTM International:
  - 1. ASTM C171 - Standard Specification for Sheet Materials for Curing Concrete.
  - 2. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
  - 3. ASTM C1315 - Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete.
  - 4. ASTM D2103 - Standard Specification for Polyethylene Film and Sheeting.

1.3 SUBMITTALS

- A. Section 013300 - Submittal Procedures: Submittal procedures.
- B. Product Data: Submit data on curing compounds, mats, paper, film, compatibilities, and limitations.

1.4 QUALITY ASSURANCE

- A. Perform Work in accordance with ACI 301.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Membrane Curing Compound Type 1.

- B. Membrane Curing Compound: ASTM C1315 Type I.
- C. Water: Potable, not detrimental to concrete.

### PART 3 EXECUTION

#### 3.1 EXAMINATION

- A. Section 013000 - Administrative Requirements: Coordination and project conditions.
- B. Verify substrate surfaces are ready to be cured.

#### 3.2 INSTALLATION - HORIZONTAL SURFACES

- A. Cure concrete in accordance with ACI 308.1.
- B. Ponding: Maintain 100 percent coverage of water over floor slab areas, continuously for 4 days.

\*\*\*\*\* OR \*\*\*\*\*

- C. Spraying: Spray water over floor slab areas and maintain wet for 7 days.

\*\*\*\*\* OR \*\*\*\*\*

- D. Absorptive Mat: Spread cotton fabric over floor slab areas. Spray with water until mats are saturated, and maintain in saturated condition for 7 days.

\*\*\*\*\* OR \*\*\*\*\*

- E. Absorptive Mat: Saturate burlap-polyethylene and place burlap-side down over floor slab areas, lapping ends and sides; maintain in place for 7 days.

#### 3.3 PROTECTION OF FINISHED WORK

- A. Section 017000 - Execution Requirements: Protecting finished Work.
- B. Do not permit traffic over unprotected floor surface.

#### 3.4 SCHEDULES

- A. Storage Area Slabs: Absorptive mats, burlap-polyethylene type.
- B. Retaining Walls: Membrane curing compound, acrylic type, clear color.
- C. Concrete Pavement: Membrane curing compound, opaque color.
- D. Other Floor Areas: Membrane curing compound, acrylic type, translucent color.

END OF SECTION

## SECTION 03 60 00

### GROUTING

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Portland cement grout.
  - 2. Rapid curing epoxy grout.
  - 3. Non-shrink cementitious grout.
- B. Related Sections:
  - 1. Section 033000 - Cast-in-Place Concrete.

##### 1.2 REFERENCES

- A. American Concrete Institute:
  - 1. ACI 301 - Specifications for Structural Concrete.
  - 2. ACI 318 - Building Code Requirements for Structural Concrete.
- B. American Society of Testing and Materials:
  - 1. ASTM C33 - Standard Specification for Concrete Aggregates.
  - 2. ASTM C40 - Test Method for Organic Impurities in Fine Aggregates for Concrete.
  - 3. ASTM C150 - Standard Specification for Portland Cement.
  - 4. ASTM C191 - Test Method for Time of Setting of Hydraulic Cement by Vicat Needle.
  - 5. ASTM C307 - Test Method for Tensile Strength of Chemical-Resistant Mortar, Grouts, and Monolithic Surfacing.
  - 6. ASTM C531 - Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes.
  - 7. ASTM C579 - Test Method for Compressive Strength of Chemical-Resistant Mortars, Grouts, monolithic Surfacing and Polymer Concretes.
  - 8. ASTM C827 - Test Method for Change in Height at Early Ages of Cylindrical Specimens from Cementitious Mixtures.
- C. U. S. Army Corps of Engineers Concrete Research Division (CRD):
  - 1. CRD C621 - Non-Shrink Grout.

#### PART 2 PRODUCTS

##### 2.1 PORTLAND CEMENT GROUT MATERIALS

- A. Portland Cement: ASTM C150, Type I and II.

- B. Water:
1. Potable; containing no impurities, suspended particles, algae or dissolved natural salts in quantities capable of causing:
    - a. Corrosion of steel.
    - b. Volume change increasing shrinkage cracking.
    - c. Efflorescence.
    - d. Excess air entraining.
- C. Fine Aggregate:
1. Washed natural sand.
  2. Gradation in accordance with ASTM C33 and represented by smooth granulometric curve within required limits.
  3. Free from injurious amounts of organic impurities as determined by ASTM C40.
- D. Mix:
1. Portland cement, sand and water. Do not use ferrous aggregate or staining ingredients in grout mixes.

## 2.2 RAPID CURING EPOXY GROUT

- A. Rapid Curing Epoxy Grout: High strength, three component epoxy grout formulated with thermosetting resins and inert fillers. Rapid-curing, high adhesion, and resistant to ordinary chemicals, acids and alkalis.

Compressive Strength	ASTM C579	12,000 psi at 7 days
Tensile Strength	ASTM C307	2,000 psi minimum
Coefficient of Expansion	ASTM C531	30x10 <sup>-6</sup> in per degree F
Shrinkage	ASTM C827	None

## 2.3 NON-SHRINK CEMENTITIOUS GROUT

- A. Properties: Certified to maintain initial placement volume or expand after set and meet the following minimum properties when tested in accordance with CRD-C621, for Type D non-shrink grout:

Property	Test	Time	Result
Setting Time	ASTM C191	Initial	2 hours (Approx)
		Final	3 hours (Approx)
Expansion			0.10% - 0.4% Maximum
Compressive Strength	CRD-C621	1 day	4,000 psi
		7 days	7,000 psi
		28 days	10,000 psi to 10,800 psi

## 2.4 FORMWORK

- A. Refer to Section 031000 for formwork requirements.

## 2.5 CURING

- A. Prevent rapid loss of water from grout during first 48 hours by use of approved membrane curing compound or with use of wet burlap method.

## PART 3 EXECUTION

### 3.1 PREPARATION

- A. Remove defective concrete, laitance, dirt, oil, grease and other foreign material from concrete surfaces by brushing, hammering, chipping or other similar means until sound, clean concrete surface is achieved.
- B. Rough concrete lightly, but not enough to interfere with placement of grout.
- C. Remove foreign materials from metal surfaces in contact with grout.
- D. Align, level and maintain final positioning of components to be grouted.
- E. Saturate concrete surfaces with clean water; remove excess water, leave none standing.

### 3.2 MIXING

- A. Portland Cement Grout:
  1. Use proportions of 2 parts sand and 1 part cement, measured by volume.
  2. Prepare grout with water to obtain consistency to permit placing and packing.
  3. Mix water and grout in two steps; pre-mix using approximately 2/3 of water; after partial mixing, add remaining water to bring mix to desired placement consistency and continue mixing 2 to 3 minutes.
  4. Mix only quantities of grout capable of being placed within 30 minutes after mixing.
  5. Do not add additional water after grout has been mixed.
  6. Capable of developing minimum compressive strength of 2400 psi in 48 hours and 7000 psi in 28 days.

\*\*\*\*\* [OR] \*\*\*\*\*

### 3.3 PLACING GROUT

- A. Place grout material quickly and continuously.
- B. Do not use pneumatic-pressure or dry-packing methods.
- C. Apply grout from one side only to avoid entrapping air.

- D. Do not vibrate placed grout mixture, or permit placement when area is being vibrated by nearby equipment.
- E. Thoroughly compact final installation and eliminate air pockets.
- F. Do not remove leveling shims for at least 48 hours after grout has been placed.

#### 3.4 CURING

- A. Immediately after placement, protect grout from premature drying, excessively hot or cold temperatures, and mechanical injury.
- B. After grout has attained its initial set, keep damp for minimum of 3 days.

#### 3.5 FIELD QUALITY CONTROL

- A. Submit proposed mix design of each class of grout to inspection and testing firm for review prior to commencement of Work.
- B. Tests of grout components may be performed to ensure conformance with specified requirements.

END OF SECTION

## SECTION 04 05 14

### MASONRY MORTAR AND GROUT

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section includes mortar and grout for masonry.
- B. Related Sections:
  - 1. Section 042016 - Reinforced Unit Masonry Assemblies: Installation of mortar and grout.

##### 1.2 REFERENCES

- A. American Concrete Institute:
  - 1. ACI 530 - Building Code Requirements for Masonry Structures.
  - 2. ACI 530.1 - Specifications for Masonry Structures.
- B. ASTM International:
  - 1. ASTM C5 - Standard Specification for Quicklime for Structural Purposes.
  - 2. ASTM C91 - Standard Specification for Masonry Cement.
  - 3. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete.
  - 4. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic Cement Concrete.
  - 5. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar.
  - 6. ASTM C150 - Standard Specification for Portland Cement.
  - 7. ASTM C199 - Standard Test Method for Pier Test for Refractory Mortars.
  - 8. ASTM C206 - Standard Specification for Finishing Hydrated Lime.
  - 9. ASTM C270 - Standard Specification for Mortar for Unit Masonry.
  - 10. ASTM C387 - Standard Specification for Packaged, Dry, Combined Materials for Mortar and Concrete.
  - 11. ASTM C404 - Standard Specification for Aggregates for Masonry Grout.
  - 12. ASTM C476 - Standard Specification for Grout for Masonry.
  - 13. ASTM C595 - Standard Specification for Blended Hydraulic Cements.
  - 14. ASTM C780 - Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry.
  - 15. ASTM C1019 - Standard Test Method for Sampling and Testing Grout.
  - 16. ASTM C1142 - Standard Specification for Extended Life Mortar for Unit Masonry.
  - 17. ASTM C1314 - Standard Test Method for Constructing and Testing Masonry Prisms Used to Determine Compliance with Specified Compressive Strength of Masonry.
  - 18. ASTM C1329 - Standard Specification for Mortar Cement.
  - 19. ASTM C1357 - Standard Test Method for Evaluating Masonry Bond Strength.



### 1.3 SUBMITTALS

- A. Section 01330 - Submittal Procedures: Submittal requirements.
- B. Design Data: Submit design mix when Property specification of ASTM C270 is to be used, required environmental conditions, and admixture limitations.

### 1.4 QUALITY ASSURANCE

- A. Perform Work in accordance with ACI 530 and ACI 530.1.

### 1.5 ENVIRONMENTAL REQUIREMENTS

- A. Section 016000 - Product Requirements.
- B. Cold Weather Requirements: In accordance with ACI 530.1 when ambient temperature or temperature of masonry units is less than 40 degrees F.
- C. Hot Weather Requirements: In accordance with ACI 530.1 when ambient temperature is greater than 100 degrees F or ambient temperature is greater than 90 degrees F with wind velocity greater than 8 mph.

## PART 2 PRODUCTS

### 2.1 COMPONENTS

- A. Portland Cement: ASTM C150, Type I
- B. Calcium chloride is not permitted.

### 2.2 MIXES

- A. Mortar Mixes:
  - 1. Extended Life Mortar: ASTM C1142, Type RS
- B. Mortar Mixing:
  - 1. Thoroughly mix mortar ingredients in accordance with ASTM C270 in quantities needed for immediate use.
  - 2. Achieve uniformly damp sand immediately before mixing process.
  - 3. Re-temper only within two hours of mixing.
- C. Grout Mixes:
  - 1. Grout for Non-Structural Masonry: 2,000 psi strength at 28 days; 8-11 inches slump; mixed in accordance with ASTM C476 grout.
  - 2. Grout for Structural Masonry: 2,000 psi strength at 28 days; 8-11 inches slump; mixed in accordance with ASTM C476 grout.
  - 3. Application:

- a. Coarse Grout: For grouting spaces with minimum 4 inches dimension in every direction.
  - b. Fine Grout: For grouting other spaces.
- D. Grout Mixing:
- 1. Mix grout in accordance with ASTM C94/C94M, modified to use ingredients complying with ASTM C476.
  - 2. Add admixtures; mix uniformly.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Section 013000 - Administrative Requirements: Coordination and project conditions.
- B. Request inspection of spaces to be grouted.

### 3.2 INSTALLATION

- A. Install mortar and grout in accordance with ACI 530.1 Specifications for Masonry Structures.

### 3.3 FIELD QUALITY CONTROL

- A. Establishing Mortar Mix: In accordance with ASTM C270.
- B. Testing Frequency: One set of specified tests for every 5,000 sf of completed wall area.
- C. Testing of Mortar Mix: In accordance with ASTM C780 for aggregate ratio and water content, air content, consistency, and compressive strength.
- D. Testing of Grout Mix: In accordance with ASTM C1019 for compressive strength, and in accordance with ASTM C143/C143M for slump.
- E. Test compressive strength of mortar and masonry to ASTM C1314; test in accordance with masonry unit sections specified.

END OF SECTION

## SECTION 04 20 16

### REINFORCED UNIT MASONRY ASSEMBLIES

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section includes concrete masonry units, reinforcement, anchorage, and accessories.
- B. Related Sections:
  - 1. Section 040514 - Masonry Mortar and Grout: Mortar and grout.

##### 1.2 REFERENCES

- A. American Concrete Institute:
  - 1. ACI 530 - Building Code Requirements for Masonry Structures.
  - 2. ACI 530.1 - Specifications for Masonry Structures.
- B. ASTM International:
  - 1. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
  - 2. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
  - 3. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength.
  - 4. ASTM A580/A580M - Standard Specification for Stainless Steel Wire.
  - 5. ASTM A615/A615M - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
  - 6. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
  - 7. ASTM A951 - Standard Specification for Masonry Joint Reinforcement.
  - 8. ASTM B370 - Standard Specification for Copper Sheet and Strip for Building Construction.
  - 9. ASTM B695 - Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel.

10. ASTM C27 - Standard Classification of Fireclay and High-Alumina Refractory Brick.
11. ASTM C34 - Standard Specification for Structural Clay Load-Bearing Wall Tile.
12. ASTM C55 - Standard Specification for Concrete Brick.
13. ASTM C56 - Standard Specification for Structural Clay Non-Load-Bearing Tile.
14. ASTM C62 - Standard Specification for Building Brick (Solid Masonry Units Made From Clay or Shale).
15. ASTM C67 - Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile.
16. ASTM C73 - Standard Specification for Calcium Silicate Face Brick (Sand-Lime Brick).
17. ASTM C90 - Standard Specification for Loadbearing Concrete Masonry Units.
18. ASTM C126 - Standard Specification for Ceramic Glazed Structural Clay Facing Tile, Facing Brick, and Solid Masonry Units.
19. ASTM C129 - Standard Specification for Nonloadbearing Concrete Masonry Units.
20. ASTM C140 - Standard Test Methods of Sampling and Testing Concrete Masonry Units.
21. ASTM C212 - Standard Specification for Structural Clay Facing Tile.
22. ASTM C216 - Standard Specification for Facing Brick (Solid Masonry Units Made from Clay or Shale).
23. ASTM C315 - Standard Specification for Clay Flue Linings.
24. ASTM C530 - Standard Specification for Structural Clay Non-Loadbearing Screen Tile.
25. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.
26. ASTM C652 - Standard Specification for Hollow Brick (Hollow Masonry Units Made From Clay or Shale).
27. ASTM C744 - Standard Specification for Prefaced Concrete and Calcium Silicate Masonry Units.
28. ASTM C1261 - Standard Specification for Firebox Brick for Residential Fireplaces.
29. ASTM C1283 - Standard Practice for Installing Clay Flue Lining.

- 30. ASTM D226 - Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing.
  - 31. ASTM E84 - Test Method for Surface Burning Characteristics of Building Materials.
  - 32. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
- C. National Fire Protection Association:
- 1. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials.
- D. Underwriters Laboratories Inc.:
- 1. UL 723 - Tests for Surface Burning Characteristics of Building Materials.

### 1.3 PERFORMANCE REQUIREMENTS

- A. Concrete Masonry Compressive Strength
- 1. Concrete Masonry Units: 1900 psi minimum net area compressive strength.

### 1.4 SUBMITTALS

- A. Section 013300 - Submittal Procedures: Submittal requirements.
- B. Shop Drawings: Indicate bars sizes, spacings, locations, reinforcement quantities, bending and cutting schedules, supporting and spacing devices for reinforcement.
- C. Product Data:
- 1. Submit data for masonry units and fabricated wire reinforcement.

### 1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with ACI 530 and ACI 530.1.

### 1.6 QUALIFICATIONS

- A. Installer: Company specializing in performing Work of this section with minimum three years experience.

### 1.7 ENVIRONMENTAL REQUIREMENTS

- A. Section 016000 - Product Requirements.
- B. Cold Weather Requirements: In accordance with ACI 530.1 when ambient temperature or temperature of masonry units is less than 40 degrees F.

- C. Hot Weather Requirements: In accordance with ACI 530.1 when ambient temperature is greater than 100 degrees F or ambient temperature is greater than 90 degrees F with wind velocity greater than 8 mph.

## PART 2 PRODUCTS

### 2.1 COMPONENTS

- A. Hollow Load Bearing Concrete Masonry Units (CMU): ASTM C90; medium weight.

### 2.2 ACCESSORIES

- A. Single Wythe Joint Reinforcement: ASTM A951; ladder type; 0.148 inch diameter side rods with 0.148 inch diameter cross ties.
- B. Reinforcing Steel: ASTM A615/A615M, 60 ksi yield grade, deformed billet bars.
- C. Anchor Rods: ASTM A307; Grade C; J-shaped or L-shaped; complete with washers and heavy hex nuts; sized for minimum 15 inch embedment.
  - 1. Hot-Dipped Galvanizing: ASTM A153/A153M.
  - 2. Mechanical Galvanizing: ASTM B695; Class 55.
- D. Mortar and Grout: As specified in Section 04065.
- E. Joint Filler: Closed cell rubber; oversized 50 percent to joint width; self expanding.

### 2.3 SOURCE QUALITY CONTROL

- A. Section 014000 - Quality Requirements: Testing, inspection and analysis requirements.
- B. Test brick efflorescence in accordance with ASTM C67. Brick rated greater than “slightly effloresced” is not acceptable.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Section 013000 - Administrative Requirements: Coordination and project conditions.
- B. Verify field conditions are acceptable and are ready to receive work.
- C. Verify items provided by other sections of work are properly sized and located.
- D. Verify 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 to other Sections.
- B. Furnish temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent support.

- C. Wet clay and shale brick before laying when initial rate of absorption is greater than 30 grams when tested in accordance with ASTM C67.

### 3.3 INSTALLATION

- A. Establish lines, levels, and coursing indicated. Protect from displacement.
- B. Maintain masonry courses to uniform dimension. Form bed and head joints of uniform thickness.
- C. Coursing of Concrete Masonry Units:
  - 1. Bond: Running.
  - 2. Coursing: One unit and one mortar joint to equal 8 inches.
  - 3. Mortar Joints: Concave.
- D. Placing And Bonding:
  - 1. Lay solid masonry units in full bed of mortar, with full head joints.
  - 2. Lay hollow masonry units with face shell bedding on head and bed joints.
  - 3. Buttering corners of joints or excessive furrowing of mortar joints are not permitted.
  - 4. Remove excess mortar as Work progresses.
  - 5. Interlock intersections and external corners.
  - 6. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment is required, remove mortar and replace.
  - 7. Perform job site cutting of masonry units with proper tools to assure straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.
  - 8. Isolate masonry from vertical structural framing members with movement joint .
  - 9. Isolate top of masonry from horizontal structural framing members and slabs or decks.
- E. Joint Reinforcement And Anchorage:
  - 1. Install horizontal joint reinforcement 16 inches oc.
  - 2. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16 inches each side of opening.
  - 3. Place joint reinforcement continuous in first and second joint below top of walls.
  - 4. Lap joint reinforcement ends minimum 6 inches.

5. Support and secure reinforcing bars from displacement. Maintain position within 1/2 inch of dimensioned position.
6. Embed anchors embedded in concrete attached to structural steel members. Embed anchorages in every sixth brick.

F. Lintels:

1. Install precast concrete lintels over openings.
2. Install reinforced unit masonry lintels over openings where steel or precast concrete lintels are not scheduled or indicated.
3. Openings Up To 42 inches Wide: Reinforce openings as indicated on Drawings.
4. Openings From 42 inches Up To 78 inches Wide: Reinforce openings as indicated on Drawings.
5. Openings Over 78 inches: Reinforce openings as indicated on Drawings.
6. Do not splice reinforcing bars.
7. Support and secure reinforcing bars from displacement.
8. Place and consolidate grout fill without displacing reinforcing.
9. Allow masonry lintels to attain specified strength before removing temporary supports.
10. Maintain minimum 8 inches bearing on each side of opening.

G. Grouted Components:

1. Reinforce bond beam with 1, No. 5 bar.
2. Reinforce pilaster with 1, No. 6 bar in each cell.
3. Lap splices bar diameters required by code.
4. Support and secure reinforcing bars from displacement.
5. Place and consolidate grout fill without displacing reinforcing.
6. At bearing locations, fill masonry cores with grout for minimum 12 inches either side of opening.

H. Reinforced Masonry:

1. Lay masonry units with cells vertically aligned and cavities between wythes clear of mortar and unobstructed.
2. Place reinforcing, reinforcement bars, and grout as indicated on Drawings.



3. Splice reinforcement in accordance with Section 03200.
4. Support and secure reinforcement from displacement.
5. Place and consolidate grout fill without displacing reinforcing.
6. Place grout in accordance with ACI 530.1 Specification for Masonry Structures.

I. Control And Expansion Joints:

1. Install control and expansion joints at the following maximum spacings, unless otherwise indicated on Drawings:
  - a. Exterior Walls: 20 feet on center and within 10 feet on one side of each interior and exterior corner.
  - b. Interior Walls: 30 feet on center.
  - c. At changes in wall height.
2. Do not continue horizontal joint reinforcement through control and expansion joints.
3. Install preformed control joint device in continuous lengths. Seal butt and corner joints.
4. Size control joint in accordance with Section 07900 for sealant performance.
5. Form expansion joint by omitting mortar and cutting unit to form open space.

J. Cutting And Fitting:

1. Obtain Architect/Engineer's approval prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.

3.4 ERECTION TOLERANCES

- A. Section 014000 - Quality Requirements: Tolerances.
- B. Maximum Variation From Alignment of Pilasters: 1/4 inch.
- C. Maximum Variation From Unit to Adjacent Unit: 1/16 inch.
- D. Maximum Variation from Plane of Wall: 1/4 inch in 10 ft and 1/2 inch in 20 ft or more.
- E. Maximum Variation from Plumb: 1/4 inch per story non-cumulative; 1/2 inch in two stories or more.
- F. Maximum Variation from Level Coursing: 1/8 inch in 3 ft and 1/4 inch in 10 ft; 1/2 inch in 30 ft.
- G. Maximum Variation of Joint Thickness: 1/8 inch in 3 ft.

- H. Maximum Variation from Cross Sectional Thickness of Walls: 1/4 inch.
- I. Maximum Variation for Steel Reinforcement:
  - 1. Install reinforcement within the tolerances specified in ACI 530.1 for foundation walls.
  - 2. Plus or minus 1/2 inch when distance from centerline of steel to opposite face of masonry is 8 inches or less.
  - 3. Plus or minus 1 inch when distance is between 8 and 24 inches.
  - 4. Plus or minus 1-1/4 inch when distance is greater than 24 inches.
  - 5. Plus or minus 2 inches from location along face of wall.

### 3.5 FIELD QUALITY CONTROL

- A. Concrete Masonry Units: Test each type in accordance with ASTM C140.

### 3.6 CLEANING

- A. Section 017000 - Execution Requirements: Final cleaning.
- B. Remove excess mortar and mortar smears as work progresses.
- C. Replace defective mortar. Match adjacent work.
- D. Clean soiled surfaces with cleaning solution.
- E. Use non-metallic tools in cleaning operations.

### 3.7 PROTECTION OF FINISHED WORK

- A. Section 017000 - Execution Requirements: Requirements for protecting finished Work.
- B. Protect exposed external corners subject to damage.
- C. Protect base of walls from mud and mortar splatter.
- D. Protect masonry and other items built into masonry walls from mortar droppings and staining caused by mortar.
- E. Protect tops of masonry work with waterproof coverings secured in place without damaging masonry. Provide coverings where masonry is exposed to weather when work is not in progress.

END OF SECTION 04 20 16

## SECTION 042613 - MASONRY VENEER

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Clay face brick.

B. Products Installed but Not Furnished under This Section:

1. Steel lintels in masonry veneer.
2. Steel shelf angles for supporting masonry veneer.

#### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples for Verification: For each type and color of brick and colored mortar.

#### 1.3 INFORMATIONAL SUBMITTALS

A. Material Certificates: For each type and size of product.

#### 1.4 QUALITY ASSURANCE

A. Sample Panels: Build sample panels to verify selections made under Sample submittals and to demonstrate aesthetic effects. Comply with requirements in Section 014000 "Quality Requirements" for mockups.

1. Build sample panels for typical exterior wall sizes approximately 48 inches long by 60 inches high by full thickness.

#### 1.5 FIELD CONDITIONS

A. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.

- B. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

## PART 2 - PRODUCTS

### 2.1 UNIT MASONRY, GENERAL

- A. Masonry Standard: Comply with TMS 602/ACI 530.1/ASCE 6, except as modified by requirements in the Contract Documents.
- B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects will be exposed in the completed Work.

### 2.2 BRICK

- A. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching finish and color of exposed faces of adjacent units:
  - 1. For ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces, provide units without cores or frogs and with exposed surfaces finished.
  - 2. Provide special shapes for applications where shapes produced by sawing would result in sawed surfaces being exposed to view.
- B. Clay Face Brick: Facing brick complying with ASTM C216.
  - 1. Grade SW
  - 2. Type FBS
  - 3. Initial Rate of Absorption: Less than 30 g/30 sq. in. per minute when tested according to ASTM C67.
  - 4. Efflorescence: Provide brick that has been tested according to ASTM C67 and is rated "not effloresced."
  - 5. Surface Coating: Brick with colors or textures produced by application of coatings shall withstand 50 cycles of freezing and thawing according to ASTM C67 with no observable difference in the applied finish when viewed from 10 feet.
  - 6. Size (Actual Dimensions): 3-5/8 inches wide by 2-1/4 inches high by 7-5/8 inches long.
  - 7. Basis of Design: ACME Brick Company
  - 8. Color and Texture: Via Roma 242 Blend

### 2.3 MORTAR MATERIALS

- A. Portland Cement: 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.
- B. Hydrated Lime: ASTM C207, Type S.

- C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.
- D. Masonry Cement: ASTM C91/C91M.
- E. Mortar Pigments: 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.
- F. Aggregate for Mortar: ASTM C144.
  - 1. White-Mortar Aggregates: Natural white sand or crushed white stone.
  - 2. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.
- G. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C494/C494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.
- H. Water-Repellent Admixture: Liquid water-repellent mortar admixture intended for use with concrete bricks containing integral water repellent from same manufacturer.
  - 1. Water: Potable.

## 2.4 TIES AND ANCHORS

- A. General: Ties and anchors shall extend at least 1-1/2 inches into veneer but with at least a 5/8-inch cover on outside face.
- B. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated:
  - 1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A82/A82M, with ASTM A153/A153M, Class B-2 coating.
  - 2. Steel Sheet, Galvanized after Fabrication: ASTM A1008/A1008M, Commercial Steel, with ASTM A153/A153M, Class B coating.
- C. Adjustable Anchors for Connecting to Structural Steel Framing: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.
  - 1. Anchor Section for Welding to Steel Frame: Crimped 1/4-inch diameter, hot-dip galvanized-steel wire.
  - 2. Tie Section: Triangular-shaped wire tie made from 0.25-inch diameter, hot-dip galvanized-steel wire.
- D. Adjustable Anchors for Connecting to Concrete: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.
  - 1. Connector Section: Dovetail tabs for inserting into dovetail slots in concrete and attached to tie section; formed from 0.105-inch thick, steel sheet, galvanized after fabrication.

2. Tie Section: Triangular-shaped wire tie made from 0.25-inch diameter, hot-dip galvanized-steel wire.
3. Corrugated-Metal Ties: Metal strips not less than 7/8-inch-wide with corrugations having a wavelength of 0.3 to 0.5 inch and an amplitude of 0.06 to 0.10 inch made from [0.105-inch thick steel sheet, galvanized after fabrication with dovetail tabs for inserting into dovetail slots in concrete.

E. Adjustable Masonry-Veneer Anchors:

1. General: Provide anchors that allow vertical adjustment but resist a 100-lbf load in both tension and compression perpendicular to plane of wall without deforming or developing play in excess of 1/16 inch.
2. Fabricate sheet metal anchor sections and other sheet metal parts from 0.105-inch thick steel sheet, galvanized after fabrication.
3. Fabricate wire ties from 0.25-inch diameter, hot-dip galvanized-steel wire unless otherwise indicated.
4. Fabricate wire connector sections from 0.25-inch diameter, hot-dip galvanized, carbon-steel wire.
5. Adjustable Masonry Veneer Anchors for Sheathed Steel Studs Walls with Rigid Insulation in Cavity:

Anchor Plate: Minimum 0.0713 in (14 gage) (1.81 mm) uncoated base metal thickness, with projecting horizontal tabs on length to allow for insulation thickness with holes or slots to receive pintel legs, with two screw holes with rubberized asphalt flexible flashing material either adhered to back of plate, or loose for separate mounting.

Wire Pintel: Minimum 3/16 in (5 mm) diameter, bent into open-end rectangle box shaped tie with 2 legs bent down to slip into anchor slot; length as required to extend at least halfway through masonry veneer but with minimum 5/8 in cover on outside face of masonry veneer.

Manufacturers and Products:

- a. Hohmann & Barnard, Inc.; HB-213-2X anchor plate and wire pintel.

6. Polymer-Coated, Steel Drill Screws for Steel Studs: ASTM C954 except with hex washer head and neoprene or EPDM washer, No. 10 diameter and with organic polymer coating with salt-spray resistance to red rust of more than 800 hours according to ASTM B117.

F. Termination Bars: ASTM A 666, Type 304 formed stainless-steel flat bars; 1 in by 1/8 in (25 mm by 3 mm) thick; predrilled at 8 in (200 mm) centers. No aluminum or plastic bars allowed.

1. Anchors: Same type screws as used to attach veneer wall ties

## 2.5 EMBEDDED FLASHING MATERIALS

A. Metal Flashing: Provide metal flashing complying with SMACNA's "Architectural Sheet Metal Manual" and as follows:

1. Fabricate continuous flashings in sections 96 inches long minimum, but not exceeding 12 feet. Provide splice plates at joints of formed, smooth metal flashing.

- B. Flexible Flashing: Use one of the following unless otherwise indicated:
  - 1. Rubberized-Asphalt Flashing: Composite flashing product consisting of a pliable, adhesive rubberized-asphalt compound, bonded to a high-density, cross-laminated polyethylene film to produce an overall thickness of not less than 0.040 inch.
    - a. Advanced Building Products – Strip-N-Flash
    - b. Carlisle – CCW-705-TWF
    - c. Hohmann and Barnard – TeXtroflash
    - d. W.R. Meadows – Air Shield Thru Wall Flashing
    - e. Polyguard Products – Polyguard 400
- C. Solder and Sealants for Sheet Metal Flashings: As specified in Section 076200 "Sheet Metal Flashing and Trim."
- D. 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.

## 2.6 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.
- B. Weep/Vent Products: Use one of the following unless otherwise indicated:
  - 1. Cellular Plastic Weep/Vent: One-piece, flexible extrusion made from UV-resistant polypropylene copolymer, full height and width of head joint and depth 1/8 less than depth of outer wythe, in color selected from manufacturer's standard.
    - a. Advanced Building Products, Inc. – Mortar Maze Weep Vents
    - b. Heckmann Building Products, Inc. – No. 85 Cell Vent
    - c. Hohmann & Barnard, Inc. – QV Quadro-Vent
    - d. Wire-Bond – Cell Vent
- C. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.
  - 1. Advanced Building Products, Inc. – Mortar Break II
  - 2. Heckmann Building Products, Inc. – No. 84 Weep-Thru Mortar Defector
  - 3. Mortar Net USA, Ltd. – Mortar Net
  - 4. Polyguard Products, Inc. – Termi-Net
  - 5. Wire Bond – Cavity Net II
  - 6. Hohmann & Barnard, Inc. – Mortar trap
- 7. Configuration: Provide one of the following:
  - a. Strips, full depth of cavity and 10 inches high, with dovetail-shaped notches 7 inches deep that prevent clogging with mortar droppings.

## 2.7 MASONRY CLEANERS

- A. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.
  - 1. Diedrich Technologies, Inc.
  - 2. EaCoChem
  - 3. Prosoco, Inc.

## 2.8 MORTAR MIXES

- A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.
  - 1. Do not use calcium chloride in mortar or grout.
  - 2. Use portland cement-lime or masonry cement mortar unless otherwise indicated.
  - 3. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.
- B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.
- C. Mortar for Unit Masonry: Comply with ASTM C270, Proportion Specification. Use Type N unless another type is indicated.
- D. Colored-Aggregate Mortar: Produce required mortar color by using colored aggregates and natural color or white cement as necessary to produce required mortar color.
  - 1. Mix to match Architect's sample.
  - 2. Application: Use colored aggregate mortar for exposed mortar joints.

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. 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.
- B. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures. Mix units from several pallets or cubes as they are placed.
- C. Wetting of Brick: Wet brick before laying if initial rate of absorption exceeds 30 g/30 sq. in. per minute when tested according to ASTM C67. Allow units to absorb water so they are damp but not wet at time of laying.



### 3.2 TOLERANCES

#### A. Dimensions and Locations of Elements:

1. For dimensions in cross section or elevation, do not vary by more than plus 1/2 inch or minus 1/4 inch.
2. For location of elements in plan, do not vary from that indicated by more than plus or minus 1/2 inch.
3. For location of elements in elevation, do not vary from that indicated by more than plus or minus 1/4 inch in a story height or 1/2 inch total.

#### B. Lines and Levels:

1. For bed joints and top surfaces of bearing walls, do not vary from level by more than 1/4 inch in 10 feet, or 1/2 inch maximum.
2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
3. For vertical lines and surfaces, do not vary from plumb by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2 inch maximum.
4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
5. For lines and surfaces, do not vary from straight by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2 inch maximum.

#### C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch.
2. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch.

### 3.3 LAYING MASONRY WALLS

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.

C. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.

### 3.4 MORTAR BEDDING AND JOINTING

A. Lay masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

- B. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

### 3.5 ANCHORED MASONRY VENEERS

- A. Anchor masonry veneers to wall framing with masonry-veneer anchors to comply with the following requirements:
  - 1. Fasten screw-attached anchors through sheathing to wall framing with metal fasteners of type indicated. Use two fasteners.
  - 2. Embed tie sections, connector sections and continuous wire in masonry joints.
  - 3. Locate anchor sections to allow maximum vertical differential movement of ties up and down.
  - 4. Space anchors as indicated, but not more than 18 inches o.c. vertically and 24 inches o.c. horizontally, with not less than one anchor for each 2 sq. ft. of wall area. Install additional anchors within 12 inches of openings and at intervals, not exceeding 8 inches, around perimeter.
- B. Provide not less than 2 inches of airspace between back of masonry veneer and face of insulation.

### 3.6 ANCHORING MASONRY TO STRUCTURAL STEEL AND CONCRETE

- A. Anchor masonry to structural steel and concrete, where masonry abuts or faces structural steel or concrete to comply with the following:
  - 1. Provide an open space not less than 1/2-inch-wide between masonry and structural steel or concrete unless otherwise indicated. Keep open space free of mortar and other rigid materials.
  - 2. Anchor masonry with anchors embedded in masonry joints and attached to structure.
  - 3. Space anchors as indicated, but not more than 24 inches o.c. vertically and 36 inches o.c. horizontally.

### 3.7 FLASHING, WEEP HOLES, 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.
- B. Install flashing as follows unless otherwise indicated:
  - 1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.

2. At lintels and shelf angles, extend flashing a minimum of 6 inches into masonry at each end. At heads and sills, extend flashing 6 inches at ends and turn up not less than 2 inches to form end dams.
  3. Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall, and adhere flexible flashing to top of metal drip edge.
  4. Install metal flashing termination beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall, and adhere flexible flashing to top of metal flashing termination.
- C. Install weep holes in veneers in head joints of first course of masonry immediately above embedded flashing.
1. Use specified weep/vent products to form weep holes.
  2. Space weep holes 24 inches o.c. unless otherwise indicated.
- D. Place cavity drainage material in airspace behind veneers to comply with configuration requirements for cavity drainage material in "Miscellaneous Masonry Accessories" Article.
- E. 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.

### 3.8 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Owner will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.
- B. Inspections: Special inspections according to Level B in TMS 402/ACI 530/ASCE 5.
1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
- C. Testing Prior to Construction: One set of tests.
- D. Clay Masonry Unit Test: For each type of unit provided, according to ASTM C67 for compressive strength.
- E. Concrete Masonry Unit Test: For each type of unit provided, according to ASTM C140 for compressive strength.
- F. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, according to ASTM C780.

### 3.9 REPAIRING, POINTING, AND CLEANING

- A. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
- B. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
  - 1. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes.
  - 2. Protect adjacent stone and non-masonry surfaces from contact with cleaner.
  - 3. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
  - 4. Clean brick by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.
  - 5. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.

### 3.10 MASONRY WASTE DISPOSAL

- A. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.
  - 1. Do not dispose of masonry waste as fill within 18 inches of finished grade.
- B. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above or recycled, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION 042613

## SECTION 047200 - CAST STONE MASONRY

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Cast-stone trim.

#### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. For cast-stone units, include dimensions and finishes.

B. Shop Drawings: Show fabrication and installation details for cast-stone units. Include dimensions, details of reinforcement and anchorages if any, and indication of finished faces.

C. Samples:

1. For each color and texture of cast stone required.
2. For colored mortar.

#### 1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer.

B. Material Test Reports: For each mix required to produce cast stone, based on testing according to ASTM C1364.

#### 1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer of cast-stone units similar to those indicated for this Project, that has sufficient production capacity to manufacture required units, and is a plant certified by the Architectural Precast Association.

### PART 2 - PRODUCTS

#### 2.1 CAST-STONE UNITS

A. Provide one of the following manufacturers:

1. Christopher Stuart Cast Stone Manufacturing and Design
2. Alamo Cast Stone Inc.

3. Dallas Cast Stone Co.
- B. Cast-Stone Units: Comply with ASTM C1364.
1. Units shall be manufactured using the vibrant dry tamp method.
  2. Units shall be resistant to freezing and thawing as determined by laboratory testing according to ASTM C666/C666M, Procedure A, as modified by ASTM C1364.
- C. Fabricate units with sharp arris and accurately reproduced details, with indicated texture on all exposed surfaces unless otherwise indicated.
1. Slope exposed horizontal surfaces 1:12 to drain unless otherwise indicated.
  2. Provide raised fillets at backs of sills and at ends indicated to be built into jambs.
  3. Provide drips on projecting elements unless otherwise indicated.
- D. Cure Units as Follows:
1. Cure units in enclosed, moist curing room at 95 to 100 percent relative humidity and temperature of 100 deg F for 12 hours or 70 deg F for 16 hours.
  2. Keep units damp and continue curing to comply with one of the following:
    - a. No fewer than five days at mean daily temperature of 70 deg F or above.
    - b. No fewer than six days at mean daily temperature of 60 deg F or above.
    - c. No fewer than seven days at mean daily temperature of 50 deg F or above.
    - d. No fewer than eight days at mean daily temperature of 45 deg F or above.
- E. Acid etch units after curing to remove cement film from surfaces to be exposed to view.
- F. Colors and Textures: As selected by Architect from manufacturer's full range.

## 2.2 ACCESSORIES

- A. Anchors: Type and size indicated, fabricated from Type 304 stainless steel complying with ASTM A240/A240M.
- B. Dowels: 1/2-inch diameter round bars, fabricated from Type 304 stainless steel complying with ASTM A240/A240M.
- C. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cast-stone manufacturer and expressly approved by cleaner manufacturer for use on cast stone and adjacent masonry materials.
1. Provide one of the following manufacturers:
    - a. PROSOCO, Inc
    - b. Diedrich Technologies, Inc.; a Hohmann & Barnard company

## 2.3 MORTAR

- A. Comply with requirements in Section 042000 "Unit Masonry" for mortar mixes.
  - 1. For setting mortar, use Type S.
- B. Pigmented Mortar: Use colored cement product.

## 2.4 SOURCE QUALITY CONTROL

- A. Engage a qualified independent testing agency to sample and test cast-stone units according to ASTM C1364.
  - 1. Include one test for resistance to freezing and thawing.

## PART 3 - EXECUTION

### 3.1 SETTING CAST STONE IN MORTAR

- A. Install cast-stone units to comply with requirements in Section 042000 "Unit Masonry."
- B. Set units in full bed of mortar with full head joints unless otherwise indicated.
  - 1. Fill dowel holes and anchor slots with mortar.
  - 2. Fill collar joints solid as units are set.
  - 3. Build concealed flashing into mortar joints as units are set.
  - 4. Keep head joints in copings and between other units with exposed horizontal surfaces open to receive sealant.
  - 5. Keep joints at shelf angles open to receive sealant.
- C. Rake out joints for pointing with mortar to depths of not less than 3/4 inch. Rake joints to uniform depths with square bottoms and clean sides. Scrub faces of units to remove excess mortar as joints are raked.
- D. Point mortar joints by placing and compacting mortar in layers not greater than 3/8 inch. Compact each layer thoroughly and allow it to become thumbprint hard before applying next layer.
- E. Tool exposed joints slightly concave when thumbprint hard. Use a smooth plastic jointer larger than joint thickness.
- F. Rake out joints for pointing with sealant to depths of not less than 3/4 inch. Scrub faces of units to remove excess mortar as joints are raked.
- G. Provide sealant joints at head joints of copings and other horizontal surfaces; at expansion, control, and pressure-relieving joints; and at locations indicated.
  - 1. Keep joints free of mortar and other rigid materials.

2. Prepare and apply sealant of type and at locations indicated to comply with applicable requirements in Section 079200 "Joint Sealants."

### 3.2 SETTING ANCHORED CAST STONE WITH SEALANT-FILLED JOINTS

- A. Set cast stone as indicated on Drawings. Set units accurately in locations indicated, with edges and faces aligned according to established relationships and indicated tolerances.
  1. Install anchors, supports, fasteners, and other attachments indicated or necessary to secure units in place.
  2. Shim and adjust anchors, supports, and accessories to set cast stone in locations indicated with uniform joints.
- B. Fill anchor holes with sealant.
  1. Where dowel holes occur at pressure-relieving joints, provide compressible material at ends of dowels.
- C. Set cast stone supported on clip or continuous angles on resilient setting shims. Use material of thickness required to maintain uniform joint widths. Hold shims back from face of cast stone a distance at least equal to width of joint.
- D. Prepare and apply sealant of type and at locations indicated to comply with applicable requirements in Section 079200 "Joint Sealants."

### 3.3 INSTALLATION TOLERANCES

- A. Variation from Plumb: Do not exceed 1/8 inch in 10 feet, 1/4 inch in 20 feet or 1/2 inch maximum.
- B. Variation from Level: Do not exceed 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
- C. Variation in Joint Width: Do not vary joint thickness more than 1/8 inch in 36 inches or one-fourth of nominal joint width, whichever is less.
- D. Variation in Plane between Adjacent Surfaces (Lipping): Do not vary from flush alignment with adjacent units or adjacent surfaces indicated to be flush with units by more than 1/16 inch, except where variation is due to warpage of units within tolerances specified.

### 3.4 ADJUSTING AND CLEANING

- A. Remove and replace stained and otherwise damaged units and units not matching approved Samples. Cast stone may be repaired if methods and results are approved by Architect.
- B. Replace units in a manner that results in cast stone matching approved Samples, complying with other requirements, and showing no evidence of replacement.
- C. In-Progress Cleaning: Clean cast stone as work progresses.



1. Remove mortar fins and smears before tooling joints.
  2. Remove excess sealant immediately, including spills, smears, and spatter.
- D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed cast stone as follows:
1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
  2. Test cleaning methods on sample; leave one sample uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of cast stone.
  3. Protect adjacent surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
  4. Wet surfaces with water before applying cleaners; remove cleaners promptly by rinsing thoroughly with clear water.
  5. Clean cast stone by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.
  6. Clean cast stone with proprietary acidic cleaner applied according to manufacturer's written instructions.

END OF SECTION 047200

## SECTION 05 12 00

### STRUCTURAL STEEL FRAMING

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Structural shapes.
  - 2. Channels and angles.
  - 3. Hollow structural sections.
  - 4. Structural pipe.
  - 5. Structural plates and bars.
  - 6. Fasteners, connectors, and anchors.
  - 7. Fasteners, connectors, and anchors.
  - 8. Grout.
  
- B. Related Sections:
  - 1. Section 036000 - Grout: Grout for setting base plates.
  - 2. Section 052100 - Steel Joists.
  - 3. Section 053123 - Steel Roof Deck
  - 4. Section 055000 – Metal Fabrications: Steel Fabrications affecting structural steel work.

##### 1.2 REFERENCES

- A. American Institute of Steel Construction:
  - 1. AISC Code of Standard Practice for Steel Buildings and Bridges.
  - 2. AISC Load and Resistance Factor Design (LRFD) Specification for Structural Steel Buildings.
  - 3. AISC Load and Resistance Factor Design Specification for Single-Angle Members.
  - 4. AISC Seismic Provisions for Structural Steel Buildings.
  - 5. AISC Specification for Allowable Stress Design of Single-Angle Members.
  - 6. AISC Specification for the Design of Steel Hollow Structural Sections.
  - 7. AISC Specification for Structural Steel Buildings Allowable Stress Design, and Plastic Design.
  
- B. ASTM International:
  - 1. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.
  - 2. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
  - 3. ASTM A108 - Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished.
  - 4. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

5. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
6. ASTM A193/A193M - Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service.
7. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength.
8. ASTM A325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
9. ASTM A354 - Standard Specification for Quenched and Tempered Alloy Steel Bolts, Studs, and Other Externally Threaded Fasteners.
10. ASTM A449 - Standard Specification for Quenched and Tempered Steel Bolts and Studs.
11. ASTM A490 - Standard Specification for Structural Bolts, Alloy Steel, Heat Treated, 150 ksi Minimum Tensile Strength.
12. ASTM A500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
13. ASTM A501 - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
14. ASTM A514/A514M - Standard Specification for High-Yield-Strength, Quenched and Tempered Alloy Steel Plate, Suitable for Welding.
15. ASTM A529/A529M - Standard Specification for High-Strength Carbon-Manganese Steel of Structural Quality.
16. ASTM A563 - Standard Specification for Carbon and Alloy Steel Nuts.
17. ASTM A572/A572M - Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.
18. ASTM A588/A588M - Standard Specification for High-Strength Low-Alloy Structural Steel with 50 ksi (345 MPa) Minimum Yield Point to 4-in. (100-mm) Thick.
19. ASTM A618 - Standard Specification for Hot-Formed Welded and Seamless High-Strength Low-Alloy Structural Tubing.
20. ASTM A786/A786M - Standard Specification for Hot-Rolled Carbon, Low-Alloy, High-Strength Low-Alloy, and Alloy Steel Floor Plates.
21. ASTM A847 - Standard Specification for Cold-Formed Welded and Seamless High Strength, Low Alloy Structural Tubing with Improved Atmospheric Corrosion Resistance.
22. ASTM A852/A852M - Standard Specification for Quenched and Tempered Low-Alloy Structural Steel Plate with 70 ksi (485 MPa) Minimum Yield Strength to 4 in. (100 mm) Thick.
23. ASTM A913/A913M - Standard Specification for High-Strength Low-Alloy Steel Shapes of Structural Quality, Produced by Quenching and Self-Tempering Process (QST).
24. ASTM A992/A992M - Standard Specification for Structural Steel Shapes.
25. ASTM B695 - Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel.
26. ASTM E94 - Standard Guide for Radiographic Examination.
27. ASTM E164 - Standard Practice for Ultrasonic Contact Examination of Weldments.
28. ASTM E165 - Standard Test Method for Liquid Penetrant Examination.

29. ASTM E709 - Standard Guide for Magnetic Particle Examination.
  30. ASTM F436 - Standard Specification for Hardened Steel Washers.
  31. ASTM F959 - Standard Specification for Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners.
  32. ASTM F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.
  33. ASTM F1852 - Standard Specification for Twist Off Type Tension Control Structural Bolt/Nut/Washer Assemblies, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
- C. American Welding Society:
1. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination.
  2. AWS D1.1 - Structural Welding Code - Steel.
- D. Research Council on Structural Connections:
1. RCSC - Specification for Structural Joints Using ASTM A325 or A490 Bolts.
- E. SSPC: The Society for Protective Coatings:
1. SSPC - Steel Structures Painting Manual.
  2. SSPC Paint 15 - Steel Joist Shop Paint.
  3. SSPC Paint 20 - Zinc-Rich Primers (Type I - Inorganic and Type II - Organic).
  4. SSPC SP 3 - Power Tool Cleaning.
  5. SSPC SP 6 - Commercial Blast Cleaning.
  6. SSPC SP 10 - Near-White Blast Cleaning.

### 1.3 SUBMITTALS

- A. Section 01330 - Submittal Procedures: Requirements for submittals.
- B. Shop Drawings:
1. Indicate profiles, sizes, spacing, and locations of structural members, openings, attachments, and fasteners.
  2. Connections.
  3. Cambers
  4. Indicate welded connections with AWS A2.4 welding symbols. Indicate net weld lengths.
- C. Mill Test Reports: Submit indicating structural strength and destructive and non-destructive test analysis.
- D. Manufacturer's Mill Certificate: Certify products meet or exceed specified requirements.
- E. Welders Certificates: Certify welders employed on the Work, verifying AWS qualifications within previous 12 months.

## 1.4 QUALITY ASSURANCE

- A. Perform Work in accordance with the following:
  - 1. AISC Code of Standard Practice for Steel Buildings and Bridges.
  - 2. AISC Code of Standard Practice for Steel Buildings and Bridges. Section 10.
  - 3. AISC Seismic Provisions for Structural Steel Buildings.
  - 4. AISC Specification for Structural Steel Buildings Allowable Stress Design, and Plastic Design.
  - 5. AISC Load and Resistance Factor Design (LRFD) Specification for Structural Steel Buildings.
  - 6. AISC Specification for the Design of Steel Hollow Structural Sections.
  - 7. AISC Specification for Allowable Stress Design of Single-Angle Members.
  - 8. AISC Load and Resistance Factor Design Specification for Single-Angle Members.
  - 9. RCSC Specification for Structural Joints Using ASTM A 325 or A 490 Bolts.
  - 10. ASCE 19.

## 1.5 COORDINATION

- A. Section {013000 - Administrative Requirements}: Requirements for coordination.

## PART 2 PRODUCTS

### 2.1 STRUCTURAL STEEL

- A. Structural W-Shapes: ASTM A992/A992M; Grade 50
- B. Structural M-Shapes: ASTM A36/A36M; Grade 50
- C. Structural T-Shapes: Cut from structural W-shapes.
- D. Channels and Angles: ASTM A36/A36M.
- E. Round Hollow Structural Sections: ASTM A500, Grade B.
- F. Square and Rectangular Hollow Structural Sections: ASTM A500, Grade B.
- G. Structural Plates and Bars: ASTM A36/A36M.

### 2.2 FASTENERS, CONNECTORS, AND ANCHORS

- A. Bolts: ASTM A307; Grade A or B.
  - 1. Finish: Unfinished
- B. High Strength Bolts: ASTM A325; Type 1 or ASTM A490; Type 1.
  - 1. Finish: Unfinished

- C. Nuts: ASTM A563 heavy hex type.
  - 1. Finish: Unfinished
- D. Washers: ASTM F436; Type 1, circular
  - 1. Finish: Unfinished
- E. Threaded Rods: ASTM A36/A36M; Grade A.
  - 1. Finish: Unfinished
- F. Forged Structural Steel Hardware:
  - 1. Clevises and Turnbuckles: ASTM A108; Grade 1085.
  - 2. Eye Nuts and Eye Bolts: ASTM A108; Grade 1030.
  - 3. Sleeve Nuts: ASTM A108; Grade 1018.
  - 4. Rod Ends, Yoke Ends and Pins, Cotter Pins, and Coupling Nuts: Carbon steel.

## 2.3 WELDING MATERIALS

- A. Welding Materials: AWS D1.1; type required for materials being welded.

## 2.4 ACCESSORIES

- A. Grout: Non-shrink type, pre-mixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing additives, capable of developing minimum compressive strength of 7,000 psi at 28 days
- B. Shop and Touch-Up Primer: SSPC Paint 15, Type 1, red oxide.

## 2.5 FABRICATION

- A. Continuously seal joined members by continuous welds. Grind exposed welds smooth.
- B. Fabricate connections for bolt, nut, and washer connectors.
- C. Develop required camber for members.

## 2.6 FINISH

- A. Prepare structural component surfaces in accordance with SSPC SP 3.
- B. Shop prime structural steel members.
- C. Galvanizing for Structural Steel Members: ASTM A123/A123M; minimum 1.2 oz/sq ft coating thickness; galvanize after fabrication.
- D. Galvanizing for Fasteners, Connectors, and Anchors:
  - 1. Hot-Dipped Galvanizing: ASTM A153/A153M.
  - 2. Mechanical Galvanizing: ASTM B695; Class 50 minimum.

## 2.7 SOURCE QUALITY CONTROL AND TESTS

- A. Section 014000 - Quality Requirements: Testing, inspection and analysis requirements.
- B. Shop test bolted and welded connections as specified for field quality control tests.
- C. When fabricator is approved by authority having jurisdiction, submit certificate of compliance indicating Work performed at fabricator's facility conforms to Contract Documents.
  - 1. Specified shop tests are not required for Work performed by approved fabricator.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Section 013000 - Administrative Requirements: Verification of existing conditions before starting work.
- B. Verify bearing surfaces are at correct elevation.
- C. Verify anchors rods are set in correct locations and arrangements with correct exposure for steel attachment.

### 3.2 PREPARATION

- A. Furnish templates for installation of anchor rods and embedments in concrete and masonry work.

### 3.3 ERECTION

- A. Allow for erection loads, and for sufficient temporary bracing to maintain structure safe, plumb, and in alignment until completion of erection and installation of permanent bracing.
- B. Field weld components and shear connectors indicated on Drawings.
- C. Field connect members with threaded fasteners; tighten to snug tight for bearing type connections.
- D. Do not field cut or alter structural members without approval of Architect/Engineer.
- E. After erection, touch up welds and abrasions to match shop finishes.

### 3.4 GROUT INSTALLATION

- A. Grout [under base plates in accordance with Section 036000.

- B. Shim bearing plates and equipment supports to proper elevation, snug tighten anchor bolts.
- C. Fill void under bearing surface with grout. Install and pack grout to remove air pockets.
- D. Moist cure grout.
- E. Remove forms after grout is set. Trim grout edges to form smooth surface, splayed 45 degrees.
- F. Tighten anchor bolts after grout has cured for a minimum of 3 days.

### 3.5 ERECTION TOLERANCES

- A. Section 014000 - Quality Requirements: Tolerances.
- B. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.
- C. Maximum Offset From Alignment: 1/4 inch.

### 3.6 FIELD QUALITY CONTROL

- A. Section 014000 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Bolted Connections: Inspect in accordance with AISC specifications.
  - 1. Visually inspect all bolted connections.
  - 2. For Direct Tension Indicators, comply with requirements of ASTM F959. Verify that gaps are less than gaps specified in Table 2.
- C. Welding: Inspect welds in accordance with AWS D1.1.
  - 1. Certify welders and conduct inspections and tests as required. Record types and locations of defects found in work. Record work required and performed to correct deficiencies.
  - 2. Visually inspect all welds.
  - 3. Ultrasonic Inspection: ASTM E164; perform on all full penetration welds.
  - 4. Liquid Penetrant Inspection: ASTM E165.
- D. Correct defective bolted connections and welds.

END OF SECTION



## SECTION 052100

### STEEL JOIST FRAMING

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Open web steel joists and shear stud connectors, with bridging, attached seats and anchors.
- B. Related Sections:
  - 1. Section 051200 - Structural Steel: Superstructure framing.
  - 2. Section 053110 – Steel Floor Deck
  - 3. Section 053123 - Steel Roof Deck
  - 4. Section 055000 - Metal Fabrications: Non-framing steel fabrications attached to joists.

##### 1.2 REFERENCES

- A. American Institute of Steel Construction:
  - 1. AISC Seismic Provisions for Structural Steel Buildings.
- B. ASTM International:
  - 1. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.
  - 2. ASTM A108 - Standard Specification for Steel Bars, Carbon, Cold Finished, Standard Quality.
  - 3. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
  - 4. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
  - 5. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength.
  - 6. ASTM A563 - Standard Specification for Carbon and Alloy Steel Nuts.
  - 7. ASTM B695 - Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel.
  - 8. ASTM F436 - Standard Specification for Hardened Steel Washers.
  - 9. ASTM F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.
- C. American Welding Society:
  - 1. AWS D1.1 - Structural Welding Code - Steel.
- D. Steel Joist Institute:
  - 1. SJI K - Standard Specifications for Open Web Steel Joists, K-series.
  - 2. SJI LH/DLH - Standard Specifications for Longspan Steel Joists, LH-Series and Deep Longspan Steel Joists, DLH-Series.

3. SJI JG - Standard Specification for Joist Girders.
- E. SSPC: The Society for Protective Coatings:
1. SSPC - Steel Structures Painting Manual.
  2. SSPC SP 1 - Solvent Cleaning.
  3. SSPC SP 10 - Near-White Blast Cleaning.

### 1.3 SUBMITTALS

- A. Section 013300 - Submittal Procedures: Submittal requirements.
- B. Shop Drawings:
1. Indicate standard designations, configuration, sizes, spacing, locations of joists, joist leg extensions.
  2. Joist coding, bridging, connections, attachments.
  3. Connection details.
  4. Cambers
- C. Welders' Certificates: Submit manufacturer's certificates, certifying welders employed on the Work, verifying AWS qualification within previous 12 months.

### 1.4 QUALITY ASSURANCE

- A. Perform Work in accordance with the following:
1. Steel Joist Institute.

### 1.5 QUALIFICATIONS

- A. Design connections not detailed on drawings under direct supervision of Professional Engineer experienced in design of this Work and licensed in State of Texas.

### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Section 016000 - Product Requirements: Product storage and handling requirements.

## PART 2 PRODUCTS

### 2.1 MATERIALS

- A. Manufactures: to be certified by SJI
1. Vulcraft Steel Joist
  2. SEYCO Joist Company
  3. Or approved equal

- B. Open Web Joists Members: SJI Type K. LH Longspan. DLH Deep Longspan and joist Girders.
- C. Nuts: ASTM A563 heavy hex type.
  - 1. Finish: Unfinished
- D. Washers: ASTM F436; Type 1
  - 1. Finish: Unfinished
- E. Structural Steel For Supplementary Framing and Joist Leg Extensions: ASTM A36/A36M.
- F. Welding Materials: AWS D1.1; type required for materials being welded.

## 2.2 FABRICATION

- A. Furnish bottom and top chord extensions as indicated on drawings.
- B. Fabricate to achieves minimum end bearing of:
  - 1. 2-1/2 inches on steel.
  - 2. 4 inches on masonry.

## 2.3 FINISH

- A. Shop prime joists and supplementary framing members. Do not prime surfaces that will be fireproofed.
- B. Prepare joist component surfaces in accordance with SSPC SP 2.

## 2.4 SOURCE QUALITY CONTROL AND TESTS

- A. Furnish shop testing and analysis of steel sections.
- B. When fabricator is approved by authority having jurisdiction, submit certificate of compliance indicating Work performed at fabricator's facility conforms to Contract Documents.
  - 1. Specified shop tests are not required for Work performed by approved fabricator.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Section 013000 - Administrative Requirements: Coordination and project conditions.

### 3.2 ERECTION

- A. Erect and bear joists on supports.
- B. Allow for erection loads. Install sufficient temporary bracing to maintain framing safe, plumb, and in alignment.
- C. Coordinate placement of anchors in masonry construction for securing bearing plates.
- D. After joist alignment and installation of framing, field weld joist seat to bearing plates or angles.
- E. Position and field weld joist chord extensions and wall attachments as detailed.
- F. Frame floor and roof openings greater than 18 inches with supplementary framing.
- G. Do not permit erection of decking until joists are bridged, and secured or until completion of erection and installation of permanent bridging and bracing.
- H. Do not field cut or alter structural members without approval of Architect/Engineer.
- I. After erection, prime welds, abrasions, and surfaces not shop primed

### 3.3 ERECTION TOLERANCES

- A. Section 014000 - Quality Requirements: Tolerances.
- B. Maximum Variation From Plumb: ¼ inch.
- C. Maximum Offset From Alignment: 1/4 inch.

### 3.4 FIELD QUALITY CONTROL

- A. Section 014000 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Field inspect members, connections, welds, and tightening of high strength bolts in slip-critical connections.

END OF SECTION 052100

SECTION 05 31 10  
STEEL FLOOR DECKING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
  - 1. Steel floor deck and accessories.
  - 2. Bearing plates and angles.
  
- B. Related Sections:
  - 1. Section 032000 - Concrete Reinforcement.
  - 2. Section 051200 - Structural Steel: Support framing for deck openings.
  - 3. Section 052100 - Steel Joists: Support framing for deck openings [and shear stud connectors].
  - 4. Section 053123 - Steel Roof Deck.

1.2 REFERENCES

- A. American Society of Civil Engineers:
  - 1. ASCE 3 - Standard Practice for the Construction and Inspection of Composite Slabs.
  
- B. ASTM International:
  - 1. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.
  - 2. ASTM A108 - Standard Specification for Steel Bars, Carbon, Cold Finished, Standard Quality.
  - 3. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
  - 4. ASTM A924/A924M - Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
  - 5. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
  
- C. American Welding Society:
  - 1. AWS D1.1 - Structural Welding Code - Steel.
  
- D. Steel Deck Institute:
  - 1. SDI 29 - Design Manual for Composite Decks, Form Decks and Roof Decks.
  
- E. SSPC: The Society for Protective Coatings:
  - 1. SSPC Paint 15 - Steel Joist Shop Paint.
  - 2. SSPC Paint 20 - Zinc-Rich Primers (Type I - Inorganic and Type II - Organic).
  
- F. Underwriters Laboratories Inc.:

1. UL - Fire Resistance Directory.
- G. Intertek Testing Services (Warnock Hersey Listed):
  1. WH - Certification Listings.

### 1.3 PERFORMANCE REQUIREMENTS

- A. Design metal deck in accordance with SDI 29 Design Manual and ASCE 3.

### 1.4 QUALITY ASSURANCE

- A. Perform Work in accordance with ASCE 3 for composite decks.

### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Section 016000 - Product Requirements: Product storage and handling requirements.
- B. Cut plastic wrap to encourage ventilation.

## PART 2 PRODUCTS

### 2.1 FABRICATION

- A. Metal Deck: Sheet steel, configured as follows:
  1. Span Design: multiple double single.
  2. Minimum Metal Thickness Excluding Finish: 28 gage.
  3. Nominal Height: 0.6 inch, fluted profile [to SDI 29 [NR] [IR] [WR]].

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. Erect metal deck in accordance with SDI 29 Manual.

### 3.2 FIELD QUALITY CONTROL

- A. Welding: Inspect welds in accordance with AWS D1.1.

END OF SECTION

## SECTION 05 31 23

### STEEL ROOF DECKING

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Steel roof deck and accessories.
  - 2. Bearing plates and angles.
- B. Related Sections:
  - 1. Section 033000 - Cast-in-Place Concrete.
  - 2. Section 035216 – Lightweight Insulating Concrete.
  - 3. Section 051200 - Structural Steel.
  - 4. Section 052100 - Steel Joists.

##### 1.2 REFERENCES

- A. American Society of Civil Engineers:
  - 1. ASCE 3 - Standard Practice for the Construction and Inspection of Composite Slabs.
- B. ASTM International:
  - 1. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.
  - 2. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
  - 3. ASTM A924/A924M - Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
  - 4. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
- C. American Welding Society:
  - 1. AWS D1.1 - Structural Welding Code - Steel.
- D. Steel Deck Institute:
  - 1. SDI 29 - Design Manual for Composite Decks, Form Decks and Roof Decks.
- E. SSPC: The Society for Protective Coatings:
  - 1. SSPC Paint 15 - Steel Joist Shop Paint.

##### 1.3 PERFORMANCE REQUIREMENTS

- A. Design metal deck in accordance with SDI 29 Design Manual and ASCE 3.

- B. Calculate to structural working stress design and maximum vertical deck deflection of 1/240.
- C. Design deck with maximum lateral diaphragm deflection of 1/500 of story height.

#### 1.4 SUBMITTALS

- A. Section 013300 - Submittal Procedures: Submittal requirements.
- B. Shop Drawings: Indicate deck plan, support locations, Projections, openings and reinforcement, pertinent details, and accessories.
- C. Product Data: Submit deck profile characteristics and dimensions, structural properties, and finishes
- D. Manufacturer's Installation Instructions: Submit manufacturer's installation instructions.
- E. Manufacturer's Certificates: Certify Products meet or exceed specified requirements.
- F. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within previous 12 months.

#### 1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with ASCE 3 for composite decks.

#### 1.6 QUALIFICATIONS

- A. Design deck layout, spans, fastening, and joints under direct supervision of Professional Engineer experienced in design of this Work and licensed. In State of Texas.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Section 016000 - Product Requirements: Product storage and handling requirements.
- B. Cut plastic wrap to encourage ventilation.
- C. Separate sheets and store deck on dry wood sleepers; slope for positive drainage.

### PART 2 PRODUCTS

#### 2.1 MATERIALS

- A. Sheet Steel: ASTM A653, Grade 33 Structural Quality; with G90 galvanized coating conforming to ASTM A525.
- B. Bearing Plates or Angles: ASTM A36 steel.
- C. Welding Materials: AWS D1.1.



## 2.2 FABRICATION

- A. Metal Deck: Sheet steel, configured as follows:
  - 1. Span Design: multiple
  - 2. Minimum Metal Thickness Excluding Finish: 22 gage.
  - 3. Minimum Allowable Diaphragm Shear: 250 plf.
  - 4. Nominal Height: 1-1/2 inch
  - 5. Side Joints: lapped

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Section 013000 - Administrative Requirements: Coordination and project conditions.

### 3.2 INSTALLATION

- A. Erect metal deck in accordance with SDI Manual.
- B. Bear deck on steel supports with 1-1/2 3 inch minimum bearing. Align and level.
- C. Fasten ribbed deck to steel support members at ends and intermediate supports with as indicated on drawings.
- D. Weld in accordance with AWS D1.1.
- E. Seal deck joints, laps, ends, and penetrations with sealant to achieve permanent air seal consistent with air barrier system specified in Section 07270.
- F. Reinforce steel deck openings from 6 to 18 inches in size with 2 x 2 x 1/4 inch steel angles. Place framing angles perpendicular to flutes; extend minimum two flutes beyond each side of opening and mechanically attach to deck at each flute.
- G. Install wet concrete stops at roof edge upturned to top surface of slab to contain wet concrete. Install stops of sufficient strength to remain stationary under wet concrete without distortion.
- H. Install sheet steel closures and angle flashings to close openings between deck and walls, columns, and openings.
- I. Position roof sump pans with flange bearing on top surface of deck. Fusion weld at each deck flute.
- J. Place metal cant strips in position and mechanically attach.
- K. Immediately after welding deck and other metal components in position, coat welds, burned areas, and damaged surface coating, with touch-up prime paint.

3.3 FIELD QUALITY CONTROL

- A. Welding: Inspect welds in accordance with AWS D1.1.

END OF SECTION

## SECTION 05 40 00

### COLD-FORMED METAL FRAMING

#### PART 1 GENERAL

##### 1.1 SUMMARY

###### A. Section Includes:

1. Load-bearing formed-steel stud exterior wall and framing and bridging.

##### 1.2 REFERENCE STANDARDS

###### A. American Iron and Steel Institute:

1. AISI S213: North American Standard for Cold-Formed Steel Framing - Lateral Design.
2. AISI General - Standard for Cold-Formed Steel Framing - General Provisions.
3. AISI Header - Standard for Cold-Formed Steel Framing - Header Design.
4. AISI NAS - North American Specification for the Design of Cold-Formed Steel Structural Members.
5. AISI WSD - Standard for Cold-Formed Steel Framing - Wall Stud Design.

###### B. American Welding Society:

1. AWS D1.1 - Structural Welding Code - Steel.
2. AWS D1.1M - Structural Welding Code - Steel.
3. AWS D1.3 - Structural Welding Code - Sheet Steel.
4. AWS D1.3M - Structural Welding Code - Sheet Steel.

###### C. ASTM International:

1. ASTM A1003 - Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members.
2. ASTM A1003M - Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members.
3. ASTM C955 - Standard Specification for Load-Bearing (Transverse and Axial) Steel Studs, Runners (Tracks), and Bracing or Bridging for Screw Application of Gypsum Panel Products and Metal Plaster Bases.

##### 1.3 COORDINATION

###### A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.

###### B. Coordinate Work of this Section with placement of components within stud framing system.

##### 1.4 SUBMITTALS

###### A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

###### B. Product Data: Submit data on standard framing members; describe materials and finish, product criteria and, limitations.

- C. Shop Drawings:
  - 1. Indicate component details, framed openings, anchorage, type and location of fasteners, and accessories or items required of related Work.
  - 2. Indicate stud layout.
  - 3. Describe method for securing studs and framing connections.
- D. Manufacturer's Installation Instructions: Submit special procedures, perimeter conditions requiring special attention.
- E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- F. Mill Certifications: Submit mill certifications for steel delivered to Site. Certify steel bare metal thickness of 1 mil (0.025 mm), yield strength, tensile strength, total elongation in 2-inch (50-mm) or 8-inch (200-mm) gauge length, chemical analysis, and galvanized coating thickness.
- G. Welders' Certificates: Certify welders and welding procedures employed on the Work, verifying AWS qualification within previous 12 months.
- H. Qualifications Statements:
  - 1. Submit qualifications for manufacturer and installer.
  - 2. Submit manufacturer's approval of installer.

## 1.5 QUALITY ASSURANCE

- A. Calculate structural properties of framing members according to AISI NAS.
- B. Furnish framing materials according to SSMA - Product Technical Guide.
- C. Perform Work according to following:
  - 1. Framing: AISI General and AISI NAS.
  - 2. Headers: AISI Header.
  - 3. Wall Studs: AISI WSD.

## 1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' documented experience.
- B. Installer: Company specializing in performing Work of this Section with minimum three years' documented experience and approved by manufacturer.

## PART 2 PRODUCTS

### 2.1 COLD-FORMED METAL FRAMING

- A. Manufacturers:

1. CEMCO; California Expanded Metal Products Co.
2. ClarkDietrich
3. MarinoWARE
4. MBA Building Supplies
5. The Steel Network, Inc
6. Substitutions: Section 01 60 00 - Product Requirements.

B. Description: ASTM C955.

## 2.2 FRAMING MATERIALS

A. Steel Sheet:

1. ASTM A1003 (A1003M).
2. Structural grade, Type H.
3. Grade: ST50H

## 2.3 FASTENERS

A. Self-Drilling, Self-Tapping Screws and Bolts, Nuts, and Washers: Steel, hot-dip galvanized.

B. Anchorage Devices: Power-actuated or screws with sleeves.

## 2.4 ACCESSORIES

A. Bracing, Furring, and Bridging: Formed sheet steel, .054 inch thick or as specified in construction documents, whichever is greater.

B. Plates, Gussets, and Clips: Formed sheet steel, .054 inch thick or as specified in construction documents, whichever is greater.

## PART 3 EXECUTION

### 3.1 EXAMINATION

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.

B. Verify that substrate surfaces and building framing components are ready to receive Work.

C. Verify that rough-in utilities are in proper location.

### 3.2 ERECTION

A. Studs:

1. Align floor and ceiling tracks and locate to partition layout.
2. Secure in place with fasteners at maximum 24 inches o.c.

3. Place studs as indicated on drawings not more than 2 inches from abutting walls, and at each side of openings.
4. Connect studs to tracks using clip-and-tie or fastener method.
5. Construct corners using minimum of three studs.
6. Double-stud wall openings, door jambs, and window jambs.
7. Erect load-bearing studs one piece, full length; splicing of studs not permitted.
8. Install intermediate studs above and below openings to align with wall stud spacing.
9. Install studs with deflection allowance in stud track, directly below horizontal building framing at non-load-bearing framing.
10. Attach cross studs or furring channels to studs for attachment of fixtures anchored to walls.
11. Install framing between studs for attachment of mechanical and electrical items and to prevent stud rotation.
12. Touch up field welds and damaged metallic-coatings surfaces with primer to match shop coating.

END OF SECTION

## SECTION 055000 - METAL FABRICATIONS (Metal Ladders and Metal Bollards)

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Metal ladders.
  - 2. Metal bollards.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For the following:
  - 1. Manufactured metal ladders.
  - 2. Metal bollards.
- B. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance of Aluminum Ladders: Ladders shall withstand the effects of loads and stresses within limits and under conditions specified in ANSI A14.3.

#### 2.2 METALS

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
- B. Aluminum Extrusions: ASTM B221, Alloy 6063-T6.
- C. Aluminum-Alloy Rolled Tread Plate: ASTM B632/B632M, Alloy 6061-T6.
- D. Aluminum Castings: ASTM B26/B26M, Alloy 443.0-F.

#### 2.3 FASTENERS

- A. General: Unless otherwise indicated, provide Type 304 stainless steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.

1. Provide stainless steel fasteners for fastening aluminum, stainless steel or nickel silver.
  2. Provide bronze fasteners for fastening bronze.
- B. Cast-in-Place Anchors in Concrete: Either threaded 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/F2329M.

#### 2.4 MISCELLANEOUS MATERIALS

- A. Shop Primers: Provide primers that comply with Section 099123 "Interior Painting," and Section 099600 "High-Performance Coatings."
- B. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.
- C. Water-Based Primer: Emulsion type, anticorrosive primer for mildly corrosive environments that is resistant to flash rusting when applied to cleaned steel, complying with MPI#107 and compatible with topcoat.
- D. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.
- E. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.
- F. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- G. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.
- H. Shrinkage-Resistant Grout: Factory-packaged, nonmetallic, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- I. Concrete: Comply with requirements in Section 033000 "Cast-in-Place Concrete" for normal-weight, air-entrained concrete with a minimum 28-day compressive strength of 3000 psi.

#### 2.5 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble items in the shop to greatest extent possible. 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.
- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.



- C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- D. Form exposed work with accurate angles and surfaces and straight edges.
- E. 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.
- F. 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.
- G. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- H. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, not less than 8 inches from ends and corners of units and 24 inches o.c.

## 2.6 METAL LADDERS

- A. General:
  - 1. Comply with ANSI A14.3, except for elevator pit ladders.
  - 2. For elevator pit ladders, comply with ASME A17.1/CSA B44.
- B. Aluminum Ladders:
  - 1. Provide one of the following manufacturers:
    - a. O'Keeffe's Inc. – Model 501
    - b. Upnovr, Inc
  - 2. Space siderails 18 inches apart unless otherwise indicated.
  - 3. Siderails: Continuous extruded-aluminum channels or tubes, not less than 2-1/2 inches deep, 3/4-inch-wide, and 1/8 inch thick.
  - 4. Rungs: Extruded-aluminum tubes, not less than 3/4-inch-deep and not less than 1/8-inch-thick, with ribbed tread surfaces.

## 2.7 METAL BOLLARDS

- A. Fabricate metal bollards from Schedule 80 steel pipe 1/4-inch wall-thickness, 6" Diam.
- B. Prime steel bollards with zinc-rich primer.

## 2.8 GENERAL FINISH REQUIREMENTS

- A. Finish metal fabrications after assembly.

## 2.9 STEEL AND IRON FINISHES

- A. Galvanizing: 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.
  - 1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
- B. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.
  - 1. Shop prime with universal shop primer.

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- C. Field Welding: Comply with the following requirements:
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove welding flux immediately.
  - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. 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.

### 3.2 INSTALLATION OF MISCELLANEOUS FRAMING AND SUPPORTS

- A. Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.
- B. Anchor supports for ceiling hung toilet partitions, overhead doors, and overhead grilles securely to, and rigidly brace from, building structure.
- C. Support steel girders on solid grouted masonry, concrete, or steel pipe columns. Secure girders with anchor bolts embedded in grouted masonry or concrete or with bolts through top plates of pipe columns.

### 3.3 INSTALLATION OF METAL BOLLARDS

- A. Fill metal-capped bollards solidly with concrete and allow concrete to cure seven days before installing.
- B. Anchor bollards in place with concrete footings. Center and align bollards in holes 3 inches above bottom of excavation. Place concrete and vibrate or tamp for consolidation. Support and brace bollards in position until concrete has cured.
- C. Fill bollards solidly with concrete, mounding top surface to shed water.

### 3.4 REPAIRS

- A. Touchup Painting:
  - 1. Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.

END OF SECTION 055000

## SECTION 055213 - PIPE AND TUBE RAILINGS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Steel railings.
  - 2. Aluminum railings.

#### 1.2 ACTION SUBMITTALS

- A. Product Data:
  - 1. Manufacturer's product lines of mechanically connected railings.
  - 2. Handrail brackets.
  - 3. Metal finishes.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
- C. Samples: For each type of exposed finish.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Product Test Reports: For tests on railings performed by a qualified testing agency, in accordance with ASTM E894 and ASTM E935.

#### 1.4 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel in accordance with the following:
  - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
  - 2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
  - 3. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: 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:
1. Handrails and Top Rails of Guards:
    - a. Uniform load of 50 lbf/ ft. applied in any direction.
    - b. Concentrated load of 200 lbf applied in any direction.
    - c. Uniform and concentrated loads need not be assumed to act concurrently.
  2. Infill of Guards:
    - a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft..
    - b. Infill load and other loads need not be assumed to act concurrently.

### 2.2 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.
- B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.
1. Provide type of bracket with flange tapped for concealed anchorage to threaded hanger bolt and that provides 1-1/2-inch clearance from inside face of handrail to finished wall surface.

### 2.3 STEEL RAILINGS

- A. Tubing: ASTM A500/A500M (cold formed).
- B. Pipe: ASTM A53/A53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.
1. Provide galvanized finish for exterior installations and where indicated.
- C. Plates, Shapes, and Bars: ASTM A36/A36M.
- D. Cast Iron Fittings: Either gray iron, ASTM A48/A48M, or malleable iron, ASTM A47/A47M, unless otherwise indicated.
- E. Architectural Wire Mesh Infill: Basis of Design: M13Z-145 Stainless Steel woven wire mesh. Multiple Wire, Rectangular Mesh, Rigid Cable Style Repeat. Crimp Style: PS3PZ; Overall thickness 0.402in.; Weight: 1.85lbs/sq. ft.; Percent Open: 64.5%; Aspect Ratio: 7.01:1; Mesh welded to inside leg of angle iron frame. Banker Wire, 1-800-523-6772, [www.bankerwire.com](http://www.bankerwire.com)

## 2.4 ALUMINUM RAILINGS

- A. Provide one of the following manufacturers:
  - 1. Blum, Julius & Co., Inc
  - 2. Hollaender Mfg. Co.
  - 3. Tuttle, a Dant Clayton Division
- B. Aluminum, General: Provide alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than the strength and durability properties of alloy and temper designated below for each aluminum form required.
- C. Extruded Bars and Tubing: ASTM B221, Alloy 6063-T5/T52.
- D. Extruded Structural Pipe and Round Tubing: ASTM B429/B429M, Alloy 6063-T6.
  - 1. Provide Standard Weight (Schedule 40) pipe unless otherwise indicated.
- E. Drawn Seamless Tubing: ASTM B210/B210M, Alloy 6063-T832.
- F. Plate and Sheet: ASTM B209, Alloy 6061-T6.
- G. Die and Hand Forgings: ASTM B247, Alloy 6061-T6.
- H. Castings: ASTM B26/B26M, Alloy A356.0-T6.

## 2.5 FASTENERS

- A. Fastener Materials:
  - 1. Ungalvanized-Steel Railing Components: Plated steel fasteners complying with ASTM F1941, Class Fe/Zn 5 for zinc coating.
  - 2. Hot-Dip Galvanized Railing Components: Type 304 stainless steel or hot-dip zinc-coated steel fasteners complying with ASTM A153/A153M or ASTM F2329/F2329M for zinc coating.
  - 3. Aluminum Railing Components: Type 304 stainless steel fasteners.
- B. Post-Installed Anchors: Fastener systems with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC193.
  - 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.

## 2.6 MISCELLANEOUS MATERIALS

- A. Handrail Brackets: Cast aluminum center of handrail 2-1/2 inches from face of railing.
- B. Etching Cleaner for Galvanized Metal: Complying with MPI#25.

- C. Galvanizing Repair Paint: High-zinc-dust-content paint, complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- D. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
  - 1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.
- E. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.
- F. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.
- G. Epoxy Intermediate Coat: Complying with MPI #77 and compatible with primer and topcoat.
- H. Polyurethane Topcoat: Complying with MPI #72 and compatible with undercoat.
- I. Bituminous Paint: Cold-applied asphalt emulsion, complying with ASTM D1187/D1187M.
- J. Non-shrink, Nonmetallic Grout: Factory-packaged, non-staining, noncorrosive, nongaseous grout, complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

## 2.7 FABRICATION

- A. Cut, drill, and punch metals cleanly and accurately.
  - 1. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated.
  - 2. Remove sharp or rough areas on exposed surfaces.
- B. Form work true to line and level with accurate angles and surfaces.
- C. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove flux immediately.
  - 4. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Finish #2 welds; good appearance, completely sanded joint, some undercutting and pinholes okay
- D. Welded Connections for Aluminum Pipe: Fabricate railings to interconnect members with concealed internal welds that eliminate surface grinding, using manufacturer's standard system of sleeve and socket fittings.
- E. Nonwelded Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.

- F. Bend members in jigs to produce uniform curvature for each configuration required. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.
- G. Close exposed ends of hollow railing members with prefabricated cap and end fittings of same metal and finish as railings.
- H. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is or less.
- I. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.
  - 1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush-resistant fillers or other means to transfer loads through wall finishes to structural supports and prevent bracket or fitting rotation and crushing of substrate.
- J. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work.
  - 1. Fabricate anchorage devices capable of withstanding loads imposed by railings.
  - 2. Coordinate anchorage devices with supporting structure.
- K. For railing posts set in concrete, provide stainless steel sleeves not less than 6 inches long with inside dimensions not less than 1/2 inch greater than outside dimensions of post, with metal plate forming bottom closure.
- L. For removable railing posts, fabricate slip-fit sockets from stainless steel tube or pipe whose ID is sized for a close fit with posts; limit movement of post without lateral load, measured at top, to not more than one-fortieth of post height.
  - 1. Provide socket covers designed and fabricated to resist being dislodged.
  - 2. Provide chain with eye, snap hook, and staple across gaps formed by removable railing sections at locations indicated. Fabricate from same metal as railings.
- M. Woven-Wire Mesh Infill:
  - 1. Orient wire mesh with weaved (3) wires oriented vertically and single wires oriented horizontally within frame.
- N. Toe Boards: Where indicated, provide toe boards at railings around openings and at edge of open-sided floors and platforms. Fabricate to dimensions and details indicated.

## 2.8 STEEL AND IRON FINISHES

- A. Galvanized Railings:
  - 1. Hot-dip galvanize exterior steel railings, including hardware, after fabrication.
  - 2. Comply with ASTM A123/A123M for hot-dip galvanized railings.
  - 3. Comply with ASTM A153/A153M for hot-dip galvanized hardware.



- B. For galvanized railings, provide hot-dip galvanized fittings, brackets, fasteners, sleeves, and other ferrous components.
- C. Preparing Galvanized Railings for Shop Priming: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with etching cleaner and as follows.
  - 1. Comply with SSPC-SP 16.
- D. For nongalvanized-steel railings, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves; however, hot-dip galvanize anchors to be embedded in exterior concrete or masonry.
- E. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with SSPC-SP 6/NACE No. 3.
- F. Primer Application: Apply shop primer to prepared surfaces of railings unless otherwise indicated. Comply with requirements in SSPC-PA 1 for shop painting. Primer need not be applied to surfaces to be embedded in concrete or masonry.
  - 1. Shop prime uncoated railings with universal shop primer unless indicated.
- G. High-Performance Coating: Apply epoxy intermediate and polyurethane topcoats to prime-coated surfaces. Comply with coating manufacturer's written instructions and with requirements in SSPC-PA 1 for shop painting. Apply at spreading rates recommended by coating manufacturer.
  - 1. Color: As selected by Architect from manufacturer's full range.

## 2.9 ALUMINUM FINISHES

- A. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are unacceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- B. Mill Finish: AA-M12, nonspecular as fabricated.
- C. Clear Anodic Finish: AAMA 611.
- D. Color Anodic Finish: AAMA 611.
  - 1. Color: As selected by Architect from full range of industry colors and color densities.
- E. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
  - 1. Color and Gloss: As selected by Architect from manufacturer's full range.

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Perform cutting, drilling, and fitting required for installing railings.
  - 1. Fit exposed connections together to form tight, hairline joints.
  - 2. Install railings level, plumb, square, true to line; without distortion, warp, or rack.
  - 3. Set railings accurately in location, alignment, and elevation; measured from established lines and levels.
  - 4. Do not weld, cut, or abrade surfaces of railing components that are coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
  - 5. Set posts plumb within a tolerance of 1/16 inch in 3 feet.
  - 6. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet.
- B. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.
  - 1. Coat concealed surfaces of aluminum that will be in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

### 3.2 ANCHORING POSTS

- A. Use stainless steel pipe sleeves preset and anchored into concrete for installing posts. After posts are inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout mixed and placed to comply with anchoring material manufacturer's written instructions.
- B. Form or core-drill holes not less than 5 inches deep and 3/4 inch larger than OD of post for installing posts in concrete. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink, nonmetallic grout mixed and placed to comply with anchoring material manufacturer's written instructions.
- C. Anchor posts to metal surfaces with flanges, angle type, or floor type, as required by conditions, connected to posts and to metal supporting members as follows:
- D. Install removable railing sections, where indicated on Drawing, in slip-fit stainless steel sockets cast in concrete.

### 3.3 ATTACHING RAILINGS

- A. Attach handrails to walls with wall brackets except where end flanges are used. Provide brackets with 1-1/2-inch clearance from inside face of handrail and finished wall surface.
- B. Secure wall brackets and railing end flanges to building construction as follows:

1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
2. For hollow masonry anchorage, use toggle bolts.
3. For wood stud partitions, use hanger or lag bolts set into studs or wood backing between studs. Coordinate with carpentry work to locate backing members.
4. For steel-framed partitions, use hanger or lag bolts set into fire-retardant-treated wood backing between studs. Coordinate with stud installation to locate backing members.
5. For steel-framed partitions, fasten brackets directly to steel framing or concealed steel reinforcements, using self-tapping screws of size and type required to support structural loads .
6. For steel-framed partitions, use toggle bolts installed through flanges of steel framing or through concealed steel reinforcements.

C. Touchup Painting:

1. Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

3.4 CLEANING

- A. Clean aluminum by washing thoroughly with clean water and soap and rinsing with clean water.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas, and repair galvanizing to comply with ASTM A780/A780M.

END OF SECTION 055213

## SECTION 061643 - EXTERIOR GYPSUM SHEATHING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes: Exterior gypsum sheathing products and supplementary items necessary for installation.
- B. Related Section:
  - 1. Refer to Division 7 for applicable Air and Water Barrier system and related requirements. Ensure compatibility of joint treatment components with Air and Water Barrier system.

#### 1.2 DEFINITIONS

- A. Gypsum Board Construction Terminology: Refer to ASTM C 11 for definitions of terms not defined in this Section or in other referenced quality standards.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: Manufacturer's technical literature for each product and system indicated.
  - 1. Include manufacturer's specifications for materials, finishes, construction details, installation instructions, and recommendations for maintenance.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Manufacturer's Project Acceptance Document: Certification by the manufacturer that its product(s) are approved, acceptable, suitable for use in specific locations, for specific details, and for applications indicated, specified, or required, and that a warranty will be issued.
- B. Warranty:
  - 1. Provide manufacturer's written warranty covering materials and installation (labor) stating obligations, remedies, limitations, and exclusions.

#### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications:
  - 1. Experience: Installer's personnel with not less than 5 years of experience in the successful performance of Work similar to scope of this Project.
  - 2. Supervision: Installer shall maintain a competent supervisor at Project while the Work is in progress, and who has not less than 5 years of experience installing products and systems similar to scope of this Project.

## 1.6 PRE-INSTALLATION CONFERENCE

A. Pre-Installation Conference: Before Work begins, conduct conference at Project site.

1. Participants:

- a. Architect.
- b. Contractor, including superintendent.
- c. Installer, including project manager and supervisor.
- d. If requested, Manufacturer's qualified technical representative.
- e. Installers of other construction interfaced with Work.

2. Minimum Agenda: Installer shall demonstrate understanding of the Work required by describing detailed procedures for preparing, installing, and cleaning the Work. Demonstration shall include, but not be limited to, following topics:

- a. Tour representative areas of Work, inspect and discuss condition of substrate, and other preparatory work performed by other trades.
- b. Review Contract Document requirements.
- c. Review approved submittals.
- d. Review inspection and testing requirements.
- e. Review environmental conditions and procedures for coping with unfavorable conditions.
- f. Resolve deviations or differences between Contract Documents and the manufacturer's specifications.

3. Record discussions, including decisions and agreements, and prepare report.

## 1.7 DELIVERY, STORAGE, AND HANDLING

A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

## 1.8 PROJECT CONDITIONS

A. Field Measurements: Where products and systems are indicated to fit walls and other construction, verify dimensions by field measurements before fabrication.

B. Exposure Limitation: Exterior gypsum sheathing shall not be exposed to weather for more than 180 days.

## 1.9 COORDINATION

A. Coordinate installation of products and systems with interfacing and adjoining construction to provide a successful installation without failure.

1. Ensure compatibility of joint treatment components with Air and Water Barrier systems incorporated into project.

## 1.10 WARRANTY

- A. **Manufacturer's Warranty:** Furnish manufacturer's written material and labor warranty signed by an authorized representative using manufacturer's standard form agreeing to furnish materials and labor required to repair or replace work which exhibits material defects caused by manufacture or design and installation of product. "Defects" is defined to include but not limited to deterioration or failure to perform as required.
1. **Warranty Period:** Manufacturer shall warrant the products to be free from material and labor defects for a period of 5 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS AND PRODUCTS

- A. **Acceptable Manufacturers and Products:** Subject to compliance with requirements of Contract Documents as judged by the Architect, provide product by one of manufacturers listed. If not listed, submit as substitution according to the Conditions of the Contract and Division 01 Section "Substitution Procedures".
- B. **Basis of Design (Product Standard):** Contract Documents are based on products and systems specified to establish a standard of quality. Other available manufacturers offering products having equivalent characteristics may be considered, provided deviations are minor and comply with requirements of Contract Documents as judged by the Architect.

### 2.2 MATERIALS

- A. **Single Source Responsibility:** Furnish each type of product from single manufacturer. Provide secondary materials only as recommended by manufacturer of primary materials.
- B. **Exterior Gypsum Sheathing Boards:**
1. **Generic Type:** Glass-mat faced exterior gypsum sheathing board.
  2. **Material Quality Standard:** ASTM C 1177 / C 1177M, Type X.
  3. **Description:** Paperless, treated, water resistant, noncombustible, gypsum core with inorganic glass mat partially or completely embedded on both faces; acrylic coated on one face; 5/8 in thick. Provide in maximum lengths and widths available that will minimize short-edge-to-short-edge butt joints and to correspond to support system indicated.
  4. **Manufacturers and Products:**
    - a. American Gypsum; M-Glass Exterior Sheathing.
    - b. CertainTeed Corporation; GlasRoc Sheathing, Type X.
    - c. Georgia-Pacific Gypsum LLC; DensGlass Gold Fireguard Type X Sheathing.
    - d. National Gypsum Company; Gold Bond Brand eXP Fire-Shield Extended Exposure Sheathing.
    - e. United States Gypsum Company (USG); Securock Firecode Type X Glass-Mat Sheathing.
- C. **Vertical Cover Boards (Back of Parapet):**
1. **Generic Type:** Glass-mat faced exterior gypsum sheathing board specifically manufactured for use beneath roofing systems.

2. Material Quality Standard: ASTM C 1177 / C 1177M, Type X.
  3. Description: Non-combustible moisture-resistant gypsum core with glass-mat facings and a non-asphaltic coating on one face; 5/8 in thick. Provide in maximum lengths and widths available that will minimize short-edge-to-short-edge butt joints and to correspond to support system indicated.
  4. Manufacturers and Products:
    - a. Georgia-Pacific Gypsum LLC; DensDeck Prime.
    - b. USG; SECUROCK Gypsum-Fiber Roof Board.
- D. Horizontal Roof Cover Boards: As specified in Division 07 Section for roofing membrane.
- E. Screw Fasteners:
1. Material Quality Standards:
    - a. Metal Framing Members less than 0.030 in Thick: ASTM C 1002, Type S.
    - b. Metal Framing Members from 0.033 in to 0.112 in Thick: ASTM C 954, Type S-12.
  2. Product Description - Standard Applications: Bugle head, self-drilling, self-tapping, steel screws with Phillips-head recess of size, holding power, and other properties recommended by manufacturer; minimum 1 in long; with corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B 117.
  3. Limitation: Nails and staples are not permitted.
- F. Joint and Penetration Treatment Materials:
1. General: Joint and penetration treatment materials shall be compatible with and recommended by gypsum sheathing manufacturer and air / water barrier manufacturer for application indicated.
  2. Air Barrier Liquid Membrane: Liquid detail and substrate patching membrane for use with sheathing tape at joints and penetrations and for covering exposed fasteners.
    - a. Sheathing Tape: Type recommended by sheathing manufacturer and air / water barrier manufacturer for use with air barrier liquid membrane in sealing joints and penetrations in glass-mat gypsum sheathing.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Acceptance of Surfaces and Conditions: Examine substrates to receive products and systems and associated work for compliance with requirements and other conditions affecting performance. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents. Starting work within a particular area will be construed as acceptance of surface conditions.

### 3.2 INSTALLATION, GENERAL

- A. Installation Quality Standard: In addition to standards listed elsewhere, perform Work according to following, unless otherwise specified:

1. GA-253.
2. ASTM C 1280.
3. Respective manufacturer's written installation instructions.
4. Accepted submittals.
5. Contract Documents.

- B. Control of Corrosion: Prevent galvanic action and other forms of corrosion by isolating metals and other materials from direct contact with incompatible materials.

### 3.3 PREPARATION

- A. General: Comply with manufacturer's instructions, recommendations and specifications for cleaning and surface preparation. Surfaces shall have no defects, contaminants, or errors which would result in poor or potentially defective installation or would cause latent defects in Work.

### 3.4 INSTALLATION

- A. Installation of Exterior Gypsum Sheathing Boards and Back of Parapet Boards:

1. Install boards with coated face out, with panel lengths oriented vertically or horizontally as recommended by manufacturer, with vertical edges centered over flanges of studs, with edges and ends fitted tightly together.
2. Do not install imperfect, damaged, wet, or damp boards.
3. Cut boards at penetrations, edges, and other obstructions of the Work; fit tightly against abutting construction, except provide maximum 3/8 in setback where boards abuts structural elements or materials that may retain moisture.
4. Coordinate installation of boards with flashing and joint treatment so materials are installed in the sequence and manner that prevent exterior moisture from passing through completed exterior wall assembly.
5. Install screws at perimeter and within field to each stud approximately 8 in on centers; set back minimum 3/8 in from edges and ends; apply so screw heads bear tightly against board face but do not cut into facing.
6. Do not bridge building expansion joints with boards; cut and space edges to match spacing of structural support elements.

- B. Joint and Penetration Treatment at Exterior Gypsum Sheathing Boards and Back of Parapet Boards:

1. Coordinate installation with applicable air / water barrier system to ensure compatibility of joint and penetration treatment.
2. Apply liquid membrane to joints and fasteners and trowel flat. Apply liquid membrane sufficiently to completely cover joints and fasteners after troweling. Seal other penetrations and openings.
3. Apply sheathing tape to glass-mat gypsum sheathing joints. Apply and trowel liquid membrane to embed entire face of tape. Apply liquid membrane to exposed fasteners with a trowel so fasteners are completely covered. Seal other penetrations and openings.



### 3.5 PROTECTION

- A. Procedures: Protect products and systems from damage during installation and remainder of construction period according to manufacturer's instructions. Remove and replace products that are exposed to weather for more than number of days allowed by manufacturer.

END OF SECTION

## SECTION 064000 - ARCHITECTURAL WOODWORK

### PART 1 - GENERAL

#### RELATED DOCUMENTS:

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

#### DESCRIPTION OF WORK:

Extent of each type of architectural woodwork is indicated on drawings and in schedules.

Types of architectural woodwork include the following:

- Shelving
- Millwork
- Countertops

Finish carpentry is specified in another section of Division 6.

#### QUALITY ASSURANCE:

**AWI Quality Marking:** Mark each assembled unit of architectural woodwork with manufacturer's identification and grade mark evidencing compliance with indicated AWI quality grade. Locate grade mark on surfaces which will not be exposed after installation. For other items requiring field assembly, a certification of compliance may be substituted for marking of individual pieces.

Arrange for architectural woodwork with sequence matched wood veneers to be produced by a single firm.

#### REFERENCES:

**AWI Quality Standard:** Comply with applicable requirements of "Architectural Woodwork Quality Standards" published by the Architectural Woodwork Institute (AWI), excets otherwise indicated.

#### SUBMITTALS:

**Product Data:** Submit manufacturer's specifications and installation instructions for each item of factory fabricated woodwork.

**Certification:** Include certification that fire -retardant treated materials comply with governing regulations.

**Quality Certification:** Submit Manufacturer's (Fabricator's) certification, stating that fabricated work complies with quality grades and other requirements indicated.

**Shop Drawings:** Submit shop drawings showing location of each item, dimensioned plans and elevations, large scale details, attachment devices and other components. Submit shop drawings for the following:

- Framed openings and lights, including trim.
- Shelving

#### PRODUCT DELIVERY, STORAGE AND HANDLING:

Protect woodwork during transit, delivery, storage and handling to prevent damage, soiling and deterioration.

Do not deliver woodwork, until painting, wet work, grinding and similar operations which could damage, soil or deteriorate woodwork have been completed in installation areas. If, due to unforeseen circumstances, woodwork must be stored in other than installation areas, store only in areas meeting requirements specified for installation areas.

JOB CONDITIONS:

Conditioning: Woodwork Manufacturer and Installer shall advise Contractor of temperature and humidity requirements for woodwork installation and storage areas. Do not install woodwork until required temperature and relative humidity have been stabilized and will be maintained in installation areas.

Maintain temperature and humidity in installation area as required to maintain moisture content of installed woodwork within a 1.0 percent tolerance of optimum moisture content, from date of installation through remainder of construction period.

The fabricator of woodwork shall determine optimum moisture content and required temperature and humidity condition.

PART 2 PRODUCTS

General: Except as otherwise indicated, comply with following requirements for architectural woodwork not specifically indicated as prefabricated or pre-finished standard products.

Wood Moisture Content: Provide kiln dried (KD) lumber with an average content range of 6% to 11% for interior work. Maintain temperature and relative humidity during fabrication, storage and finishing operations so that moisture content values for woodwork at time of installation do not exceed the following:

Interior Wood Finish: 5% - 10% for mild regions (as defined by AWI).

Plywood: Closed grain hardwood plywood with exterior glue complying with requirements for specified woodwork grade.

Plastic Laminate: Comply with NEMA LD-3 for type, thickness, color, pattern and finish as indicated for each application, or if not indicated, as selected by Architect from manufacturer's standard products as well as the following;

Wilsonart -	All Available Colors, including Premium Colors
Formica -	All Available Colors, including Premium Colors
Nevamar-	All Available Colors, including Premium Colors

Quality Standards: For following types of architectural woodwork; comply with indicated standards as applicable:

Standing and Running Trim: AWI Section 300.

Casework and Countertops: AWI Section 400.

Shelving: AWI Section 600.

Miscellaneous Work: AWI Section 700.

Exterior Frames: AWI Section 900.

Design and Construction Features: Comply with details shown for profile and construction of architectural woodwork, and, where not otherwise shown, comply with applicable Quality Standards, with alternate details as Fabricator's option.

Pre -Cut Openings: Fabricate architectural woodwork with pre -cut openings, where possible, to receive hardware, appliances, plumbing fixtures, electrical work and similar items. Locate openings accurately and use templates or roughing -in diagrams for proper size and shape. Smooth edges of cutoffs and, where located in countertops and similar exposures seal edges of cutouts with a water -resistant coating.

Measurements: Before proceeding with fabrication of woodwork required to be fitted to other construction, obtain field measurements and verify dimensions and shop drawing details as required for accurate fit.

Where sequence of measuring substrates before fabrication would delay the project, proceed with fabrication (without field measurements) and provide ample borders and edges to allow for subsequent scribing and trimming of woodwork for accurate fit.

#### INTERIOR ARCHITECTURAL WOODWORK:

Core: Plywood. Particle core panels will not be accepted.

Construction: Reveal overlay.

Exposed Surfaces: Provide high pressure laminate in grades indicated for the following types of surfaces:

Horizontal Surfaces: GP -50 (0.050" nominal thickness).

Post Formed Surfaces: PF -42 (0.042" nominal thickness).

Vertical Surfaces: GP -28 (0.028" nominal thickness).

Except as otherwise indicated, provide separate plastic laminate countertops (installed over closed grain plywood substrate) to comply with requirements for casework for plastic laminate finish. Provide with coved backsplash. Note at science lab countertops, provide epoxy resin tops, black in color.

Fabricate exposed edges of casework, including edges of doors and drawers when open, with matching plastic laminate, except as otherwise indicated.

Shelves: 1" thick, reversible, plastic laminate finish all sides and all edges.

General: These requirements do not apply to shelving which is either integral with or indicated as "casework"; comply with casework requirements for those units of shelving.

Grade: Custom.

#### FINISH FOR ARCHITECTURAL WOODWORK:

General: The priming and pre-finishing (if any) of architectural woodwork required to be performed at the shop or factory is specified as work of this section. Refer to Division 9 sections for final finishing of installed architectural woodwork.

At the Contractor's option, he may use plastic laminate interior finish in lieu of painted surfaces.

Preparations for Finish: Comply with AWI Quality Standards, Section 1500, for sanding, filling countersunk fasteners, back priming and similar preparations for finishing of architectural woodwork, as applicable to each unit of work.

## CABINET HARDWARE AND ACCESSORY MATERIALS:

General: Provide cabinet hardware and accessory materials associated with architectural woodwork, except for units which are specified as "door hardware" in other sections of these specifications.

Hardware Standards: Except as otherwise indicated, comply with ANSI A156.9 "American National Standard for Cabinet Hardware".

Quality Level: Type 2 (institutional), unless otherwise indicated.

Quality Certification: Where available, provide cabinet hardware bearing the BHMA certification label, affixed either to hardware or its packaging, showing compliance with BHMA.

Cabinet Hardware Standard 201.

Cabinet Hardware: Provide all cabinet hardware required for proper installation and operation, whether listed below or not.

Metal Shelf Standards and Brackets: Provide one of the following:  
No. 87 Standards and No. 187 Brackets; Knape & Vogt Mfg. Co.  
Finish: Nickel-plated.

Pivoted Hinges: model no. Snap on 300 Series Hinge by Grass America

Finish for Butts and Hinges: Stain nickel-plated.

Cabinet Door Pulls: Steel Wire Pulls 4" C/C, Satin Chrome Finish

Door Pull Finish: Satin Chrome

Magnetic Cabinet Catches: Provide one of the following:  
Aluminum, satin finish, No.916, Knape & Vogt.  
Aluminum, satin finish, No.46 ALD, Standley Hardware Div.

Drawer Slides: KV 4100 Low Profile - Knape & Vogt Mfg. Co.

Locks: Master Lock Five (5) pin tumbler at all drawers and doors. Typical

Cabinet Door Hardware: Provide hinges, catches and pulls of types indicated, to accommodate each door size and style.

Drawer Hardware: Provide slides and pulls of types indicated, to accommodate each drawer size and style.

Equip each drawer with side-mounted, full-extension, ball-bearing, nylon roller drawer slides with load capacity of 75 lbs. per pair.

Locks: provide standard pin-type or disc-type (5 pins or discs) tumbler locks, keyed alike in each room, at all base and wall cabinets unless noted otherwise.

Shelf Supports: Where shelving is indicated as "adjustable:", provide slotted-type standards and brackets of type needed to properly support shelves with uniform 40-lb per sq. ft. loading.

Closet Bars: Telescoping steel or brass tubing, with forged end brackets; size and wall thickness as required to support full continuous hanging of clothing.

Exposed Hardware Finish: Provide exposed hardware with BHMA Code 626 satin chromium plate finish (US26D). Where not available, provide either satin aluminum or satin stainless steel finish.

### PART 3 - EXECUTION

#### PREPARATION:

Condition woodwork to average prevailing humidity conditions in installation areas prior to installing.

Prior to installation of architectural woodwork, examine shop fabricated work for completion, and complete work as required, including back priming and removal of packing.

#### INSTALLATION:

Install woodwork plumb, level, true and straight with no distortions. Shim as required using concealed shims. Install to a tolerance of 1/8" in 8' -0" for plumb and level (including countertops); and with 1/16" maximum offset in flush adjoining surfaces, 1/8" maximum offsets in revealed adjoining surfaces.

Scribe and cut work to fit adjoining work, and refinish cut surfaces or repair damaged finish at cuts.

Standing and Running Trim: Install with minimum number of joints possible, using full length pieces (from maximum length of lumber available) to the greatest extent possible. Stagger joints in adjacent and related members. Cope at returns, miter at corners and comply with referenced Quality Standards for joinery.

Anchor woodwork to anchors or blocking built -in or directly attached to substrates. Secure to grounds, stripping and blocking with countersunk, concealed fasteners and blind nailing as required for a complete installation. Except where pre-finished matching fasteners heads are required, use fine finishing nails for exposing nailing, countersunk and filled flush with woodwork, and matching final finish where transparent finish is indicated.

Wood Storage Shelving: Complete the assembly of units and install in the areas indicated, including hardware and accessories as indicated.

#### ADJUSTMENT, CLEANING, FINISHING AND PROTECTION:

Repair damaged and defective woodwork where possible to eliminate defects functionally and visually; where not possible to repair replace woodwork. Adjust joinery for uniform appearance.

Clean woodwork on exposed and semi -exposed surfaces. Touch up shop applied finishes restoring damaged or soiled areas.

Protection: Installer of architectural woodwork shall advise Contractor of final protection and maintained conditions necessary to ensure that work will be without damage or deterioration at time of acceptance.

END OF SECTION 06400

## SECTION 071326 - SELF-ADHERING SHEET WATERPROOFING

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Modified bituminous sheet waterproofing.

#### 1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

- B. Shop Drawings: Show locations and extent of waterproofing and details of substrate joints and cracks, expansion joints, sheet flashings, penetrations, inside and outside corners, tie-ins with adjoining waterproofing, and other termination conditions.

1. Include setting drawings showing layout, sizes, sections, profiles, and joint details of pedestal-supported concrete pavers.

- C. Samples: For each exposed product and for each color and texture specified.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Sample warranties.

#### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by waterproofing manufacturer.

#### 1.6 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to furnish replacement waterproofing material for waterproofing that does not comply with requirements or that fails to remain watertight within specified warranty period.

1. Warranty Period: Three years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MODIFIED BITUMINOUS SHEET WATERPROOFING

- A. Modified Bituminous Sheet Waterproofing: Minimum 60-mil nominal thickness, self-adhering sheet consisting of 56 mils of rubberized asphalt laminated on one side to a 4-mil thick, polyethylene-film reinforcement, and with release liner on adhesive side
1. Provide one of the following manufacturers:
    - a. W.R. Meadows – Air Shield SMP
    - b. Henry – Blue Skin SA
    - c. Vapro Shield- WrapShield SA Self-Adhered
  2. Physical Properties:
    - a. Tensile Strength, Membrane: 250 psi minimum; ASTM D412, Die C, modified.
    - b. Ultimate Elongation: 300 percent minimum; ASTM D412, Die C, modified.
    - c. Low-Temperature Flexibility: Pass at minus 20 deg F ASTM D1970/D1970M.
    - d. Crack Cycling: Unaffected after 100 cycles of 1/8-inch movement; ASTM C836/C836M.
    - e. Puncture Resistance: 40 lbf minimum; ASTM E154/E154M.
    - f. Water Absorption: 0.2 percent weight-gain maximum after 48-hour immersion at 70 deg F; ASTM D570.
    - g. Water Vapor Permeance: 0.05 perm maximum; ASTM E96/E96M, Water Method.
    - h. Hydrostatic-Head Resistance: 200 feet minimum; ASTM D5385.
  3. Sheet Strips: Self-adhering, rubberized-asphalt strips of same material and thickness as sheet waterproofing.

### 2.2 AUXILIARY MATERIALS

- A. Furnish auxiliary materials recommended by waterproofing manufacturer for intended use and compatible with sheet waterproofing.
1. Furnish liquid-type auxiliary materials that comply with VOC limits of authorities having jurisdiction.
- B. Primer: Liquid waterborne primer recommended for substrate by sheet-waterproofing material manufacturer.
- C. Surface Conditioner: Liquid, waterborne surface conditioner recommended for substrate by sheet-waterproofing material manufacturer.
- D. Liquid Membrane: Elastomeric, two-component liquid, cold fluid applied, of trowel grade or low viscosity.
- E. Substrate Patching Membrane: Low-viscosity, two-component, modified asphalt coating.



- F. Metal Termination Bars: Aluminum bars, approximately 1 by 1/8 inch predrilled at 9-inch centers.
- G. Protection Course, Extruded-Polystyrene Board Insulation, Unfaced: ASTM C578, Type X, 1/2 inch thick.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Clean, prepare, and treat substrates according to manufacturer's written instructions. Provide clean, dust-free, and dry substrates for waterproofing application.
- B. Mask off adjoining surfaces not receiving waterproofing to prevent spillage and overspray affecting other construction.

### 3.2 INSTALLATION OF MODIFIED BITUMINOUS SHEET-WATERPROOFING

- A. Install modified bituminous sheets according to waterproofing manufacturer's written instructions.
- B. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by sheet waterproofing in same day. Reprime areas exposed for more than 24 hours.
- C. Apply and firmly adhere sheets over area to receive waterproofing. Accurately align sheets and maintain uniform 2-1/2-inch minimum lap widths and end laps. Overlap and seal seams, and stagger end laps to ensure watertight installation.
  - 1. When ambient and substrate temperatures range between 25 and 40 deg F install self-adhering, modified bituminous sheets produced for low-temperature application. Do not use low-temperature sheets if ambient or substrate temperature is higher than 60 deg F.
- D. Horizontal Application: Apply sheets from low to high points of decks to ensure that laps shed water.
- E. Apply continuous sheets over already-installed sheet strips, bridging substrate cracks, construction, and contraction joints.
- F. Seal edges of sheet-waterproofing terminations with mastic.
- G. Install sheet-waterproofing and auxiliary materials to tie into adjacent waterproofing.
- H. Repair tears, voids, and lapped seams in waterproofing not complying with requirements. Slit and flatten fishmouths and blisters. Patch with sheet waterproofing extending 6 inches beyond repaired areas in all directions.
- I. Immediately install protection course with butted joints over waterproofing membrane.

1. Board insulation may be used in place of a separate protection course to vertical applications when approved by waterproofing manufacturer and installed immediately.

### 3.3 PROTECTION, REPAIR, AND CLEANING

- A. Do not permit foot or vehicular traffic on unprotected membrane.
- B. Protect installed insulation drainage panels from damage due to UV light, harmful weather exposures, physical abuse, and other causes. Provide temporary coverings where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.
- C. Correct deficiencies in or remove waterproofing that does not comply with requirements; repair substrates, reapply waterproofing, and repair sheet flashings.
- D. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended in writing by manufacturer of affected construction.

END OF SECTION 071326

## SECTION 072100-THERMAL INSULATION

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes: Thermal insulation products and systems and supplementary items necessary for installation.

#### 1.2 SUBMITTALS

- A. Product Data: Manufacturer's technical literature for each product and system indicated.
  - 1. Include manufacturer's specifications for materials, finishes, construction details, installation instructions, and recommendations for maintenance.
- B. Field Quality Control Reports: Written report of testing and inspection required by "Field Quality Control".
- C. Manufacturer's Project Acceptance Document: Certification by the manufacturer that its product(s) are approved, acceptable, suitable for use in specific locations, for specific details, and for applications indicated, specified, or required.

#### 1.3 PRE-INSTALLATION CONFERENCE

- A. Pre-Installation Conference: Before Work begins, conduct conference at Project site to comply with requirements of applicable Division 01 Sections.
  - 1. Required Attendees:
    - a. Owner.
    - b. Architect.
    - c. Contractor, including superintendent.
    - d. Installer, including project manager and supervisor.
    - e. Manufacturer's qualified technical representative.
    - f. Installers of other construction interfaced with Work.
    - g. Owner's testing agency.
  - 2. Minimum Agenda: Installer shall demonstrate understanding of the Work required by describing detailed procedures for preparing, installing, and cleaning the Work. Demonstration shall include, but not be limited to, following topics:
    - a. Tour representative areas of Work, inspect and discuss condition of substrate, and other preparatory work performed by other trades.
    - b. Review Work requirements (Drawings, Specifications, and other Contract Documents).
    - c. Review required submittals, both completed and yet to be completed.

- d. Review and finalize construction schedule related to Work and verify availability of materials, installer's personnel, equipment, and facilities needed to make progress and avoid delays.
  - e. Review required inspection, testing, certifying, and material usage accounting procedures.
  - f. Review environmental conditions and procedures for coping with unfavorable conditions.
  - g. Resolve deviations or differences between Contract Documents and the manufacturer's specifications.
3. Contractor shall record discussions of conference, including decisions and agreements reached, and furnish copy of record to each party attending. If substantial disagreements exist at conclusion of conference, determine how disagreements will be resolved and set date for reconvening conference.

#### 1.4 DELIVERY, STORAGE, AND HANDLING

- A. Protect insulation materials from physical damage and from deterioration by 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 plastic insulation as follows:
  - 1. Do not expose to sunlight, except to extent necessary for period of installation and concealment.
  - 2. Protect against ignition at all times. Do not deliver plastic insulating materials to Project site before installation time.
  - 3. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

#### 1.5 COORDINATION

- A. Coordinate installation of products and systems with interfacing and adjoining construction to provide a successful installation without failure.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS AND PRODUCTS

- A. Acceptable Manufacturers and Products: Subject to compliance with requirements of Contract Documents as judged by the Architect, provide product by one of manufacturers listed. If not listed, submit as substitution according to Conditions of the Contract and Division 01 Section "Substitution Procedures".
- B. Basis of Design (Product Standard): Contract Documents are based on products and systems specified to establish a standard of quality. Other available manufacturers offering products having equivalent characteristics may be considered, provided deviations are minor and comply with requirements of Contract Documents as judged by the Architect.

#### 2.2 MATERIALS, GENERAL

- A. Single Source Responsibility: Furnish each type of product from single manufacturer. Provide secondary materials only as recommended by manufacturer of primary materials.

- B. General: Provide insulating materials that comply with requirements and referenced standards in sizes to fit applications indicated, selected from manufacturer's standard thicknesses, widths, and lengths.

## 2.3 PERFORMANCE REQUIREMENTS

- A. Plenum Rating: Provide fiberglass insulation to be installed within ceiling plenums rated as follows for use in plenums as determined by testing identical products per "Erosion Test" and "Mold Growth and Humidity Test" described in UL 181, or by comparable tests from another standard acceptable to authorities having jurisdiction.
  - 1. Erosion Test Results: No visible evidence of cracking, flaking, peeling, or delamination of interior surface of duct assembly, after testing for 4 hours at 2500 fpm (13 m/s) air velocity.
  - 2. Mold Growth and Humidity Test Results: No evidence of mold growth, delamination, or other deterioration due to the effects of high humidity, after inoculation with Chaetomium globosum on all surfaces and storing for 60 days at 100 percent relative humidity in the dark.
- B. Fire-Test-Response Characteristics:
  - 1. Fire Resistance Ratings: Materials and construction identical to assemblies tested for fire resistance according to ASTM E 119/NFPA 251/UL 263 and included under Categories listed below that are published in Underwriters Laboratories, Inc. (UL) "Fire Resistance Directory"; or listing of another testing and inspecting agency acceptable to authorities having jurisdiction.
    - a. Polystyrene Insulation: Category CCVW.
    - b. Fiberglass Insulation: Category BZJZ
  - 2. Surface Burning Characteristics: Materials and construction identical to assemblies tested for fire resistance according to ASTM E 84/NFPA 255/UL 723 by an independent testing and inspecting agency acceptable to authorities having jurisdiction listed below. Identify products with appropriate markings of applicable testing agency.
  - 3. Fire Rated Assembly Design: Selected from Product Category BXUV published in UL's "Fire Resistance Directory", or design of other testing agency acceptable to authorities having jurisdiction.
  - 4. Combustion Characteristics: Materials and construction identical to assemblies tested for fire resistance according to ASTM E 136 by an independent testing and inspecting agency acceptable to authorities having jurisdiction

## 2.4 MASONRY CAVITY WALL INSULATION

- A. Description: Unfaced rigid cellular extruded polystyrene thermal insulation formed from polystyrene base resin by an extrusion process, and with other requirements indicated below:
- B. Product Quality Standard: ASTM C 578, Type IV, 25 psi minimum compressive strength.
- C. Surface Burning Characteristics:
  - 1. Flame Spread: Class A - no greater than 25.
  - 2. Smoke Developed: No greater than 175.
- D. Size: 16 in high by 96 in long, square edges, thickness as indicated on drawings.

- E. Water Vapor Permeance: 1.1 maximum per ASTM E96.
- F. R-Value: Per indicated thickness.
- G. Manufacturers and Products:
  1. Dow Chemical Company; Styrofoam CavityMate Plus
  2. Owens Corning; FOAMULAR CW25
  3. Pactiv Building Products Division; GreenGuard Type IV 25.
- H. Adhesive for Bonding Insulation: Product compatible with insulation being bonded and with demonstrated capability to bond insulation securely to substrates indicated without damaging insulation or substrates.

## 2.5 UNFACED FIBERGLASS SEMI-RIGID INSULATION

- A. Description: ASTM C 612, Type IA or Types IA and IB. Unfaced, semi-rigid boards produced by bonding inorganic glass fibers with a thermosetting binder.
- B. Manufacturers and Products:
  1. CertainTeed Corporation; CB-300.
  2. Johns Manville; Insul-SHIELD 300.
  3. Knauf Fiber Glass; IB Board 3.00 PCF.
  4. Owens-Corning; 703.
- C. Nominal Density: 3 lb/cu ft (48 kg/cu m), thermal resistivity of 4.3 deg F x h x sq ft/Btu x in at 75 deg F (29.8 K x m/W at 24 deg C).
- D. Surface-Burning Characteristics:
  1. Flame Spread: Class A - no greater than 25.
  2. Smoke Developed: No greater than 50.
  3. Combustion Characteristics: Pass.
- E. Thickness: As indicated.

## 2.6 UNFACED FIBERGLASS BATT INSULATION

- A. Description: ASTM C 665, Type I. Unfaced blankets produced by bonding inorganic glass fibers with a thermosetting binder. Minimum R-Value of 13.
- B. Manufacturers and Products:
  1. CertainTeed Corporation; CertaPro.
  2. Guardian Fiberglass, Inc.; Unfaced Batts for Metal Framing.
  3. Johns Manville; Unfaced Batts for Metal Framing.
  4. Knauf Fiber Glass; QuietTherm Unfaced QT.
  5. Owens-Corning; Thermal Batts for Metal Frame Construction.
- C. Surface Burning Characteristics:
  1. Flame Spread: Class A - no greater than 25.
  2. Smoke Developed: No greater than 50.

**add - FSK or PSK E  
Faced—EcoTouch.  
Flame Spread  
25 Batt Insulation**

3. Combustion Characteristics: Pass.

D. Thickness: Full depth of metal stud cavity.

## 2.7 MINERAL WOOL SEMI-RIGID INSULATION

A. Exterior Wall Cavity Locations: ASTM C 612, Type IVA or IVB. Unfaced rock mineral wool board insulation, lightweight and water repellent, and intended for use in cavity wall installations; attached to substrate with mechanical fasteners.

1. Surface Burning Characteristics per ASTM E 84:

- a. Flame spread: 25 or less.
- b. Smoke developed: 50 or less.

2. Thickness: As indicated on drawings.

3. R-Value: Minimum of 4.3 per in.

4. Fiber Color: Dark brown.

5. Manufacturers and Products:

- a. Roxul, Inc.; CavityRock MD
- b. Owens Corning; Thermafiber, Inc.; RainBarrier 45

B. Other-than-Cavity Wall Locations:

1. Unfaced: ASTM C 612, Types IA and IB. Unfaced rock mineral wool board insulation.

2. Density: Nominal density of 4 lb/cu. ft., thermal resistivity of 4 deg F x h x sq. ft./Btu x in. at 75 deg F.

3. Surface Burning Characteristics per ASTM E 84:

- a. Flame spread: 25 or less.
- b. Smoke developed: 50 or less.

4. Thickness: As indicated on drawings but not less than required for an R-value of 19.

5. Fiber Color: Regular color, unless otherwise indicated.

6. Manufacturers:

- a. Rock Wool Manufacturing Company.
- b. Roxul, Inc.
- c. Themafiber, Inc.

## 2.8 POLYISOCYANURATE FOAM-PLASTIC BOARD

A. Polyisocyanurate Board, Foil Faced: ASTM C 1289, foil faced, Type I, Class 1 or 2.

## 2.9 SPRAYED FOAM INSULATING GAP FILLER

A. As specified in Division 07 Section "Joint Sealants".

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Acceptance of Surfaces and Conditions: Examine substrates to which thermal insulation will be applied for compliance with requirements and other conditions affecting performance. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents. Starting Work within a particular area will be construed as acceptance of surface conditions.

### 3.2 INSTALLATION, GENERAL

- A. Installation Quality Standards: In addition to standards listed elsewhere, perform Work according to following, unless otherwise specified:
  - 1. Respective manufacturer's written installation instructions.
  - 2. Accepted submittals.
  - 3. Contract Documents.
- B. General Requirements:
  - 1. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed at any time to ice, rain, or snow.
  - 2. Comply with insulation manufacturer's written instructions applicable to products and application indicated.
  - 3. Extend insulation in thickness indicated to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
  - 4. Extend insulation full thickness to envelop entire area to be insulated. Cut and fit tightly around obstructions, and fill voids with insulation. Remove projections that interfere with placement.
  - 5. Apply a single layer of insulation to produce thickness indicated, unless multiple layers are otherwise shown or required to make up total thickness.

### 3.3 PREPARATION

- A. General: Comply with manufacturer's instructions, recommendations, and specifications for cleaning and surface preparation. Surfaces shall have no defects, contaminants, or errors which would result in poor or potentially defective installation or would cause latent defects in Work.

### 3.4 INSTALLATION OF INSULATION SYSTEMS

- A. Masonry Cavity Wall Insulation: Attach cavity wall insulation by placing beads of adhesive at 12 in (300 mm) on center both ways on inside face of insulation and pressing firmly against inside wythe of cavity. Fit insulation between veneer wall ties and other confining obstructions in cavity, with edges butted tightly.
- B. Unfaced Fiberglass Semi-Rigid and Batt Insulation: Install insulation in cavities formed by framing members according to following:
  - 1. Use insulation widths and lengths that fill the cavities formed by framing members. Where more than one length is required to fill cavity, 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. Where partition will be covered by gypsum board on only one side, apply adhesive to backside of gypsum board that is installed and press insulation in place to form bond to prevent insulation from sagging within cavity.
- C. Mineral Wool Semi-Rigid Insulation: Install in cavities formed by framing members according to the following requirements:
1. Cavity Wall Installations:
    - a. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill cavity, provide lengths that will produce a snug fit between ends.
    - b. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
- D. Foam-Plastic Board Insulation: Install pads of adhesive spaced approximately 24 inches 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.
- E. Sprayed Foam Insulating Gap Filler: As specified in Division 07 Section "Joint Sealants".
- 3.5 PROTECTION
- A. Protection: Protect installed insulation and vapor retarders 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

## SECTION 074113.16 - STANDING-SEAM METAL ROOF PANELS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Standing-seam metal roof panels.

#### 1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.
- C. Samples: For each type of metal panel indicated.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Product test reports.
- B. Warranties: Sample of special warranties.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Maintenance data.

#### 1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- B. UL-Certified, Portable Roll-Forming Equipment: UL-certified, portable roll-forming equipment capable of producing metal panels warranted by manufacturer to be the same as factory-formed products. Maintain UL certification of portable roll-forming equipment for duration of work.

## 1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Two years from date of Substantial Completion.
- B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
  - 1. Finish Warranty Period: 20 years from date of Substantial Completion.
- C. Special Weathertightness Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace standing-seam metal roof panel assemblies that fail to remain weathertight, including leaks, within specified warranty period.
  - 1. Warranty Period: 20 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E1592:
  - 1. Wind Loads: As indicated on Structural Drawings.
  - 2. Other Design Loads: As indicated on Structural Drawings.
  - 3. Deflection Limits: For wind loads, no greater than 1/240 of the span.
- B. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. when tested according to ASTM E1680 at the following test-pressure difference:
  - 1. Test-Pressure Difference: 1.57 lbf/sq. ft.
- C. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E1646 at the following test-pressure difference:
  - 1. Test-Pressure Difference: 2.86 lbf/sq. ft.
- D. Hydrostatic-Head Resistance: No water penetration when tested according to ASTM E2140.
- E. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for wind-uplift-resistance class indicated.
  - 1. Uplift Rating: UL 60.

## 2.2 STANDING-SEAM METAL ROOF PANELS

- A. Provide factory-formed metal roof panels designed to be installed by lapping and interconnecting raised side edges of adjacent panels with joint type indicated and mechanically attaching panels to supports using concealed clips in side laps. Include clips, cleats, pressure plates, and accessories required for weathertight installation.
1. Steel Panel Systems: Unless more stringent requirements are indicated, comply with ASTM E1514.
- B. Vertical-Rib, Seamed-Joint, Standing-Seam Metal Roof Panels: Formed with vertical ribs at panel edges and intermediate stiffening ribs symmetrically spaced between ribs; designed for sequential installation by mechanically attaching panels to supports using concealed clips located under one side of panels, engaging opposite edge of adjacent panels, and mechanically seaming panels together.
1. Provide one of the following Manufacturers:
    - a. Drexel Metals
    - b. McElroy
  2. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A653/A653M, G90 coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A792/A792M, Class AZ50 coating designation; structural quality. Pre-painted by the coil-coating process to comply with ASTM A755/A755M.
    - a. Nominal Thickness: 26Ga
    - b. Exterior Finish: Two-coat fluoropolymer.
    - c. Color: As selected by Architect from manufacturer's full range.
  3. Clips: One-piece fixed to accommodate thermal movement.
    - a. Material: 0.064-inch nominal thickness, zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet.
  4. Joint Type: Single folded.
  5. Panel Coverage: 16 inches.
  6. Panel Height: 1.5 inches.

## 2.3 UNDERLAYMENT MATERIALS

- A. Self-Adhering, High-Temperature Underlayment: Provide self-adhering, cold-applied, sheet underlayment, a minimum of 30 mils thick, consisting of slip-resistant, polyethylene-film top surface laminated to a layer of butyl or SBS-modified asphalt adhesive, with release-paper backing. Provide primer when recommended by underlayment manufacturer.
1. Thermal Stability: Stable after testing at 240 deg F; ASTM D1970.
  2. Low-Temperature Flexibility: Passes after testing at minus 20 deg F; ASTM D1970.
  3. Provide one of the following:
    - a. Carlisle WIP Products
    - b. Henry Company

c. Protecto Wrap Company

- B. Slip Sheet: Manufacturer's recommended slip sheet, of type required for application.

2.4 MISCELLANEOUS MATERIALS

- A. Miscellaneous Metal Subframing and Furring: ASTM C645; cold-formed, metallic-coated steel sheet, ASTM A653/A653M, G90 designation or ASTM A792/A792M, Class AZ50 coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.
- B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.
1. Closures: Provide closures at eaves and ridges, fabricated of same metal as metal panels.
  2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
  3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
- C. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.
- D. Gutters and Downspouts: Formed from same material as roof panels according to SMACNA's "Architectural Sheet Metal Manual." Finish to match roof fascia and rake trim.
- E. Roof Curbs: Fabricated from same material as roof panels, 0.048-inch nominal thickness; with bottom of skirt profiled to match roof panel profiles and with welded top box and integral full-length cricket. Fabricate curb sub-framing of 0.060-inch nominal thickness, angle-, C-, or Z-shaped steel sheet. Fabricate curb and sub-framing to withstand indicated loads of size and height indicated. Finish roof curbs to match metal roof panels.
- F. Panel Fasteners: Self-tapping screws designed to withstand design loads.
- G. Panel Sealants: Provide sealant type recommended by manufacturer that are compatible with panel materials, are non-staining, and do not damage panel finish.
1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing; 1/2 inch wide and 1/8 inch thick.
  2. Joint Sealant: ASTM C920; as recommended in writing by metal panel manufacturer.
  3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C1311.

## 2.5 FABRICATION

- A. Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
- B. On-Site Fabrication: Subject to compliance with requirements of this Section, metal panels may be fabricated on-site using UL-certified, portable roll-forming equipment if panels are of same profile and warranted by manufacturer to be equal to factory-formed panels. Fabricate according to equipment manufacturer's written instructions and to comply with details shown.
- C. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.
- D. Fabricate metal panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.
- E. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.

## 2.6 FINISHES

- A. Panels and Accessories:
  - 1. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in color coat.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Miscellaneous Supports: Install sub-framing, furring, and other miscellaneous panel support members and anchorages according to ASTM C754 and metal panel manufacturer's written recommendations.

### 3.2 INSTALLATION OF UNDERLAYMENT

- A. Self-Adhering Sheet Underlayment: Apply primer if required by manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation. Apply at locations indicated below, wrinkle free, in shingle fashion to shed water, and with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches. Roll laps with roller. Cover underlayment within 14 days.
  - 1. Apply over the entire roof surface.
  - 2. Apply over the roof area indicated below:

- a. Roof perimeter for a distance up from eaves of 24 inches beyond interior wall line.
  - b. Valleys, from lowest point to highest point, for a distance on each side of 18 inches. Overlap ends of sheets not less than 6 inches.
  - c. Rake edges for a distance of 18 inches.
  - d. Hips and ridges for a distance on each side of 12 inches.
  - e. Roof-to-wall intersections for a distance from wall of 18 inches.
- B. Slip Sheet: Apply slip sheet over underlayment before installing metal roof panels if required.
  - C. Flashings: Install flashings to cover underlayment to comply with requirements specified in Section 076200 "Sheet Metal Flashing and Trim."

### 3.3 INSTALLATION OF STANDING SEAM METAL ROOF PANELS

- A. Standing-Seam Metal Roof Panel Installation: Fasten metal roof panels to supports with concealed clips at each standing-seam joint at location, spacing, and with fasteners recommended in writing by manufacturer.
  - 1. Install clips to supports with self-tapping fasteners.
  - 2. Install pressure plates at locations indicated in manufacturer's written installation instructions.
  - 3. Snap Joint: Nest standing seams and fasten together by interlocking and completely engaging factory-applied sealant.
  - 4. Seamed Joint: Crimp standing seams with manufacturer-approved, motorized seamer tool so clip, metal roof panel, and factory-applied sealant are completely engaged.
  - 5. Watertight Installation:
    - a. Apply a continuous ribbon of sealant or tape to seal joints of metal panels, using sealant or tape as recommend in writing by manufacturer as needed to make panels watertight.
    - b. Provide sealant or tape between panels and protruding equipment, vents, and accessories.
    - c. At panel splices, nest panels with minimum 6-inch end lap, sealed with sealant and fastened together by interlocking clamping plates.
- B. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
- C. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

### 3.4 CLEANING AND PROTECTION

- A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On

completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.

END OF SECTION 074113.16



## SECTION 074213.23 - METAL COMPOSITE MATERIAL WALL PANELS

### 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 MCM wall panels.

#### 1.3 DEFINITIONS

- A. DBVR: Drained and back-ventilated rainscreen system; rainscreen system designed to drain and dry cavity entering water through drainage channels, weeps, and air ventilation.
- B. MCM: Metal composite material; cladding material formed by joining two thin metal skins to polyethylene or fire-retardant core and bonded under precise temperature, pressure, and tension.
- C. PER: Pressure equalized rainscreen system; rainscreen system designed for no water intrusion with equal pressure between interior system cavity and outside cladding barrier.

#### 1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference:
  - 1. Meet with Owner, Architect, Owner's insurer if applicable, MCM panel Fabricator and Installer, MCM sheet manufacturer's representative, structural-support Installer, and installers whose work interfaces with or affects MCM panels, including installers of doors, windows, and louvers.
  - 2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
  - 3. Review methods and procedures related to MCM panel installation, including manufacturer's written instructions.
  - 4. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
  - 5. Review flashings, special siding details, wall penetrations, openings, and condition of other construction that affect MCM panels.
  - 6. Review governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.
  - 7. Review temporary protection requirements for MCM panel assembly during and after installation.
  - 8. Review procedures for repair of panels damaged after installation.

9. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

## 1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.
- B. Shop Drawings:
  1. Include fabrication and installation layouts of MCM panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment assembly, trim, flashings, closures, and accessories; and special details.
  2. Accessories: Include details of the flashing, trim and anchorage, at a scale of not less than 1-1/2 inches per 12 inches (1:10).
- C. Samples for Initial Selection: For each type of MCM panel indicated with factory-applied color finishes.
  1. Include similar Samples of trim and accessories involving color selection.
- D. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below.
  1. MCM Panels: 12 inches (305 mm) long by actual panel width. Include fasteners, closures, and other MCM panel accessories. Submit custom color samples in paint manufacturer's standard size.

## 1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Test Reports: For each product, tests performed by a qualified testing agency.
  1. MCM Manufacturer's Material Test Reports: Certified test reports showing compliance with specific performance or third-party listing documenting compliance to comparable code sections IBC 1407.14 and IBC 1703.5.
  2. MCM System Fabricator's Certified System Tests Reports: Certified system test reports showing system compliance with specific performance or third-party listing documenting compliance code section. Base performance requirements on MCM system type provided.
    - a. DBVR System: Tested to AAMA 509.
    - b. PER System: Tested to AAMA 508.
- C. Field quality-control reports.
- D. Sample Warranties: For special warranties.

## 1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For MCM panels to include in maintenance manuals.

## 1.8 QUALITY ASSURANCE

- A. Composite Panel Manufacturer Qualifications: Minimum 5 years' experience manufacturing this product at a facility located within the United States.
- B. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by MCM Fabricator.
- C. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for MCM fabrication and installation.
  - 1. Build mockup of typical MCM panel assembly as shown on Drawings including corner, soffits, supports, attachments, and accessories.
  - 2. Water-Spray Test: Conduct water-spray test of mockup of MCM panel assembly, testing for water penetration in accordance with AAMA 501.2.
  - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  - 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

## 1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver components, MCM panels, and other manufactured items so as not to be damaged or deformed. Package MCM panels for protection during transportation and handling.
- B. Unload, store, and erect MCM panels in a manner to prevent bending, warping, twisting, and surface damage.
- C. Stack MCM panels on platforms or pallets, covered with suitable weathertight and ventilated covering. Store MCM panels to ensure dryness, with positive slope for drainage of water. Do not store MCM panels in contact with other materials that might cause staining, denting, or other surface damage.
- D. Retain strippable protective covering on MCM panels during installation.

## 1.10 FIELD CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of MCM panels to be performed in accordance with manufacturers' written instructions and warranty requirements.

## 1.11 COORDINATION

- A. Coordinate MCM panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

## 1.12 WARRANTY

- A. Warranty on Panel Material: Manufacturer's standard form in which manufacturer agrees to replace MCM that fails within specified warranty period.
  - 1. Warranty Period: Five years from date of Substantial Completion.
- B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace MCM panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
  - 1. Finish Warranty Period: 20 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide MCM panel systems capable of withstanding the effects of the following loads, based on testing in accordance with ASTM E330:
  - 1. Wind Loads: As indicated on Structural Drawings.
  - 2. Other Design Loads: As indicated on Structural Drawings
  - 3. Deflection Limits: For wind loads, panel deflection no greater than L/60 of the span.
- B. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. (0.3 L/s per sq. m) of wall area when tested in accordance with ASTM E283 at the following test-pressure difference:
  - 1. Test-Pressure Difference: 6.24 lbf/sq. ft. (300 Pa).
- C. Water Penetration under Static Pressure: No water penetration to room side of assembly when tested for 15 minutes in accordance with ASTM E331 at the following test-pressure difference:
  - 1. Test-Pressure Difference: 6.24 lbf/sq. ft. (300 Pa).
- D. Thermal Movements: Include expansion and contraction points as needed to allow for free and noiseless thermal movements from surface temperature changes.
  - 1. Temperature Change (Range): minus 20 deg F to 175 deg F (minus 29 to 79.4 deg C), material surfaces.
- E. Fire Propagation Characteristics: MCM wall assembly passes NFPA 285 testing.

## 2.2 MCM WALL PANELS

- A. MCM Wall Panel Systems: Provide factory-formed and -assembled, MCM wall panels fabricated from two metal facings that are bonded to a solid, extruded thermoplastic core; formed into profile for installation method indicated. Include attachment assembly components, panel stiffeners, and accessories required for weathertight system.
1. Basis-of-Design Product: Subject to compliance with requirements, provide 3A Composites USA Inc.; ALUCOBOND® PLUS; Contact [john.tarr@3acomposites.com](mailto:john.tarr@3acomposites.com); (941) 276-0221; or comparable product by one of the following:
    - a. Arconic Architectural Products (USA).
    - b. Mitsubishi Chemical Composites.
- B. Aluminum-Faced Composite Wall Panels: Formed with 0.020-inch- (0.50-mm-) thick, aluminum sheet facings.
1. Panel Thickness: 0.157 inch (4 mm).
  2. Core: Fire retardant.
  3. Exterior Finish: [PVDF fluoropolymer with coats and thicknesses that comply with MCM panel manufacturer's performance and warranty requirements and specified basis of design colors.
    - a. Color: As indicated by manufacturer's designations.
      - 1) Color 1: Classic Collection - Anodic Clear Mica (50%)
      - 2) Color 2: Spectra Collection – Cupral (50%)
  4. Peel Strength: 22.5 in-lb/in. (100 N x mm/mm) when tested for bond integrity in accordance with ASTM D1781.
  5. Fire Performance: Flame spread less than 25 and smoke developed less than 450, in accordance with ASTM E84.
- C. Attachment Assembly Components: Formed from extruded aluminum or other material compatible with panel facing as shown on the drawings.

## 2.3 MISCELLANEOUS MATERIALS

- A. Miscellaneous Metal Subframing and Furring: ASTM C645, cold-formed, metallic-coated steel sheet ASTM A653/A653M, G90 (Z275) hot-dip galvanized coating designation or ASTM A792/A792M, Class AZ50 (Class AZM150) aluminum-zinc-alloy coating designation unless otherwise indicated. Provide Fabricator's standard sections as required for support and alignment of MCM panel system.
- B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of MCM panels unless otherwise indicated.

- C. Flashing and Trim: Provide flashing and trim formed from same material as MCM panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent MCM panels.
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide 3A Composites USA Inc.; ALUCOBOND® Axcen™ Trim or comparable product by one of the following:
    - a. Arconic Architectural Products (USA).
    - b. Mitsubishi Chemical Composites.
  - 2. Aluminum Trim: Formed with 0.040-inch (1.00-mm-) thick, coil-coated aluminum sheet facings.
  - 3. Color: To match 4mm MCM wall panel system unless otherwise indicated on the drawings.
- D. Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads matching color of MCM panels by means of plastic caps or factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.
- E. Panel Sealants: ASTM C920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in MCM panels and remain weathertight; and as recommended in writing by MCM panel manufacturer.

## 2.4 FABRICATION

- A. General: Fabricate and finish MCM panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
- B. Fabricate MCM panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.
- C. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations or recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.
  - 1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
  - 2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
  - 3. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
  - 4. Sealed Joints: Form non-expansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.

5. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
6. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.
  - a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal wall panel manufacturer for application but not less than thickness of metal being secured.

## 2.5 FINISHES

- A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- C. Aluminum Panels and Accessories:
  1. PVDF Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
  2. FEVE Fluoropolymer: One-coat clear, or tinted fluoropolymer finish containing 100 percent fluorinated ethylene vinyl ether resin in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
  3. Siliconized Modified Polyester (SMP): Epoxy primer and silicone-modified, polyester-enamel topcoat; with a dry film thickness of not less than 0.2 mil (0.005 mm) for primer and 0.8 mil (0.02 mm) for topcoat.
  4. Exposed Anodized Finish:
    - a. Clear Anodized Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.
    - b. Color Anodized Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, MCM 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 MCM 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 MCM 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 MCM panels to verify actual locations of penetrations relative to seam locations of MCM panels before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages in accordance with ASTM C754 and MCM panel manufacturer's written recommendations.

### 3.3 MCM PANEL INSTALLATION

- A. General: Install MCM panels in accordance with Fabricator's written instructions in orientation, sizes, and locations indicated on Drawings. Install panels perpendicular to supports unless otherwise indicated. Anchor MCM panels and other components of the Work securely in place, with provisions for thermal and structural movement.
1. Shim or otherwise plumb substrates receiving MCM panels.
  2. Flash and seal MCM 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 MCM 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 MCM 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 MCM 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 MCM panel manufacturer.



- D. Attachment Assembly, General: Install attachment assembly required to support MCM 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. Panel Installation: Attach MCM wall panels to supports at locations, spacings, and with fasteners recommended by Fabricator to achieve one of the system types and performance requirements below.
1. DBVR System: Install using Fabricator's standard 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 Fabricator. Attach MCM 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.
    - a. Track-Support Installation: Install support assembly at locations, spacings, and with fasteners recommended by manufacturer. Use Fabricator's standard horizontal tracks and vertical tracks and/or drain channels that provide support and secondary drainage assembly, draining to the exterior at horizontal joints through drain tube. Attach MCM wall panels to tracks by interlocking panel edges with Fabricator's standard "T" clips.
    - b. Panel Installation:
      - 1) Attach routed-and-turned flanges of wall panels to perimeter extrusions with manufacturer's standard fasteners.
      - 2) Install wall panels to allow individual panels to "free float" and be installed and removed without disturbing adjacent panels.
    - c. Joints: Seal all joints in accordance with AAMA 509. Tested result for dynamic water penetration shall be no greater than W1 or 1.0 oz/sf<sup>2</sup>. Do not apply sealants to joints unless otherwise indicated.
- F. 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 MCM panel assembly including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by MCM panel Fabricator; or, if not indicated, provide types recommended in writing by MCM system Fabricator.
- G. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, or SMACNA's "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. Site Verifications of Conditions:

1. Verify conditions of substrate previously installed under other Sections are acceptable for the MCM system installation. Provide documentation indicating detrimental conditions to the MCM system performance.
2. Once conditions are verified, MCM system installation tolerances are as follows:
  - a. Shim and align MCM wall panel units within installed tolerance of 1/4 inch in 20 feet (6 mm in 6 m), non-accumulative, 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: If Required, a qualified independent testing agency to perform field tests and inspections.
- B. Water-Spray Test: After installation, test area of assembly as shown on Drawings or as directed by Architect for water penetration in accordance with AAMA 501.2.
- C. Fabricator's Field Service: Engage a factory-authorized service representative to test and inspect completed MCM wall panel installation, including accessories.
- D. MCM wall panels will be 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, if any, as MCM panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of MCM panel installation, clean finished surfaces as recommended by MCM panel manufacturer. Maintain in a clean condition during construction.

- B. After MCM panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.
- C. Replace MCM panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 074213.23

## SECTION 075200 - MODIFIED BITUMINOUS MEMBRANE ROOFING

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Base Sheet and/or Rigid Insulation Application
- B. Roof Membrane Application
- C. Roof Flashing Application

#### 1.02 RELATED SECTIONS

- A. Section 13300 - Submittals
- B. Section 61000 - Rough Carpentry
- C. Section 05310 - Roof Decks
- D. Section 07600 - Sheet Metal Flashing and Trim

#### 1.03 REFERENCE STANDARDS

References in these specifications to standards, test methods, codes etc., are implied to mean the latest edition of each such standard adopted. The following is an abbreviated list of associations, institutions, and societies which may be used as references throughout this specification section.

ASTM	American Society for Testing and Materials Philadelphia, PA
FM	Factory Mutual Engineering Research Corp. Norwood, MA
NRCA	National Roofing Contractors Association Rosemont, IL
CERTA	Certified Roofing Torch Applicator Rosemont, IL
OSHA	Occupational Safety and Health Administration Washington, DC
SMACNA	Sheet Metal and Air Conditioning Contractors National Association Chantilly, VA
UL	Underwriters Laboratories Northbrook, IL

#### 1.04 SUBMITTALS

All submittals which do not conform to the following requirements will be rejected.

##### A. Submittals Prior to Contract Award:

1. Letter from the proposed primary roofing manufacturer confirming that the bidder is an acceptable Contractor authorized to install the proposed system.
2. Letter from the primary roofing manufacturer stating that the proposed application will comply with the Manufacturer's requirements in order to qualify the project for the specified guarantee.

#### 1.05 QUALITY ASSURANCE

- A. Acceptable Products: Provide primary roofing products, including each type of sheet, all manufactured in the United States, supplied by a single manufacturer which has been successfully producing the specified types of primary products for not less than 10 years. Provide secondary or accessory products which are acceptable to the manufacturer of the primary roofing products.
- B. Product Quality Assurance Program: Primary roofing materials shall be manufactured under a quality management system that is monitored regularly by a third party auditor under the ISO 9001 audit process. A certificate of analysis for reporting/confirming the tested values of the actual material being supplied for the project will be required prior to project close-out.
- C. Agency Approvals: The proposed roof system shall conform to the following requirements. No other testing agency approvals will be accepted.
1. Underwriters Laboratories Class acceptance of the proposed roofing system.
  2. Evidence by an accredited independent testing agency or agencies that the roof configuration meets a design windload pressure of - [---] psf or greater.
  3. The roof membrane system shall be eligible to contribute toward 1 credit point according to SS Credit Heat Island Reduction as described in LEED v4 for Building Design and Construction.
- D. Project Acceptance: Submit a completed manufacturer's application for roof guarantee form along with shop drawings of the roofs showing all dimensions, penetrations, and details. The form shall contain all the technical information applicable to the project including deck types, roof slopes, base sheet and/or insulation assemblies (with method of attachment, and fastener type), and manufacturer's membrane assembly proposed for installation. The project must receive approval, through this process, prior to shipment of materials to the project site.
- E. Scope of Work: The work to be performed under this specification shall include but is not limited to the following: Attend necessary job meetings and furnish competent and full time supervision, experienced roof mechanics, all materials, tools, and equipment necessary to complete, in an acceptable manner, the roof installation in accordance with this specification. Comply with the latest written application instructions of the

manufacturer of the primary roofing products. In addition, application practice shall comply with requirements and recommendations contained in the latest edition of the Handbook of Accepted Roofing Knowledge (HARK) as published by the National Roofing Contractor's Association, amended to include the acceptance of a phased roof system installation.

- F. Local Regulations: Conform to regulations of public agencies, including any specific requirements of the city and/or state of jurisdiction.
- G. Manufacturer Requirements: The primary roofing materials manufacturer shall provide direct trained company personnel to attend necessary job meetings, perform periodic inspections as necessary, and conduct a final inspection upon successful completion of the project.

#### 1.06 PRODUCT DELIVERY STORAGE AND HANDLING

- A. Delivery: Deliver materials in the manufacturer's original sealed and labeled containers and in quantities required to allow continuity of application.
- B. Storage: Store materials out of direct exposure to the elements. Store roll goods on a clean, flat and dry surface. All material stored on the roof overnight shall be stored on pallets. Rolls of roofing must be stored on ends. Store materials on the roof in a manner so as to preclude overloading of deck and building structure. Store materials such as solvents, adhesives and asphalt cutback products away from open flames, sparks or excessive heat. Cover all material using a breathable cover such as a canvas. Polyethylene or other non-breathable plastic coverings are not acceptable.
- C. Handling: Handle all materials in such a manner as to preclude damage and contamination with moisture or foreign matter. Handle rolled goods to prevent damage to edges or ends.
- D. Damaged Material: Any materials that are found to be damaged or stored in any manner other than stated above will be automatically rejected, and will require removal and replacement at the Contractor's expense.

#### 1.07 PROJECT/SITE CONDITIONS

- A. Requirements Prior to Job Start
  - 1. Notification: Give a minimum of 5 days notice to the Owner and manufacturer prior to commencing any work and notify both parties on a daily basis of any change in work schedule.
  - 2. Safety: Familiarize every member of the application crew with all fire and safety regulations recommended by OSHA, NRCA and other industry or local governmental groups.
- B. Environmental Requirements

1. Precipitation: Do not apply roofing materials during precipitation or in the event there is a probability of precipitation during application. Take adequate precautions to ensure that materials, applied roofing, and building interiors are protected from possible moisture damage or contamination.
2. Temperature Restrictions - asphalt: At ambient temperatures of 40°F (4°C) and below, special precautions must be taken to ensure that the specified Type IV asphalt maintains a minimum acceptable 400°F (204°C) at the point of sheet application. Do not overheat asphalt to compensate for cold conditions. The use of insulated handling equipment is strongly recommended. Use insulated hot luggers, mop carts, and kettle-to-roof supply lines. Use hand mops constructed with a smaller yarn head to facilitate short moppings. Do not fill luggers and mop carts to more than half their capacity at all times.
3. Temperature Restrictions - cold adhesive: At low temperatures, the specified cold adhesive becomes more viscous, making even distribution more difficult. The optimal temperature of the adhesive at point of application is 70° - 100°F (21° - 38°C). To facilitate application when ambient temperatures are below 50°F (10°C), store the adhesive and roll goods in a warm place immediately prior to use. Bulk warmers, inline heaters, or other pre-heating equipment should be used to maintain the proper viscosity of the adhesive when using mechanical application equipment. Consider "flying in" the pre-cut roofing sheets in by placing them into the adhesive rather than rolling them into position. Roll or broom the sheets to ensure contact with the underlying adhesive. Suspend application in situations where the adhesive cannot be kept at temperatures allowing for even distribution.
4. Temperature Restrictions - self-adhesive sheets: The minimum required substrate temperature at point of application is 40°F (4°C). Maintain a minimum roof membrane material temperature above 60° F (16° C). In low temperature conditions, keep materials warm prior to application. Suspend application in situations where the self-adhered base ply cannot be kept at temperatures allowing for proper adhesion.

#### C. Protection Requirements

1. Membrane Protection: Provide protection against staining and mechanical damage for newly applied roofing and adjacent surfaces throughout this project.
2. Torch Safety: Crew members handling torches shall be trained by an Authorized Certified Roofing Torch Applicator (CERTA) Trainer, be certified according to CERTA torch safety guidelines as published by the National Roofing Contractor's Association (NRCA), and follow torch safety practices as required by the contractor's insurance carrier. Designate one person on each crew to perform a daily fire watch. The designated crew member shall watch for fires or smoldering materials on all areas during roof construction activity, and for the minimum period required by CERTA guidelines after roofing material application has been suspended for the day.
3. Debris Removal: Remove all debris daily from the project site and take to a legal dumping area authorized to receive such materials.
4. Site Condition: Complete, to the owner's satisfaction, all job site clean-up including building interior, exterior and landscaping where affected by the construction.

## 1.08 GUARANTEE

- A. Roof Membrane Guarantee: Upon successful completion of the project, and after all post installation procedures have been completed, furnish the Owner with the manufacturer's twenty year labor and materials membrane guarantee. The guarantee shall be a term type, without deductibles or limitations on coverage amount, and shall be issued at no additional cost to the Owner. This guarantee shall not exclude random areas of ponding from coverage.
- > Siplast (20) Year Roof Membrane Guarantee

## PART 2 PRODUCTS

### 2.01 ROOFING SYSTEM ASSEMBLY/PRODUCTS

#### A. Base Sheet

1. Base Sheet: A fiberglass reinforced, asphalt coated sheet with a polyolefin film backing, having a minimum weight of 20 lb/sq. The sheet shall conform to ASTM D 4601, Type II requirements.
  - > Parabase FS by Siplast; Irving, TX
2. Modified Base Sheet: A fiberglass reinforced, Styrene-Butadiene-Styrene (SBS) modified asphalt coated sheet having a minimum weight of 30 lb/sq.
  - > Parabase Plus by Siplast; Irving, TX

#### B. Rigid Roof Insulation: Roof insulation shall be UL and FM approved. Insulation shall be approved in writing by the insulation manufacturer for intended use and for use with the specified roof assembly. Maintain a maximum panel size of 4 feet by 4 feet where polyisocyanurate / fiberboard insulation is specified to be installed in hot asphalt or insulation adhesive.

1. Polyisocyanurate: A closed cell, rigid polyisocyanurate foam core material, integrally laminated between glass fiber reinforced organic facers in full compliance with ASTM C 1289, Type II, Class 1, Grade 2 (20 psi). Panels shall have a nominal thickness of 2 inches. Acceptable types are as follows:
  - > Paratherm by Siplast; Irving, TX
2. Polyisocyanurate Tapered Roof Insulation: Tapered panels and standard fill panels composed of a closed cell, rigid polyisocyanurate foam core material, integrally laminated between glass fiber reinforced organic facers in full compliance with ASTM C 1289, Type II, Class 1, Grade 2 (20 psi). The tapered system shall provide for a roof slope of [---] inch per foot. Acceptable types are as follows.
  - > Tapered Paratherm by Siplast; Irving, TX



3. Gypsum Sheathing Panel/Thermal Barrier: A non-structural gypsum panel composed of fiber reinforced synthetic gypsum. Provide panels having a nominal thickness of [---] inch. Acceptable types are as follows:
  - > Securock by United States Gypsum; Chicago, IL
4. Gypsum Sheathing Panel: A panel composed of a gypsum based, non-structural water-resistant core material integrally bonded with fiberglass mats on both sides. Provide panels having a nominal thickness of 5/8 inch. Acceptable types are as follows:
  - > DensDeck Gypsum Roof Board, by Georgia Pacific Corporation; Atlanta, GA
5. Gypsum Sheathing Panel: A panel composed of a gypsum based, non-structural water-resistant core material integrally bonded with fiberglass mats on both sides having a nominal thickness of 5/8 inch. The panel surface shall be factory primed with a non-asphaltic primer. Acceptable types are as follows:
  - > DensDeck Prime Gypsum Roof Board, by Georgia Pacific Corporation; Atlanta, GA
6. Fiberboard: A high density panel composed of interlocking wood fibers and waterproofing binders, having a top surface that is pre-treated with a paraffin-based coating. Fiberboard panels shall be in full compliance with ASTM C 208, Type II, Grade 2, and ASTM C 209 (water absorption - 10% volume maximum) requirements. Panels shall have a nominal thickness of 1/2 inch. Acceptable types are as follows:
  - > Knight-Celotex Structodek by Blue Ridge Fiberboard, Inc.; Danville, VA
  - > G-P Roof Fiberboard by Georgia Pacific Corp.; Atlanta, GA
  - > FiberBase HD by Temple-Inland.; Austin, TX
7. Perlite Tapered Edge Panels: A tapered panel composed of expanded volcanic minerals combined with waterproofing binders. The top surface shall be pre-treated with an asphalt-based coating. The panels shall have a dimension sufficient to provide for a smooth transition and provide proper support for the membrane layer or subsequent layer of insulation when there are transitions of 1/4 inch or greater.

## 2.02 DESCRIPTION OF SYSTEMS

- A. Roofing Membrane Assembly: A roof membrane assembly consisting of two plies of a prefabricated, reinforced, homogeneous Styrene-Butadiene-Styrene (SBS) block copolymer modified asphalt membrane, applied over a prepared substrate. Reinforcement mats shall be impregnated/saturated and coated each side with SBS modified bitumen blend. The cross-sectional area of the sheet material shall contain no oxidized or non-SBS modified bitumen. The roof system shall pass 500 cycles of ASTM D 5849 Resistance to Cyclic Joint Displacement (fatigue) at 14°F (-10°C). Passing results shall show no signs of membrane cracking or interply delamination after 500 cycles. The roof system shall pass 200 cycles of ASTM D 5849 after heat conditioning performed in accordance with ASTM D 5147. The assembly shall possess waterproofing capability, such that a phased roof application, with only the modified

bitumen base ply in place, can be achieved for prolonged periods of time without detriment to the watertight integrity of the entire roof system.

> Siplast Paradiene 20/30 FR BW roof system

#### 1. Modified Bitumen Base and Stripping Ply

- a) Thickness (avg): 91 mils (2.3 mm) (ASTM D 5147)
- b) Thickness (min): 87 mils (2.2 mm) (ASTM D 5147)
- c) Weight (min per 100 ft<sup>2</sup> of coverage): 62 lb (3.0 kg/m<sup>2</sup>)
- d) Peak filler content in elastomeric blend - 35% by weight
- e) Low temperature flexibility @ -15°F (-26°C): PASS (ASTM D 5147)
- f) Peak Load (avg) @ 73°F (23°C): 30 lbf/inch (5.3 kN/m) (ASTM D 5147)
- g) Peak Load (avg) @ 0°F (-18°C): 70 lbf/inch (12.3 kN/m) (ASTM D 5147)
- h) Ultimate Elongation (avg.) @ 73°F (23°C): 50% (ASTM D 5147)
- i) Compound Stability (max): 0.1% (ASTM D 5147)
- j) High Temperature Stability (min): 250°F (121°C) (ASTM D 5147)
- k) Approvals: UL Class listed, FM Approved (products shall bear seals of approval)
- l) Reinforcement: fiberglass mat or other meeting the performance and Compound stability criteria

> Paradiene 20 by Siplast; Irving, TX

#### 2. Modified Bitumen Finish Ply

- a) Thickness (avg): 130 mils (3.3 mm) (ASTM D 5147)
- b) Thickness at selvage (coating thickness) (avg): 98 mils (2.5 mm) (ASTM D 5147)
- c) Thickness at selvage (coating thickness) (min): 94 mils (2.4 mm) (ASTM D 5147)
- d) Weight (min per 100 ft<sup>2</sup> of coverage): 80 lb (3.9 kg/m<sup>2</sup>)
- e) Peak filler content in elastomeric blend: 35% by weight
- f) Low temperature flexibility @ -15° F (-26° C): PASS (ASTM D 5147)
- g) Peak Load (avg) @ 73°F (23°C): 30 lbf/inch (5.3 kN/m) (ASTM D 5147)
- h) Peak Load (avg) @ 0°F (-18°C): 75 lbf/inch (13.2 kN/m) (ASTM D 5147)
- i) Ultimate Elongation (avg.) @ 73°F (23°C): 55% (ASTM D 5147)
- j) Compound Stability (max): 0.1% (ASTM D 5147)
- k) High Temperature Stability (min): 250°F (121° C) (ASTM D 5147)
- l) Granule Embedment (max loss): 2.0 grams per sample (ASTM D 5147)
- m) Approvals: UL Class listed, FM Approved (products shall bear seals of approval)
- n) Reinforcement: fiberglass mat or other meeting the performance and Compound stability criteria
- o) Surfacing: ceramic granules specially treated for cool roof applications

> Paradiene 30 FR BW by Siplast; Irving, TX

B. Roofing Membrane Assembly: A roof membrane assembly consisting of two plies of a prefabricated, reinforced, homogeneous Styrene-Butadiene-Styrene (SBS) block copolymer modified asphalt membrane, applied over a prepared substrate. Reinforcement mats shall be impregnated/saturated and coated each side with SBS modified bitumen blend and coated one side with a torch grade SBS bitumen blend adhesive layer. The adhesive layer shall be manufactured using a process that

embosses the surface with a grooved pattern to provide optimum burn-off of the plastic film and to maximize application rates. The cross sectional area of the sheet material shall contain no oxidized or non-SBS modified bitumen. The roof system shall pass 500 cycles of ASTM D 5849 Resistance to Cyclic Joint Displacement (fatigue) at 14°F (-10°C). Passing results shall show no signs of membrane cracking or interply delamination after 500 cycles. The roof system shall pass 200 cycles of ASTM D 5849 after heat conditioning performed in accordance with ASTM D 5147. The assembly shall possess waterproofing capability, such that a phased roof application, with only the modified bitumen base ply in place, can be achieved for prolonged periods of time without detriment to the watertight integrity of the entire roof system.

> Siplast Paradiene 20 TG/30 FR TG BW torchable roof system

#### 1. Modified Bitumen Base and Stripping Ply

- a) Thickness (avg): 114 mils (2.9 mm) (ASTM D 5147)
- b) Thickness (min): 110 mils (2.8 mm) (ASTM D 5147)
- c) Weight (min per 100 ft<sup>2</sup> of coverage): 76 lb (3.7 kg/m<sup>2</sup>)
- d) Maximum filler content in elastomeric blend: 35% by weight
- e) Low temperature flexibility @ -15° F (-26° C) - PASS (ASTM D 5147)
- f) Peak Load (avg) @ 73°F (23°C): 30 lbf/inch (5.3 kN/m) (ASTM D 5147)
- g) Peak Load (avg) @ 0°F (-18°C): 75 lbf/inch (13.2 kN/m) (ASTM D 5147)
- h) Ultimate Elongation (avg.) @ 73°F (23°C): 50% (ASTM D 5147)
- i) Dimensional Stability (max): 0.1% (ASTM D 5147)
- j) Compound Stability (min): 250°F (121°C) (ASTM D 5147)
- k) Approvals: UL Class listed, FM Approved (products shall bear seals of approval)
- l) Reinforcement: fiberglass mat or other meeting the performance and dimensional stability criteria

> Paradiene 20 TG by Siplast; Irving, TX

#### 2. Modified Bitumen Finish Ply

- a) Thickness (avg): 138 mils (3.5 mm) (ASTM D 5147)
- b) Thickness at selvage (coating thickness) (avg): 118 mils (3.0 mm) (ASTM D 5147)
- c) Thickness at selvage (coating thickness) (min): 114 mils (2.9 mm) (ASTM D 5147)
- d) Weight (min per 100 ft<sup>2</sup> of coverage): 96 lb (4.68 kg/m<sup>2</sup>)
- e) Maximum filler content in elastomeric blend: 35% by weight
- f) Low temperature flexibility @ -15°F (-26°C): PASS (ASTM D 5147)
- g) Peak Load (avg) @ 73°F (23°C): 30 lbf/inch (5.3 kN/m) (ASTM D 5147)
- h) Peak Load (avg) @ 0°F (-18°C): 75 lbf/inch (13.2 kN/m) (ASTM D 5147)
- i) Ultimate Elongation (avg.) @ 73°F (23°C): 55% (ASTM D 5147)
- j) Dimensional Stability (max): 0.1% (ASTM D 5147)
- k) Compound Stability (min): 250°F (121° C) (ASTM D 5147)
- l) Granule Embedment (max individual loss): 2.0 grams per sample (ASTM D 5147)
- m) Approvals: UL Class listed, FM Approved (products shall bear seals of approval)
- n) Reinforcement: fiberglass mat or other meeting the performance and dimensional stability criteria
- o) Surfacing: ceramic granules specially treated for cool roof applications

> Paradiene 30 FR TG BW by Siplast; Irving, TX

C. Flashing Membrane Assembly: A flashing system consisting of a prefabricated, granule surfaced, reinforced, Styrene-Butadiene-Styrene (SBS) block copolymer modified asphalt flashing membrane.

> Siplast Paradiene 40 FR BW flashing system

1. Modified Bitumen Flashing Ply

- a) Thickness (avg.) - 154 mils - 3.9 mm
- b) Thickness at selvage (avg.) - 130 mils (3.3 mm) (ASTM D 5147)
- c) Thickness at selvage (min.) - 126 mils (3.2 mm) (ASTM D 5147)
- d) Weight (min. per 100 ft<sup>2</sup> of coverage) - 98 lb. - 4.78 kg/m<sup>2</sup>
- e) Filler content in elastomeric blend - less than 35% by weight
- f) Low temperature flexibility @ -15° F (-26° C) - PASS (ASTM D 5147)
- g) Peak Load (avg.) @ 73° F - 80 lbf/inch (14.1 kN/m) (ASTM D 5147)
- h) Peak Load (avg.) @ 0° F - 150 lbf/inch (26.5 kN/m) (ASTM D 5147)
- i) Ultimate Elongation (avg.) @ 73° F - 80% (ASTM D 5147)
- j) Dimensional Stability (max.) - 0.5% (ASTM D 5147)
- k) Compound Stability (min.) - 250° F (121° C) (ASTM D 5147)
- l) Granule Embedment (max. individual loss) - 2.0 grams per sample (ASTM D 5147)
- m) Approvals - UL Class listed (products shall bear seal of approval)
- n) Reinforcement - fiberglass scrim/fiberglass mat or other meeting the performance criteria
- o) Surfacing - ceramic granules specially treated for cool roof applications.

> Siplast Paradiene 40 FR BW

C. Flashing Membrane Assembly. A flashing system consisting of a prefabricated, granule surfaced, reinforced, Styrene-Butadiene-Styrene (SBS) block copolymer modified asphalt flashing membrane. The reinforcement mat shall be impregnated and coated each side with SBS modified bitumen blend.

> Siplast Paradiene 40 FR TG BW, flashing system

1. Cant Backing Sheet and Flashing Reinforcing Ply

- a) Thickness (avg): 102 mils (2.6 mm) (ASTM D 5147)
- b) Thickness (min): 98 mils (2.5 mm) (ASTM D 5147)
- c) Weight (min per 100 ft<sup>2</sup> of coverage): 72 lb (3.5 kg/m<sup>2</sup>)
- d) Maximum filler content in elastomeric blend: 35% by weight
- e) Low temperature flexibility @ -15° F (-26° C) - PASS (ASTM D 5147)
- f) Peak Load (avg) @ 73°F (23°C): 30 lbf/inch (5.3 kN/m) (ASTM D 5147)
- g) Peak Load (avg) @ 0°F (-18°C): 75 lbf/inch (13.2 kN/m) (ASTM D 5147)
- h) Ultimate Elongation (avg.) @ 73°F (23°C): 50% (ASTM D 5147)
- i) Dimensional Stability (max): 0.1% (ASTM D 5147)
- j) Compound Stability (min - sheet): 250°F (121°C) (ASTM D 5147)
- j) Compound Stability (min – adhesive coating): 212°F (100°C) (ASTM D 5147)
- k) Approvals: UL Class listed, FM Approved (products shall bear seals of approval)

- l) Reinforcement: fiberglass mat or other meeting the performance and dimensional stability criteria
- m) Back Surfacing: polyolefin film
  - > Siplast Paradiene 20 SA

## 2. Modified Bitumen Flashing Ply

- a) Thickness (avg): 153 mils (3.9 mm) (ASTM D 5147)
- b) Thickness at selvage (coating thickness) (avg): 130 mils (3.3 mm) (ASTM D 5147)
- c) Thickness at selvage (coating thickness) (min): 126 mils (3.2 mm) (ASTM D 5147)
- d) Weight (min per 100 ft<sup>2</sup> of coverage): 108 lb (5.3 kg/m<sup>2</sup>)
- e) Maximum filler content in elastomeric blend: 35% by weight
- f) Low temperature flexibility @ -15°F (-26°C) - PASS (ASTM D 5147)
- g) Peak Load (avg) @ 73°F (23°C): 80 lbf/inch (14.1 kN/m) (ASTM D 5147)
- h) Peak Load (avg) @ 0°F (-18°C): 150 lbf/inch (26.5 kN/m) (ASTM D 5147)
- i) Ultimate Elongation (avg.) @ 73°F (23°C): 80% (ASTM D 5147)
- j) Dimensional Stability (max): 0.1% (ASTM D 5147)
- k) Compound Stability (min): 250°F (121°C) (ASTM D 5147)
- l) Granule Embedment (max individual loss): 2.0 grams per sample (ASTM D 5147)
- m) Approvals: UL Class listed, FM Approved (products shall bear seals of approval)
- n) Reinforcement: fiberglass scrim/fiberglass mat or other meeting the performance and dimensional stability criteria
- o) Surfacing: ceramic granules specially treated for cool roof applications.

- > Siplast Paradiene 40 FR TG BW

C. Flashing Membrane Assembly: A flashing membrane assembly consisting of a prefabricated, reinforced, Styrene-Butadiene-Styrene (SBS) block copolymer modified asphalt membrane with a continuous, channel-embossed metal-foil surfacing. The finish ply shall conform to ASTM D 6298 and the following physical and mechanical property requirements.

- > Siplast Veral flashing system, aluminum finish

### 1. Cant Backing Sheet and Flashing Reinforcing Ply

- a) Thickness (avg): 102 mils (2.6 mm) (ASTM D 5147)
- b) Thickness (min): 98 mils (2.5 mm) (ASTM D 5147)
- c) Weight (min per 100 ft<sup>2</sup> of coverage): 72 lb (3.5 kg/m<sup>2</sup>)
- d) Maximum filler content in elastomeric blend: 35% by weight
- e) Low temperature flexibility @ -15° F (-26° C) - PASS (ASTM D 5147)
- f) Peak Load (avg) @ 73°F (23°C): 30 lbf/inch (5.3 kN/m) (ASTM D 5147)
- g) Peak Load (avg) @ 0°F (-18°C): 75 lbf/inch (13.2 kN/m) (ASTM D 5147)
- h) Ultimate Elongation (avg.) @ 73°F (23°C): 50% (ASTM D 5147)
- i) Dimensional Stability (max): 0.1% (ASTM D 5147)
- j) Compound Stability (min - sheet): 250°F (121°C) (ASTM D 5147)
- j) Compound Stability (min – adhesive coating): 212°F (100°C) (ASTM D 5147)
- k) Approvals: UL Class listed, FM Approved (products shall bear seals of approval)

- l) Reinforcement: fiberglass mat or other meeting the performance and dimensional stability criteria
- m) Back Surfacing: polyolefin film
  - > Siplast Paradiene 20 SA

## 2. Metal-Clad Modified Bitumen Flashing Sheet

- a) Thickness (avg): 150 mils (3.8 mm) (ASTM D 5147)
- b) Thickness (min): 146 mils (3.7 mm) (ASTM D 5147)
- c) Weight (min per 100 ft<sup>2</sup> of coverage): 96 lb (4.6 kg/m<sup>2</sup>)
- d) Coating Thickness – back surface (min): 40 mils (1 mm) (ASTM D 5147)
- e) Low temperature flexibility @ 0° F (-18° C): PASS (ASTM D 5147)
- f) Peak Load (avg) @ 73°F (23°C): 85 lbf/inch (15 kN/m) (ASTM D 5147)
- g) Peak Load (avg) @ 0°F (-18°C): 180 lbf/inch (31.7 kN/m) (ASTM D 5147)
- h) Ultimate Elongation (avg) @ 73°F (23°C): 45% (ASTM D 5147)
- i) Tear-Strength (avg): 120 lbf (0.54 kN) (ASTM D 5147)
- j) Dimensional Stability (max): 0.2% (ASTM D 5147)
- k) Compound Stability (min): 225°F (107°C) (ASTM D 5147)
- l) Cyclic Thermal Shock Stability (maximum): 0.2% (ASTM D 7051)
- m) Approvals: UL Approved, FM Approved (products shall bear seals of approval)
- n) Reinforcement: fiberglass scrim mat or other meeting the performance and dimensional stability criteria
- o) Surfacing: aluminum metal foil
  - > Siplast Veral Aluminum

D. Catalyzed Acrylic Resin Flashing System: A specialty flashing system consisting of a PMMA-based, fully reinforced membrane installed over a prepared or primed substrate. The flashing system consists of a catalyzed acrylic resin primer, basecoat and topcoat, combined with a non-woven polyester fleece. The use of the specialty flashing system shall be specifically approved in advance by the membrane manufacturer for each application.

- > Parapro 123 Flashing System by Siplast; Irving, TX

## 2.03 ROOFING ACCESSORIES

### A. Insulation Adhesives

1. Insulation Adhesive: A single component, moisture cured, polyurethane foam adhesive, dispensed from a portable, pre-pressurized container used to adhere insulation panels to the substrate, as well as to other insulation panels.
  - > Para-Stik Insulation Adhesive by Siplast; Irving, TX
2. Insulation Adhesive: A dual component, polyurethane foam adhesive used to adhere insulation panels to the substrate, as well as to other insulation panels.
  - > Parafast Insulation Adhesive by Siplast; Irving, TX

## B. Roofing Adhesives

1. Mopping Asphalt: Type IV asphalt certified for full compliance with the requirements listed in Table I, ASTM D 312. Each container or bulk shipping ticket shall indicate the equiviscous temperature, EVT, the finished blowing temperature, FBT, and the flash point, FP. Mopping asphalt shall be approved in writing by the roof membrane manufacturer.
2. Membrane Cold Adhesive: An asphalt, solvent blend conforming to ASTM D 4479, Type II requirements.
  - > PA-311 Adhesive by Siplast; Irving, TX
3. Membrane Cold Adhesive: An asphalt, solvent blend conforming to ASTM D 4479, Type II requirements.
  - > PA-311 M Adhesive by Siplast; Irving, TX
4. Mastic: An asphalt cutback mastic, reinforced with non-asbestos fibers, used as a base for setting metal flanges conforming to ASTM D 4586 Type II requirements.
  - > PA-1021 Plastic Cement by Siplast; Irving, TX
5. Flashing Adhesive: A slump resistant, asphalt cutback flashing adhesive, reinforced with non-asbestos fibers, conforming to ASTM D 4586 Type II requirements.
  - > PA-828 Flashing Cement
6. Membrane Adhesive: A single component, modified asphalt adhesive designed for application of the specified roof membrane system.
  - > SFT Adhesive by Siplast; Irving, TX
7. Flashing Adhesive: A single-component, modified adhesive. The adhesive blend shall be formulated in a grade for application of flashing materials.
  - > SFT Cement by Siplast; Irving, TX

## C. Primers

1. Primer: An asphalt/solvent blend meeting ASTM D 41, South Coast Air Quality District and Ozone Transport Commission requirements.
  - > PA-917 LS Primer by Siplast; Irving, TX
2. Primer: An asphalt, solvent blend conforming to ASTM D 41 requirements.
  - > PA-1125 Asphalt Primer by Siplast; Irving, TX
3. Primer for Self-Adhesive Sheets: A quick drying, low-VOC, water-based, high-tack primer specifically designed to promote adhesion of roofing and waterproofing sheets

to approved substrates. Primer shall meet South Coast Air Quality District and Ozone Transport Commission requirements.

> TA-119 Primer by Siplast; Irving, TX

D. Sealant: A moisture-curing, elastomeric sealant designed for roofing applications. The sealant shall be approved by the roof membrane manufacturer for use in conjunction with the roof membrane materials. Acceptable types are as follows:

- > PS-209 Elastomeric Sealant by Siplast; Irving, TX
- > PS-715 NS Elastomeric Sealant by Siplast; Irving, TX

E. Ceramic Granules: No. 11 grade specification ceramic granules of color scheme matching the granule surfacing of the finish ply.

F. Perlite Cant Strips: A cant strip composed of expanded volcanic minerals combined with waterproofing binders. The top surface shall be pre-treated with an asphalt based coating. The face of the cant shall have a nominal 4 inch dimension.

G. Fasteners

1. Insulation Fasteners: Insulation fasteners and plates shall be FM Approved, and/or approved by the manufacturer of the primary roofing products. The insulation fasteners shall provide attachment required to meet the specified uplift performance and to restrain the insulation panels against the potential for ridging. The fastening pattern for each insulation panel to be used shall be as recommended by the insulation manufacturer and approved by the manufacturer of the primary roofing products. Acceptable insulation fastener manufacturers for specific deck types are listed below.

a) Metal Decks: Insulation mechanical fasteners for metal decks shall be factory coated for corrosion resistance. The fastener shall conform meet or exceed Factory Mutual Standard 4470 and when subjected to 30 Kesternich cycles, show less than 15% red rust. Acceptable insulation fastener types for metal decks are listed below.

- A fluorocarbon coated screw type roofing fastener having a minimum 0.220 inch thread diameter. Plates used in conjunction with the fastener shall be a metal type having a minimum 3 inch diameter, as supplied by the fastener manufacturer.

- > Parafast Fastener by Siplast; Irving, TX
- > Standard RoofGrip Drill Point Fastener by OMG; Agawam, MA

H. Walktread: A prefabricated, puncture resistant polyester core reinforced, polymer modified bitumen sheet material topped with a ceramic-coated granule wearing surface.

1. Thickness: 0.217 in (5.5 mm)
2. Weight: 1.8 lb/ft<sup>2</sup> (8.8 kg/m<sup>2</sup>)
3. Width: 30 in (76.2 cm)

> Paratread by Siplast; Irving, TX



## PART 3 EXECUTION

### 3.01 PREPARATION

- A. General: Sweep or vacuum all surfaces, removing all loose aggregate and foreign substances prior to commencement of roofing.
- B. Primer for Self-Adhesive Sheets: Apply the specified high-tack primer by roller or spray in an even film. Refer to the manufacturer's literature for the approved rate of application over various substrate types. Allow the primer to dry until it leaves a slightly sticky surface without transfer when touched.
- C. Asphaltic Primer: Prime metal and concrete and masonry surfaces with a uniform coating of the specified asphalt primer.

### 3.02 SUBSTRATE PREPARATION

- A. Base Sheet Securement to Prepared Substrate: Lay the base sheet over entire area to be roofed, lapping sides 3 inches and ends 6 inches. Using the specified fasteners, fasten each sheet every 9 inches through laps and stagger fasten the remainder of the sheet in 2 rows on nominal 12-inch centers with fasteners in each row on 12 inch centers. Increase the fastening pattern by 70% at the perimeter of the roof and 160% at the corners.
- B. Base Sheet Securement to Prepared Substrate: Lay the base sheet over entire area to be roofed, lapping sides 3 inches and ends 6 inches. Using the specified fasteners, fasten each sheet every 7 1/2 inches through laps and stagger fasten the remainder of the sheet in 2 rows on nominal 12-inch centers with fasteners in each row on 10 inch centers. Increase the fastening pattern by 70% at the perimeter of the roof and 160% at the corners.
- C. Insulation: Install insulation panels with end joints offset; edges of the panels shall be in moderate contact without forcing applied in strict accordance with the insulation manufacturer's requirements and the following instructions. Where insulation is installed in two or more layers, stagger joints between layers. Maintain a maximum panel size of 4 feet by 4 feet for *polyisocyanurate* / *fiberboard* insulation applied in hot asphalt or insulation adhesive. Install only as much insulation as can be made watertight within the same work day.

### 3.03 ROOF MEMBRANE INSTALLATION

- A. Membrane Application: Apply roofing in accordance with roofing system manufacturer's instructions and the following requirements. Application of roofing membrane components shall immediately follow application of base sheet and/or insulation as a continuous operation.
- B. Aesthetic Considerations: Construction of 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 including granules, and exercise care in ensuring that the finished application is acceptable to the Owner.

- C. Kettles And Tankers: Kettles and tankers shall be equipped with accurate, fully readable thermometers. Do not heat asphalt to or above its flash point. Avoid heating at or above the FBT, should conditions make this impractical, heating must be no more than 25°F below the EVT and no more than 25°F above EVT.
- D. Asphalt Temperatures: If the EVT information is not provided, the following asphalt temperature shall be observed. Maximum heating temperature shall be 525°F (274°C). Minimum application temperature shall be 400°F (204°C).
- E. Asphalt Moppings: Ensure that all moppings do not exceed a maximum of 25 lb/sq. Mopping shall be total in coverage, leaving no breaks or voids.
- F. Membrane Adhesive Application: Membrane adhesive can be applied by roller, squeegee or spray unit. Apply cold adhesive in a smooth, even, continuous layer without breaks or voids. Utilize an application rate of 2 to 2 1/2 gal/sq (0.6 to 1.0 l/m<sup>2</sup>) over irregular or porous substrates. Utilize an application rate of 1 1/2 to 2 gal/sq (0.6 to 0.8 kg/m<sup>2</sup>) for interply applications. Double the adhesive application rate at the end laps of granule surfaced sheets. Refer to the manufacturer's inter-ply flashing detail at the locations that are to receive the specified catalyzed acrylic resin primer/flashing system.
- G. Bitumen Consistency: Cutting or alterations of bitumen, primer, and sealants will not be permitted.
- H. Roofing Application: Apply all layers of roofing free of wrinkles, creases or fishmouths. Exert sufficient pressure on the roll during application to ensure prevention of air pockets.
  1. Apply all layers of roofing perpendicular to the slope of the deck.
  2. Fully bond the base ply to the prepared substrate, utilizing minimum 3 inch side and end laps. Apply each sheet directly behind the *asphalt/torch/cold adhesive* applicator. Cut a dog ear angle at the end laps on overlapping selvage edges. Using a clean trowel, apply top pressure to top seal T-laps immediately following sheet application. Stagger end laps a minimum of 3 feet.
  3. Fully bond the finish ply to the base ply, utilizing minimum 3 inch side and end laps. Apply each sheet directly behind the *asphalt/torch/cold adhesive* applicator. Stagger end laps of the finish ply a minimum 3 feet. Cut a dog ear angle at the end laps on overlapping selvage edges. Using a clean trowel, apply top pressure to top seal T-laps immediately following sheet application. Stagger side laps of the finish ply a minimum 12 inches from side laps in the underlying base ply. Stagger end laps of the finish ply a minimum 3 feet from end laps in the underlying base ply.
  4. Apply all layers of roofing parallel to the slope of the deck.
  5. Fully bond the base ply to the prepared substrate, utilizing minimum 3 inch side and end laps. Apply each sheet directly behind the *\*[asphalt/torch/cold adhesive]* applicator. Cut dog ear angles on underlying end laps at the finish edge and the

overlapping selvage edges. Using a clean trowel, apply top pressure to top seal T-laps immediately following sheet application. Stagger end laps a minimum of 3 feet.

6. Fully bond the finish ply to the base ply, utilizing minimum 3 inch side and end laps. Apply each sheet directly behind the \*[asphalt/torch/cold adhesive] applicator. Stagger end laps of the finish ply a minimum 3 feet. Cut dog ear angles on underlying end laps at the finish edge and the overlapping selvage edges. Using a clean trowel, apply top pressure to top seal T-laps immediately following sheet application. Stagger side laps of the finish ply a minimum 12 inches from side laps in the underlying base ply. Stagger end laps of the finish ply a minimum 3 feet from end laps in the underlying base ply.
  7. Maximum sheet lengths and special fastening of the specified roof membrane system may be required at various slope increments where the roof deck slope exceeds 1/2 inch per foot. The manufacturer shall provide acceptable sheet lengths and the required fastening schedule for all roofing sheet applications to applicable roof slopes.
- I. Granule Embedment: Broadcast mineral granules over all bitumen overruns on the finish ply surface, while the bitumen is still hot or the adhesive is soft, to ensure a monolithic surface color.
  - K. Torch-applied Flashing Application (granule-surfaced): Cut the cant backing sheet into 12 inch widths and peel the release film from the back of the sheet. Set the sheet into place over the primed substrate extending 6 inches onto the field of the roof area and 6 inches up the vertical surface utilizing minimum 3 inch laps. Set the non-combustible cant into place dry prior to installation of the roof membrane base ply. Flash walls and curbs using the reinforcing sheet and the granule-surfaced flashing membrane. After the base ply has been applied to the top of the cant, prime the base ply surfaces to receive the reinforcing sheet. Fully adhere the reinforcing sheet, utilizing minimum 3 inch side laps onto the primed base ply surface and up the primed wall or curb to the desired flashing height. After the final roofing ply has been applied to the top of the cant, prepare the surface area that is to receive flashing coverage by torch heating granular surfaces or by application of asphalt primer; allowing primer to dry thoroughly. Torch apply the granule-surfaced flashing into place using three foot widths (cut off the end of roll) always lapping the factory selvage edge. Stagger the laps of the flashing layer from lap seams in the reinforcing layer. Extend the flashing sheet a minimum of 4 inches beyond the toe of the cant onto the prepared surface of the finished roof and up the wall or curb to the desired flashing height. Exert pressure on the flashing sheet during application to ensure complete contact with the vertical/horizontal surfaces, preventing air pockets. Check and seal all loose laps and edges. Nail the top edge of the flashing on 9 inch centers. (See manufacturer's schematic for visual interpretation).
  - N. Water Cut-Off: At 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 the resumption of roofing.
  - O. Sealant: Apply a smooth continuous bead of the specified sealant at the exposed finish ply edge transition to metal flashings incorporated into the roof system.

### 3.04 FIELD QUALITY CONTROL AND INSPECTIONS

- A. Site Condition: Leave all areas around job site free of debris, roofing materials, equipment and related items after completion of job.
- B. Notification of Completion: Notify the manufacturer by means of manufacturer's printed Notification of Completion form of job completion in order to schedule a final inspection date.
- C. Final Inspection/Post-Installation Meeting: Hold a meeting at the completion of the project, attended by all parties that were present at the pre-job conference. A punch list of items required for completion shall be compiled by the Contractor and the manufacturer's representative. Complete, sign, and mail the punch list form to the manufacturer's headquarters.
- D. Issuance of the Guarantee: Complete all post installation procedures and meet the manufacturer's final endorsement for issuance of the specified guarantee.

## SECTION 076200 - SHEET METAL FLASHING AND TRIM

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Manufactured reglets with counterflashing.
2. Formed roof-drainage sheet metal fabrications.
3. Formed low-slope roof sheet metal fabrications.
4. Formed wall sheet metal fabrications.

#### 1.2 PREINSTALLATION MEETINGS

- ##### A. Preinstallation Conference: Conduct conference at Project site.

#### 1.3 ACTION SUBMITTALS

##### A. Product Data: For each of the following

1. Underlayment materials.
2. Elastomeric sealant.
3. Butyl sealant.
4. Epoxy seam sealer.

##### B. Shop Drawings: For sheet metal flashing and trim.

1. Include plans, elevations, sections, and attachment details.
2. Detail fabrication and installation layouts, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled Work.
3. Include identification of material, thickness, weight, and finish for each item and location in Project.
4. Include details for forming, including profiles, shapes, seams, and dimensions.
5. Include details for joining, supporting, and securing, including layout and spacing of fasteners, cleats, clips, and other attachments. Include pattern of seams.
6. Include details of termination points and assemblies.
7. Include details of expansion joints and expansion-joint covers, including showing direction of expansion and contraction from fixed points.
8. Include details of roof-penetration flashing.
9. Include details of edge conditions, including eaves, ridges, valleys, rakes, crickets, flashings, and counter-flashings.
10. Include details of special conditions.
11. Include details of connections to adjoining work.

- ##### C. Samples: For each exposed product and for each color and texture specified, 12 inches long by actual width.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of coping and roof edge flashing that is ANSI/SPRI/FM 4435/ES-1 tested.
- B. Evaluation Reports: For copings and roof edge flashing, from ICC-ES showing compliance with ANSI/SPRI/FM 4435/ES-1.
- C. Sample warranty.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Maintenance data.
- B. Special warranty.

#### 1.6 QUALITY ASSURANCE

- A. Fabricator Qualifications: Employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.
  - 1. For copings and roof edge flashings that are ANSI/SPRI/FM 4435/ES-1 tested, shop shall be listed as able to fabricate required details as tested and approved.

#### 1.7 WARRANTY

- A. Special Warranty on Finishes: Manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.
  - 1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
    - a. Color fading more than 5 Delta E units when tested in accordance with ASTM D2244.
    - b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
    - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
  - 2. Finish Warranty Period: **20**years from date of Substantial Completion.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Sheet metal flashing and trim assemblies, including cleats, anchors, and fasteners, shall withstand wind loads, structural movement, thermally induced movement, and exposure to

weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.

- B. Sheet Metal Standard for Flashing and Trim: Comply with NRCA's "The NRCA Roofing Manual: Architectural Metal Flashing, Condensation and Air Leakage Control, and Reroofing" and SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.
- C. Sheet Metal Standard for Copper: Comply with CDA's "Copper in Architecture Handbook." Conform to dimensions and profiles shown unless more stringent requirements are indicated.
- D. SPRI Wind Design Standard: Manufacture and install copings, roof edge flashings tested in accordance with ANSI/SPRI/FM 4435/ES-1 and capable of resisting the following design pressure:
  - 1. Design Pressure: As indicated on Structural Drawings.
- E. FM Approvals Listing: Manufacture and install copings, roof edge flashings that are listed in FM Approvals' "RoofNav" and approved for windstorm classification. Refer to Structural Requirements. Identify materials with name of fabricator and design approved by FM Approvals.
- F. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
  - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

## 2.2 SHEET METALS

- A. Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.
- B. Metallic-Coated Steel Sheet: Provide [zinc-coated (galvanized) steel sheet in accordance with ASTM A653/A653M, G90 coating designation prepainted by coil-coating process to comply with ASTM A755/A755M.
  - 1. Surface: Smooth, flat.
  - 2. Exposed Coil-Coated Finish:
    - a. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions for seacoast and severe environments.
  - 3. Color: As selected by Architect from manufacturer's full range.

## 2.3 UNDERLAYMENT MATERIALS

- A. Felt: ASTM D226/D226M, Type II (No. 30), asphalt-saturated organic felt; nonperforated.
- B. Self-Adhering, High-Temperature Sheet Underlayment: Minimum 30 mils thick, consisting of a slip-resistant polyethylene- or polypropylene-film top surface laminated to a layer of butyl- or SBS-modified asphalt adhesive, with release-paper backing; specifically designed to withstand high metal temperatures beneath metal roofing. Provide primer in accordance with underlayment manufacturer's written instructions.
  - 1. Provide one of the following manufacturers:
    - a. Carlisle Construction Materials
    - b. Henry Company
    - c. Owens Corning
    - d. Protecto Wrap Company
  - 2. Low-Temperature Flexibility: ASTM D1970/D1970M; passes after testing at minus 20 deg F or lower.

## 2.4 MISCELLANEOUS MATERIALS

- A. Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and as recommended by manufacturer of primary sheet metal unless otherwise indicated.
- B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal.
  - 1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
    - a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating. Provide metal-backed EPDM or PVC sealing washers under heads of exposed fasteners bearing on weather side of metal.
    - b. Blind Fasteners: High-strength aluminum or stainless steel rivets suitable for metal being fastened.
    - c. Spikes and Ferrules: Same material as gutter; with spike with ferrule matching internal gutter width.
  - 2. Fasteners for Copper Sheet: Copper, hardware bronze or passivated Series 300 stainless steel.
  - 3. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.
  - 4. Fasteners for Stainless Steel Sheet: Series 300 stainless steel.
  - 5. Fasteners for Zinc-Coated (Galvanized) Steel Sheet: Series 300 stainless steel or hot-dip galvanized steel in accordance with ASTM A153/A153M or ASTM F2329.
- C. Sealant Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2-inch-wide and 1/8 inch thick.



- D. Elastomeric Sealant: ASTM C920, elastomeric polyurethane polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.
- E. Butyl Sealant: ASTM C1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.
- F. Epoxy Seam Sealer: Two-part, noncorrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior nonmoving joints, including riveted joints.
- G. Bituminous Coating: Cold-applied asphalt emulsion in accordance with ASTM D1187/D1187M.
- H. Asphalt Roofing Cement: ASTM D4586, asbestos free, of consistency required for application.
- I. Reglets: Units of type, material, and profile required, formed to provide secure interlocking of separate reglet and counterflashing pieces, and compatible with flashing indicated with factory-mitered and -welded corners and junctions and with interlocking counterflashing on exterior face, of same metal as reglet.
  - 1. Provide the following manufacturers:
    - a. Fry Reglet Corporation
    - b. Hohmann & Barnard, Inc
  - 2. Material: Aluminum, 0.024 inch thick.
  - 3. Surface-Mounted Type: Provide with slotted holes for fastening to substrate, with neoprene or other suitable weatherproofing washers, and with channel for sealant at top edge.
  - 4. Stucco Type: Provide with upturned fastening flange and extension leg of length to match thickness of applied finish materials.
  - 5. Concrete Type: Provide temporary closure tape to keep reglet free of concrete materials, special fasteners for attaching reglet to concrete forms, and guides to ensure alignment of reglet section ends.
  - 6. Masonry Type: Provide with offset top flange for embedment in masonry mortar joint.
  - 7. Accessories:
    - a. Flexible-Flashing Retainer: Provide resilient plastic or rubber accessory to secure flexible flashing in reglet where clearance does not permit use of standard metal counterflashing or where Drawings show reglet without metal counterflashing.
    - b. Counterflashing Wind-Restraint Clips: Provide clips to be installed before counterflashing to prevent wind uplift of counterflashing's lower edge.
  - 8. Finish: With manufacturer's standard color coating.

## 2.5 FABRICATION, GENERAL

- A. Custom fabricate sheet metal flashing and trim to comply with details indicated and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required.

1. Fabricate sheet metal flashing and trim in shop to greatest extent possible.
2. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
3. Verify shapes and dimensions of surfaces to be covered and obtain field measurements for accurate fit before shop fabrication.
4. Form sheet metal flashing and trim to fit substrates without excessive oil-canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
5. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.

B. Fabrication Tolerances:

1. Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.
2. Fabricate sheet metal flashing and trim that is capable of installation to tolerances specified.

C. Expansion Provisions: Form metal for thermal expansion of exposed flashing and trim.

1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with butyl sealant concealed within joints.
2. Use lapped expansion joints only where indicated on Drawings.

D. Sealant Joints: Where movable, nonexpansion-type joints are required, form metal in accordance with cited sheet metal standard to provide for proper installation of elastomeric sealant.

E. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.

F. Fabricate cleats and attachment devices of sizes as recommended by cited sheet metal standard **and** by FM Global Property Loss Prevention Data Sheet 1-49 for application, but not less than thickness of metal being secured.

G. Seams:

1. Fabricate nonmoving seams with flat-lock seams. Tin edges to be seamed, form seams, and solder.
2. Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use.
3. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer.

## 2.6 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

A. Copings: Fabricate in minimum 96-inch long, but not exceeding 12-foot long, sections. Fabricate joint plates of same thickness as copings. Furnish with continuous cleats to support

edge of external leg and drill elongated holes for fasteners on interior leg. Miter corners, fasten and seal watertight. Shop fabricate interior and exterior corners.

1. Fabricate from the following materials:
  - a. Galvanized Steel: 0.040 inch thick.
- B. Base Flashing: Shop fabricate interior and exterior corners. Fabricate from the following materials:
  1. Galvanized Steel: 0.028 inch thick.
- C. Counterflashing: Shop fabricate interior and exterior corners. Fabricate from the following materials:
  1. Galvanized Steel: 0.022 inch thick.
- D. Roof-Penetration Flashing: Fabricate from the following materials:
  1. Galvanized Steel: 0.028 inch thick.

## 2.7 WALL SHEET METAL FABRICATIONS

- A. Through-Wall Flashing: Fabricate continuous flashings in minimum 96-inch long, but not exceeding 12-foot long, sections, under copings, and at shelf angles. Fabricate discontinuous lintel, sill, and similar flashings to extend 6 inches beyond each side of wall openings; and form with 2-inch high, end dams. Fabricate from the following materials:
  1. Stainless Steel: 0.0156 inch thick.
- B. Opening Flashings in Frame Construction: Fabricate head, sill, jamb, and similar flashings to extend 4 inches beyond wall openings. Form head and sill flashing with 2-inch high, end dams. Fabricate from the following materials:
  1. Galvanized Steel: 0.022 inch thick.
- C. Wall Expansion-Joint Cover: Fabricate from the following materials:
  1. Galvanized Steel: 0.028 inch thick.

## PART 3 - EXECUTION

### 3.1 INSTALLATION OF UNDERLAYMENT

- A. Felt Underlayment: Install felt underlayment, wrinkle free, using adhesive to minimize use of mechanical fasteners under sheet metal flashing and trim.
  1. Install in shingle fashion to shed water.
  2. Lap joints not less than 2 inches .
- B. Synthetic Underlayment: Install synthetic underlayment, wrinkle free, in accordance with manufacturers' written instructions, and using adhesive where possible to minimize use of mechanical fasteners under sheet metal.
  1. Lap horizontal joints not less than 4 inches.
  2. Lap end joints not less than 12 inches.

- C. Self-Adhering, High-Temperature Sheet Underlayment:
1. Install self-adhering, high-temperature sheet underlayment; wrinkle free.
  2. Prime substrate if recommended by underlayment manufacturer.
  3. Comply with temperature restrictions of underlayment manufacturer for installation; use primer for installing underlayment at low temperatures.
  4. Apply in shingle fashion to shed water, with end laps of not less than 6 inches staggered 24 inches between courses.
  5. Overlap side edges not less than 3-1/2 inches. Roll laps and edges with roller.
  6. Roll laps and edges with roller.
  7. Cover underlayment within 14 days.
- D. Install slip sheet, wrinkle free, over underlayment before installing sheet metal flashing and trim.
1. Install in shingle fashion to shed water.
  2. Lapp joints not less than 4 inches.

### 3.2 INSTALLATION, GENERAL

- A. Install sheet metal flashing and trim to comply with details indicated and recommendations of cited sheet metal standard that apply to installation characteristics required unless otherwise indicated on Drawings.
1. Install fasteners, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
  2. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of welds.
  3. Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement.
  4. Install sheet metal flashing and trim to fit substrates and to result in watertight performance.
  5. Install continuous cleats with fasteners spaced not more than 12 inches o.c.
  6. Space individual cleats not more than 12 inches apart. Attach each cleat with at least two fasteners. Bend tabs over fasteners.
  7. Install exposed sheet metal flashing and trim with limited oil-canning, and free of buckling and tool marks.
  8. Do not field cut sheet metal flashing and trim by torch.
- B. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating or by other permanent separation as recommended by sheet metal manufacturer or cited sheet metal standard.
1. Coat concealed side of uncoated-aluminum sheet metal flashing and trim with bituminous coating where flashing and trim contact wood, ferrous metal, or cementitious construction.
  2. Underlayment: Where installing sheet metal flashing and trim directly on cementitious or wood substrates, install underlayment and cover with slip sheet.

- C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim.
1. Space movement joints at maximum of 10 feet with no joints within 24 inches of corner or intersection.
  2. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with sealant concealed within joints.
  3. Use lapped expansion joints only where indicated on Drawings.
- D. Fasteners: Use fastener sizes that penetrate wood blocking or sheathing not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws.
- E. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.
- F. Seal joints as required for watertight construction.
1. Use sealant-filled joints unless otherwise indicated.
    - a. Embed hooked flanges of joint members not less than 1 inch into sealant.
    - b. Form joints to completely conceal sealant.
    - c. When ambient temperature at time of installation is between 40 and 70 deg F, set joint members for 50 percent movement each way.
    - d. Adjust setting proportionately for installation at higher ambient temperatures.
      - 1) Do not install sealant-type joints at temperatures below 40 deg F.
  2. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."
- G. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter.
1. Pretin edges of sheets with solder to width of 1-1/2 inches; however, reduce pretinning where pretinned surface would show in completed Work.
  2. Do not solder metallic-coated steel and aluminum sheet.
  3. Do not pretin zinc-tin alloy-coated copper.
  4. Do not use torches for soldering.
  5. Heat surfaces to receive solder, and flow solder into joint.
    - a. Fill joint completely.
    - b. Completely remove flux and spatter from exposed surfaces.
  6. Stainless Steel Soldering:
    - a. Tin edges of uncoated sheets, using solder for stainless steel and acid flux.
    - b. Promptly remove acid-flux residue from metal after tinning and soldering.
    - c. Comply with solder manufacturer's recommended methods for cleaning and neutralization.
  7. Copper Soldering: Tin edges of uncoated sheets, using solder for copper.

- H. Rivets: Rivet joints in uncoated aluminum where necessary for strength.

### 3.3 INSTALLATION OF ROOF FLASHINGS

- A. Install sheet metal flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and cited sheet metal standard.
  - 1. Provide concealed fasteners where possible, and set units true to line, levels, and slopes.
  - 2. Install work with laps, joints, and seams that are permanently watertight and weather resistant.
- B. Roof Edge Flashing:
  - 1. Install roof edge flashings in accordance with ANSI/SPRI/FM 4435/ES-1.
  - 2. Anchor to resist uplift and outward forces in accordance with recommendations in cited sheet metal standard unless otherwise indicated. Interlock bottom edge of roof edge flashing with continuous cleat anchored to substrate at staggered 3-inch centers.
  - 3. Anchor to resist uplift and outward forces in accordance with recommendations in FM Global Property Loss Prevention Data Sheet 1-49 for FM Approvals' listing for required windstorm classification.
- C. Copings:
  - 1. Install roof edge flashings in accordance with ANSI/SPRI/FM 4435/ES-1.
  - 2. Anchor to resist uplift and outward forces in accordance with recommendations in cited sheet metal standard unless otherwise indicated.
    - a. Interlock exterior bottom edge of coping with continuous cleat anchored to substrate at 16-inch centers.
    - b. Anchor interior leg of coping with washers and screw fasteners through slotted holes at 24-inch centers.
  - 3. Anchor to resist uplift and outward forces in accordance with recommendations in FM Global Property Loss Prevention Data Sheet 1-49 for specified FM Approvals' listing for required windstorm classification.
- D. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending minimum of 4 inches over base flashing. Install stainless steel draw band and tighten.
- E. Counterflashing: Coordinate installation of counterflashing with installation of base flashing.
  - 1. Insert counterflashing in reglets or receivers and fit tightly to base flashing.
  - 2. Extend counterflashing 4 inches over base flashing.
  - 3. Lap counterflashing joints minimum of 4 inches.
- F. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Seal with elastomeric sealant and clamp flashing to pipes that penetrate roof.

### 3.4 INSTALLATION OF WALL FLASHINGS

- A. Install sheet metal wall flashing to intercept and exclude penetrating moisture in accordance with cited sheet metal standard unless otherwise indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.
- B. Opening Flashings in Frame Construction: Install continuous head, sill, jamb, and similar flashings to extend 4 inches beyond wall openings.

### 3.5 INSTALLATION TOLERANCES

- A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

### 3.6 CLEANING

- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- B. Clean and neutralize flux materials. Clean off excess solder.
- C. Clean off excess sealants.

### 3.7 PROTECTION

- A. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions.
- B. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures, as determined by Architect.

END OF SECTION 076200

## SECTION 077200 - ROOF ACCESSORIES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. This Section includes the following: Factory fabricated roof curbs.

#### 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, materials, dimensions of individual components and profiles, and finishes.
- B. Coordination Drawings: Roof plans drawn to scale and coordinating penetrations and roof-mounted items. Show the following:
  1. Size and location of roof accessories specified in this Section.
  2. Method of attaching roof accessories to roof or building structure.
  3. Other roof-mounted items including mechanical and electrical equipment, ductwork, piping, and conduit.
  4. Coordinate dimensions with shop drawings of equipment to be supported.

#### 1.4 QUALITY ASSURANCE

- A. Substitutions: Requests for substitution shall be submitted in writing at least 10 days prior to bid date and shall be accompanied by product literature and samples. No substitution will be permitted after bid date.
- B. Standards: Comply with the following:
  1. SMACNA's "Architectural Sheet Metal Manual" details for fabrication of units, including flanges and cap flashing to coordinate with type of roofing indicated.
  2. NRCA's "Roofing and Waterproofing Manual" details for installing units.

### PART 2 - PRODUCTS

#### 2.1 MATERIALS, GENERAL

- A. G-90 galvanized steel with paint-grip coating.
- B. Insulation: Manufacturer's standard rigid or semirigid glass-fiber board of 2" thickness, 1-1/2lb density, R8 value.
- C. Wood Nailers: Softwood lumber, pressure treated with waterborne preservatives for aboveground use, complying with AWPA C2; not less than 1-1/2 inches thick.



## SECTION 077200 - ROOF ACCESSORIES

- D. Fasteners: Stainless steel metal as recommended by manufacturer. Match finish of exposed fasteners with finish of material being fastened.
- E. Gaskets: Manufacturer's standard tubular or fingered design of neoprene, EPDM, or PVC; or flat design of foam rubber, sponge neoprene, or cork.
- F. Bituminous Coating: SSPC-Paint 12, solvent-type bituminous mastic, nominally free of sulfur and containing no asbestos fibers, compounded for 15-mil dry film thickness per coating.
- G. Mastic Sealant: Polyisobutylene; nonhardening, nonskinning, nondrying, nonmigrating sealant.
- H. Elastomeric Sealant: Generic type recommended by unit manufacturer that is compatible with joint surfaces; ASTM C 920, Type S, Grade NS, Class 25, and Uses NT, G, A, and, as applicable to joint substrates indicated, O.
- I. Roofing Cement: ASTM D 4586, nonasbestos, fibrated asphalt cement designed for trowel application or other adhesive compatible with roofing system.

### 2.2 ROOF CURBS

- A. General: Provide roof curbs capable of supporting superimposed live and dead loads, including equipment loads and other construction to be supported on roof curbs. Coordinate dimensions with rough-in information or Shop Drawings of equipment to be supported.
- B. Fabrication: Unless otherwise indicated or required for strength, fabricate units from minimum 16 gauge, galvanized steel with paint grip coating, with welded corners and with seams joined by continuous water and air-tight welds. Tack or spot welding is unacceptable.
  - 1. All external welds shall be prepared and coated with corrosion inhibitor compound.
  - 2. Curb adapter walls shall be insulated with 1-1/2" thick, three-pound density insulation. Exposed edges shall be encapsulated to ensure no insulation erodes into the air stream. Insulation shall be either foil faced or coated with antimicrobial coating such that the fibers are not airborne over the life of the building.
  - 3. Provide preservative-treated wood nailers at tops of curbs and formed flange at perimeter bottom for mounting to roof.
  - 4. Provide formed cants and base profile coordinated with roof insulation thickness.
  - 5. The Manufacturer shall limit static pressure gain to .25 inches/water gauge
  - 6. Fabricate units to minimum height of 18 inches, unless otherwise indicated.
  - 7. Changes in airflow direction to be accomplished by 90-degree elbows with turning vanes.
  - 8. Curb adapters shall be manufactured in one piece except when width exceeds 108". If width exceeds 108", the curb shall be designed with prefabricated joints for ease of installation. It will be manufactured in separate pieces with the number and length of the pieces determined by the total length of the unit. The Manufacturer shall supply drawings for assembly and installation.
  - 9. Curb adapters shall provide full support of the new unit and shall include 3/8" gasketing.
  - 10. Counter flashing shall extend over the original curb a minimum of 1" and be welded and weatherproof.

### 2.3 FINISHES, GENERAL

## SECTION 077200 - ROOF ACCESSORIES

- A. Surface preparation: Oil, grease and other deposits of surface contamination shall be removed by solvent or detergent washing. All surfaces must be clean, dry and free of any dirt, dust, grease, oil or other deleterious materials prior to coating. Care shall be taken to ensure surfaces remain clean before and during coating process.
- B. Application system:
  - 1. Coating shall provide a standard 5 year manufacturer's limited warranty.
  - 2. Metal surfaces shall be finished with a corrosion protection system equal to one of the following:
    - a. Energy Guard ZRU Primer. Finish coat shall consist of EnergyGuard DCC Cabinet Casing polyurethane coating. Coatings shall be applied by a certified applicator and shall result in a finish with an ASTM B117-90 salt spray rating of 10,000 hours.
    - b. Prime coat of ICI Devran 201 Universal Epoxy Primer to thickness of not less than 3.0 mils DFT (dry film thickness) nor more than 8.0 mils DFT. Minimum recoat time for Devran 201 Universal Epoxy Primer is 3.5 hours at 77 F with 80% relative humidity. Finish coat shall consist of Devthane 379 UVA Aliphatic Urethane Gloss Enamel applied to thickness of not less than 1.0 mils DFT nor more than 5.0 mils DFT.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. General: Comply with manufacturer's written instructions. Coordinate installation of roof accessories with installation of roof deck, roof insulation, flashing, roofing membranes, penetrations, equipment, and other construction involving roof accessories to ensure that each element of the Work performs properly and that combined elements are waterproof and weather tight. Anchor roof accessories securely to supporting structural substrates so they are capable of withstanding lateral and thermal stresses, and inward and outward loading pressures.
- B. Separation: 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.
- C. Flange Seals: Unless otherwise indicated, set flanges of accessory units in a thick bed of roofing cement to form a seal.
- D. Cap Flashing: Where required as component of accessory, install cap flashing to provide waterproof overlap with roofing or roof flashing (as counter flashing). Seal overlap with thick bead of mastic sealant.
- E. Operational Units: Test-operate units with operable components. Clean and lubricate joints and hardware. Adjust for proper operation.

### 3.2 CLEANING AND PROTECTION

- A. Clean exposed surfaces according to manufacturer's written instructions. Touch up damaged metal coatings.

END OF SECTION 077200

## SECTION 077201 - ROOF HATCH

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Roof hatches.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of roof accessory.
- B. Shop Drawings: For roof accessories.
- C. Samples: For each exposed product and for each color and texture specified.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Sample warranties.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

### PART 2 - PRODUCTS

#### 2.1 ROOF HATCHES

- A. Roof Hatches: Metal roof-hatch units with lids and insulated single walled curbs, welded or mechanically fastened and sealed corner joints, continuous lid-to-curb counterflashing and weathertight perimeter gasketing, straight side and integrally formed deck-mounting flange at perimeter bottom.
  - 1. Provide one of the following manufacturers:
    - a. Babcock-Davis – Hurricane Hatch
    - b. BILCO Company – Series “S”
    - c. O’Keeffe’s Inc.
  - 2. Type and Size: Single-leaf lid, 30 by 36 inches.
  - 3. Loads: Minimum 40-lbf/sq. ft. external live load and 30-lbf/sq. ft. internal uplift load.
    - a. When release is actuated, lid shall open against 10-lbf/sq. ft. snow or wind load and lock in position.

4. Heat and Smoke Vent Standard: Provide units that have been tested and listed to comply with UL 793.
5. Curb, Framing, and Lid Material: Aluminum-zinc alloy-coated steel sheet.
  - a. Thickness: Manufacturer's standard thickness for hatch size indicated.
  - b. Finish: Factory prime coating.
  - c. Color: As selected by Architect from manufacturer's full range.
6. Construction:
  - a. Insulation: 1-inch thick, cellulosic-fiber board.
  - b. Nailer: Factory-installed wood nailer continuous around hatch perimeter.
  - c. Hatch Lid: Opaque, insulated, and double walled, with manufacturer's standard metal liner of same material and finish as outer metal lid.
  - d. Hatch Lid: Glazed, insulated, and double walled, with manufacturer's standard metal liner of same material and finish as outer metal lid.
  - e. Exterior Curb Liner: Manufacturer's standard, of same material and finish as metal curb.
  - f. Fabricate curbs to minimum height of 12 inches above roofing surface unless otherwise indicated.
7. Hardware: Manufacturer's standard stainless steel; with hinges, hold-open devices, and independent manual-release devices for inside and outside operation of lids.

## 2.2 METAL MATERIALS

- A. Zinc-Coated (Galvanized) Steel Sheet: ASTM A653/A653M, G90 coating designation.
  1. Mill-Phosphatized Finish: Manufacturer's standard for field painting.
  2. Factory Prime Coating: Where field painting is indicated, apply pretreatment and white or light-colored, factory-applied, baked-on epoxy primer coat, with a minimum dry film thickness of 0.2 mil.
  3. Exposed Coil-Coated Finish: Prepainted by the coil-coating process to comply with ASTM A755/A755M. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
    - a. Two-Coat Fluoropolymer Finish: AAMA 621. System consisting of primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight.
  4. Baked-Enamel or Powder-Coat Finish: After cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat to a minimum dry film thickness of 2 mils.
  5. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester-backer finish consisting of prime coat and wash coat, with a minimum total dry film thickness of 0.5 mil.
- B. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A792/A792M, AZ50 coated.

1. Factory Prime Coating: Where field painting is indicated, apply pretreatment and white or light-colored, factory-applied, baked-on epoxy primer coat, with a minimum dry film thickness of 0.2 mil.
  2. Exposed Coil-Coated Finish: Prepainted by the coil-coating process to comply with ASTM A755/A755M. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
    - a. Two-Coat Fluoropolymer Finish: AAMA 621. System consisting of primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight.
  3. Baked-Enamel or Powder-Coat Finish: After cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat to a minimum dry film thickness of 2 mils.
  4. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester-backer finish consisting of prime coat and wash coat, with a minimum total dry film thickness of 0.5 mil.
- C. Aluminum Sheet: ASTM B209 manufacturer's standard alloy for finish required, with temper to suit forming operations and performance required.
1. Mill Finish: As manufactured.
  2. Factory Prime Coating: Where field painting is indicated, apply pretreatment and white or light-colored, factory-applied, baked-on epoxy primer coat, with a minimum dry film thickness of 0.2 mil.
  3. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm.
  4. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm. or thicker.
  5. Exposed Coil-Coated Finish: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
    - a. Two-Coat Fluoropolymer Finish: AAMA 2605. System consisting of primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight.
  6. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
  7. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester-backer finish consisting of prime coat and wash coat, with a minimum total dry film thickness of 0.5 mil.
- D. Aluminum Extrusions and Tubes: ASTM B22 manufacturer's standard alloy and temper for type of use, finished to match assembly where used; otherwise mill finished.
- E. Stainless Steel Sheet and Shapes: ASTM A240/A240M or ASTM A666, Type 304.
- F. Steel Shapes: ASTM A36/A36M, hot-dip galvanized according to ASTM A123/A123M unless otherwise indicated.
- G. Steel Tube: ASTM A500/A500M, round tube.

- H. Galvanized-Steel Tube: ASTM A500/A500M, round tube, hot-dip galvanized according to ASTM A123/A123M.
- I. Steel Pipe: ASTM A53/A53M, galvanized.

## 2.3 MISCELLANEOUS MATERIALS

- A. Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items required by manufacturer for a complete installation.
- B. Acrylic Glazing: ASTM D4802, thermoformable, monolithic sheet, manufacturer's standard, Type UVA (formulated with UV absorber), Finish 1 (smooth or polished).
- C. Cellulosic-Fiber Board Insulation: ASTM C208, Type II, Grade 1, thickness as indicated.
- D. Glass-Fiber Board Insulation: ASTM C726, nominal density of 3 lb/cu. ft. thermal resistivity of 4.3 deg F x h x sq. ft./Btu x in. at 75 deg F thickness as indicated.
- E. Polyisocyanurate Board Insulation: ASTM C1289, thickness and thermal resistivity as indicated.
- F. Wood Nailers: Softwood lumber, pressure treated with waterborne preservatives for aboveground use, acceptable to authorities having jurisdiction, and complying with AWWA C2; not less than 1-1/2 inches thick.
- G. Underlayment:
  - 1. Felt: ASTM D226/D226M, Type II (No. 30), asphalt-saturated organic felt, nonperforated.
  - 2. Polyethylene Sheet: 6-mil thick polyethylene sheet complying with ASTM D4397.
  - 3. Slip Sheet: Building paper, 3 lb/100 sq. ft. minimum, rosin sized.
  - 4. Self-Adhering, High-Temperature Sheet: Minimum 30 to 40 mils thick, consisting of slip-resisting polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.
- H. Fasteners: Roof accessory manufacturer's recommended fasteners suitable for application and metals being fastened. Match finish of exposed fasteners with finish of material being fastened. Provide nonremovable fastener heads to exterior exposed fasteners. Furnish the following unless otherwise indicated:
- I. Gaskets: Manufacturer's standard tubular or fingered design of neoprene, EPDM, PVC, or silicone or a flat design of foam rubber, sponge neoprene, or cork.
- J. Elastomeric Sealant: ASTM C920, elastomeric polymer sealant as recommended by roof accessory manufacturer for installation indicated; low modulus; of type, grade, class, and use classifications required to seal joints and remain watertight.
- K. Butyl Sealant: ASTM C1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for expansion joints with limited movement.

- L. Asphalt Roofing Cement: ASTM D4586/D4586M, asbestos free, of consistency required for application.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Verify dimensions of roof openings for roof accessories. Install roof accessories according to manufacturer's written instructions.
  - 1. Install roof accessories level; plumb; true to line and elevation; and without warping, jogs in alignment, buckling, or tool marks.
  - 2. Anchor roof accessories securely in place so they are capable of resisting indicated loads.
  - 3. Use fasteners, separators, sealants, and other miscellaneous items as required to complete installation of roof accessories and fit them to substrates.
  - 4. Install roof accessories to resist exposure to weather without failing, rattling, leaking, or loosening of fasteners and seals.
- B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.
  - 1. Coat concealed side of uncoated aluminum roof accessories with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
  - 2. Underlayment: Where installing roof accessories directly on cementitious or wood substrates, install a course of underlayment and cover with manufacturer's recommended slip sheet.
- C. Seal joints with elastomeric sealant as required by roof accessory manufacturer.

### 3.2 REPAIR AND CLEANING

- A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing according to ASTM A780/A780M.
- B. Touch up factory-primed surfaces with compatible primer ready for field painting according to Section 099113 "Exterior Painting."
- C. Clean exposed surfaces according to manufacturer's written instructions.
- D. Replace roof accessories that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION 077200

## SECTION 077300 - WIND LOAD RATED ROOF CURBS AND RESTRAINT BRACKETS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Design, construct, furnish and install roof curbs, brackets and related items to meet governing building codes, as demonstrated by comprehensive analysis that the load resisting capabilities meet or exceed requirements.

#### 1.3 QUALITY ASSURANCE

- A. Meet requirements of the International Building Code, ASCE Std 7, TDI, and other applicable codes for the location. This specification shall be a minimum requirement for wind load design consideration, and is not intended as a substitute for legislated, more stringent, national, state or local requirements.
- B. Wind-induced forces shall be determined by governing code requirements. [See attached Design Wind Pressure Requirements Memo by Structural Engineer.](#)
  - 1. Wind-generated force shall be reduced into an equivalent statically applied force.
  - 2. The statically applied force shall act in horizontal and vertical directions at the center of gravity of the rooftop mounted equipment, resulting in torsion, flexure, tension and shear forces that the wind restraint brackets shall be shown to be able to resist.
- C. Install products in strict accordance with applicable codes and manufacturers' standards. Whenever a conflict occurs between the manufacturers or construction standards, the most stringent shall apply.

#### 1.4 SUBMITTALS

- A. Manufacturer's statement showing that the curbs and wind load restraint brackets meet the applicable code requirements, signed and sealed by a licensed professional engineer (PE). Provide the following:
  - 1. Wind restraint calculations for all connections of rooftop-mounted equipment to roof curb, and roof curb to the structure.
  - 2. Drawings showing curbs, wind restraint bracket dimensions, make and model compatible with rooftop unit, including type of connection hardware required.



## SECTION 077300 - WIND LOAD RATED ROOF CURBS AND RESTRAINT BRACKETS

### PART 2 - PRODUCTS

#### 2.1 ROOF CURBS AND RESTRAINTS

- A. Approved manufacturers of roof curbs and wind load restraint brackets:
  - 1. Curbs Plus, Complete Curbs, Thybar Corporation.
  - 2. Others shall obtain a written pre-approval one week prior to bidding.
- B. Products shall be made of a material (Prime G-90 galvanized steel or galvalume) compatible with roof curb and the rooftop unit base-rail material. Dissimilar metals shall not to be used.
  - 1. Fully welded mitered corners for wind load consideration
  - 2. Base flange attachments for securing curb to structure.
  - 3. Factory installed wood nailer for attachment of roofing material.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Install in accordance with manufacturer's written instructions.
- B. Attach rooftop equipment to roof curbs with wind load restraint brackets of size, type and quantity as determined by equipment manufacturer.
- C. Attach roof curb to the building structure at the curb base flanges. Base flange attachment options include anchor bolts, welded connections and mechanical fasteners.
- D. Do not install wind load restraint brackets in a manner that will result in inadequate maintenance access, base-rail damage, or roof curb reduced weight carrying capacity.
- E. Prior to performing installation of restraint brackets, notify Engineer of any conflicts with other trades or equipment that may result in undesirable contact due to inadequate space or other unforeseen conditions. Notify Engineer of any discrepancies between the specifications and field conditions or changes required due to specific equipment selection prior to installation.
- F. Corrective work necessitated by discrepancies or conflicts after installation shall be at the contractor's expense.

#### 3.2 INSPECTION

- A. On completion of installation, inspect the completed system and report in writing any installation error or other faults in the system that could affect the wind load resistant capabilities of the roof top assembly.

SECTION 077300 - WIND LOAD RATED ROOF CURBS AND RESTRAINT BRACKETS

- B. The Contractor shall submit a report to the project designer, including the above report with consequent steps taken to properly complete the wind load restraint installation.

END OF SECTION

## SECTION 078440 - FIRE-RESISTIVE JOINT SYSTEMS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes firestopping systems for joints at perimeter and through smoke and fire-resistance-rated assemblies, and supplementary items necessary to complete their installation.

#### 1.2 PERFORMANCE REQUIREMENTS

- A. General: Provide firestopping systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of assembly in which firestopping systems are installed.
- B. Fire-Resistant Joint Sealants: Provide systems for sealing linear joints in fire resistive rated assemblies that have ratings with movement capabilities equaling or exceeding the fire resistance rating of construction which joint occurs, as determined by UL 2079 or ASTM E 1966.
- C. For firestopping systems exposed to view, provide products with flame-spread ratings of less than 25 and smoke-developed ratings of less than 450, as determined per ASTM E 84.

#### 1.3 SUBMITTALS

- A. Product Data: For each type of firestopping system product indicated.
- B. Shop Drawings: For each firestopping system, show each kind of construction condition and relationships to adjoining construction. Include firestopping design designation of testing and inspecting agency acceptable to authorities having jurisdiction that evidences compliance with requirements for each condition indicated.
  - 1. Submit documentation, including illustrations, from a qualified testing and inspecting agency that is applicable to each firestopping system configuration for each type construction.
  - 2. Where Project conditions require modification of qualified testing and inspecting agency's illustration to suit a particular firestopping condition, submit illustration, with modifications marked, approved by firestopping system manufacturer's fire-protection engineer.
- C. Product Certificates: Signed by manufacturers of firestopping system products certifying that products furnished comply with requirements.
- D. Product Test Reports: From a qualified testing agency indicating firestopping system complies with requirements, based on comprehensive testing of current products.
- E. Qualification Data: For installer.

#### 1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has completed firestopping systems 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. Source Limitations: Obtain firestopping systems, for each kind of construction condition required, from a single manufacturer.
- C. Compatibility and Adhesion Testing: Manufacturer of fire stopping material shall be responsible for testing samples of materials that will contact or affect firestopping materials.
  - 1. Use manufacturer's standard test methods to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of fill materials to joint substrates.
  - 2. Perform tests under environmental conditions replicating those that will exist during installation.
  - 3. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
  - 4. For materials failing tests, obtain fire-resistant joint sealants manufacturer's written instructions for corrective measures, including the use of specially formulated primers.
- D. Fire-Test-Response Characteristics: Provide firestopping systems that comply with the following requirements and those specified in "Performance Requirements" Article:
  - 1. Firestopping tests are performed by a qualified testing and inspecting agency performing testing and follow-up inspection services for firestopping systems acceptable to authorities having jurisdiction.
  - 2. Fire Resistive Joint System: Provide materials that are identical to those tested according to UL 2079 or ASTM E 1966. Products shall have a flame spread rating of less than 25.
    - a. Where UL-classified fire-resistant joint sealants are indicated, they refer to alphanumeric designations listed in UL's "Fire Resistance Directory" under product Category XHBN.
- E. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

#### 1.5 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install firestopping systems when ambient or substrate temperatures are outside limits permitted by firestopping system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.
- B. Ventilate firestopping systems per manufacturer's written instructions by natural means or, where this is inadequate, forced-air circulation.

#### 1.6 COORDINATION

- A. Coordinate construction of openings to ensure that firestopping systems are installed according to specified requirements.

## PART 2 - PRODUCTS

### 2.1 FIRESTOPPING, GENERAL

- A. Acceptable Manufacturers: Manufacturer is “acceptable” if firestopping system has been tested and listed by UL or other testing and inspection agency acceptable to authorities having jurisdiction and manufacturer can evidence product compliance with requirements of the Contract Documents.
- B. Compatibility: Provide firestopping systems that are compatible with one another and the substrates forming openings, under conditions of service and application, as demonstrated by firestopping system manufacturer based on testing and field experience.
- C. Accessories: Provide components for each firestopping system that are needed to install fill materials and to comply with “Performance Requirements” Article. Use only components specified by firestopping system manufacturer and approved by the qualified testing and inspecting agency for firestopping systems indicated.

### 2.2 TOP-OF-WALL JOINT FIRESTOPPING

- A. Safing Insulation: Semi rigid board insulation produced by combining slag-wool fibers with thermosetting resin binders and complying with the following:
  - 1. ASTM C 612, Type 1A and 1B.
  - 2. Nominal density of 4 lb/cu. ft.
  - 3. ASTM E119 Fire rating indicated, but not less than 2 hours.
- B. Coating Material: Manufacturers standard fill material or spray applied product for sealing surface of safing insulation and adjacent construction against penetration of fire and smoke.
- C. Fire Resistive Sealants: Intumescent single-component, water based, high solids, elastomeric sealants. Nonsag formulation for openings in vertical and other surfaces requiring a nonslumping, gunnable sealant.

### 2.3 EDGE-OF-SLAB JOINT FIRESTOPPING

- A. Safing Insulation: Semi rigid board insulation produced by combining slag-wool fibers with thermosetting resin binders and complying with the following:
  - 1. ASTM C 612, Type 1A and 1B.
  - 2. Nominal density of 4 lb/cu. ft.
  - 3. ASTM E119 Fire rating indicated, but not less than 2 hours.
- B. Coating Material: Manufacturers standard fill material or spray applied product for sealing surface of safing insulation and adjacent construction against penetration of fire and smoke.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrate surfaces to receive firestopping systems and associated work and conditions under which work will be installed. Do not proceed until unsatisfactory conditions have been

corrected in a manner acceptable to the Installer. Starting of work within a particular area will be construed as installer's acceptance of surface conditions.

### 3.2 PREPARATION

- A. Surface Cleaning: Clean joints immediately prior to installing firestopping to comply with recommendations of firestopping manufacturer and the following requirements:
  - 1. Remove foreign materials from surfaces of joints that could interfere with adhesion of firestopping.
  - 2. Clean joint substrates to produce clean, sound surfaces capable of developing optimum bond with firestopping. Remove loose particles remaining from cleaning operation.
  - 3. Remove laitance and form release agents from concrete.
- B. Priming: Prime substrates where recommended by firestopping manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.
- C. Masking Tape: Use masking tape to prevent firestopping from contacting adjoining surfaces that will remain exposed upon completion of Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove smears from firestopping materials. Remove tape as soon as it is possible to do so without disturbing firestopping's seal with substrates.

### 3.3 INSTALLATION - GENERAL

- A. Install fire-stopping systems to comply with Part 1 "Performance Requirements" Article and fire-stopping system manufacturer's written installation instructions for products and applications indicated.
- B. Install forming/packing/backing materials and other accessories of types required to support fill materials during their application and in position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
- C. Install fill materials for fire-resistant joint sealants by proven techniques to produce the following results:
  - 1. Fill voids and cavities formed by openings and forming/packing/backing materials as required to achieve fire-resistance ratings indicated.
  - 2. Apply fill materials so they contact and adhere to substrates formed by joints.
  - 3. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

### 3.4 INSTALLATION OF FIRE-RESISTANT JOINT SEALANTS

- A. Comply with ASTM C 1193, and with the sealant manufacturer's installation instructions and drawings pertaining to products and applications indicated.
- B. Install joint fillers to provide support of sealants during application and at position required to produce the cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability and develop fire-resistance rating required.
- C. Install sealants by proven techniques that result 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 width that optimum sealant movement capability. Install sealants at the same time joint fillers are installed.

- D. Tool nonsag sealants immediately after sealant application and prior to the time skinning or curing begin. Form smooth, uniform beads of configuration indicated or required to produce fire-resistance rating, as well as to eliminate air pockets, and to ensure contact and adhesion of sealants with sides of joint. Remove excess sealant from surfaces adjacent to joint. Do not use tooling agents that discolor sealants or adjacent surfaces or are not approved by sealant manufacturer.

### 3.5 INSTALLATION OF FIRE SAFING PROTECTION

- A. Top of Wall: Install safing insulation to fill gap between top of wall and floor slab above. Cut safing insulation 50 percent wider than gap to be filled to ensure compression fit.
- B. Edge of Slab: Install safing insulation to fill gap between edge of structural floor/roof slab and back of exterior wall on safing clips spaced as needed to support insulation but not further apart than 24 inches o.c. unless not required by tested system. Cut safing insulation 50 percent wider than gap to be filled to ensure compression fit or install vertically as required by tested assembly.
- C. Install coating material or smoke seal compound to cover fill material and seal opening.

### 3.6 IDENTIFICATION

- A. Identify fire-resistive joint systems with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of joint edge so labels will be visible to anyone seeking to remove or penetrate joint system. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:
  - 1. The words "Warning - Fire-Resistive Joint System - Do Not Disturb. Notify Building Management of Any Damage."
  - 2. Contractor's name, address, and phone number.
  - 3. Designation of applicable testing agency.
  - 4. Date of installation.
  - 5. Manufacturer's name.
  - 6. Installer's name.

### 3.7 CLEANING

- A. Clean off excess fill materials and sealants adjacent to openings and joints as work progresses by methods and with cleaning materials approved by manufacturers of firestopping system products and of products in which joints occur.
- B. Protect firestopping system components during and after curing period from contact with contaminating substances or from damage resulting from construction operations or other causes so that they are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated firestopping immediately and install new materials to produce firestopping complying with specified requirements.

END OF SECTION

## SECTION 079200 - JOINT SEALANTS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes: Joint sealants, backing materials, and supplementary items necessary for installation.

#### 1.2 SUBMITTALS

- A. Product Data: Manufacturer's technical literature for each product and system indicated.
  - 1. Include manufacturer's specifications for materials, finishes, construction details, installation instructions, and recommendations for maintenance.
- B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing full range of colors available for each product exposed to view.
- C. Samples for Verification Purposes: Samples for each kind and color of joint sealants in 1/2 in (12 mm) wide joints formed between two 6 in (150 mm) long strips of material matching appearance of exposed surfaces adjacent to joint sealants.
- D. Manufacturer's Project Acceptance Document: Certification by the manufacturer that its product(s) are approved, acceptable, suitable for use in specific locations, for specific details, and for applications indicated, specified, or required, and that a warranty will be issued.
- E. Qualification Data: For installer.
  - 1. For firms and persons specified in "Quality Assurance" to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of Architects and Owners, and other information specified.
- F. Product Test Reports: Written reports based on evaluation of comprehensive tests performed by qualified testing agency indicating that each product complies with requirements.
- G. Field Quality Control Reports: Written report of testing and inspection required by "Field Quality Control" Article.
- H. Warranties: Sample of warranties.
  - 1. Provide manufacturer's and installer's written warranty covering materials and installation (labor) stating obligations, remedies, limitations, and exclusions.



### 1.3 QUALITY ASSURANCE

#### A. Installer Qualifications:

1. Experience: Installer with not less than 10 years experience in performing specified Work similar to scope of this Project, with a record of successful in-service performance and completion of projects for a period of not less than 10 years, and with sufficient production capability, facilities, and personnel to produce required Work.
2. Supervision: Installer shall maintain a competent supervisor who is at Project site during times specified Work is in progress that is experienced in installing systems similar to type and scope required.
3. Manufacturer Acceptance: Installer shall be certified, approved, licensed, or acceptable to manufacturer to install products.

#### B. Pre-Construction Compatibility and Adhesion Testing: Provide samples of joint substrate materials that will contact or affect urethane and silicone joint sealants to respective joint sealant manufacturers for following testing:

1. General Requirements: Test materials forming joint substrates and joint sealant backings for compatibility and adhesion with joint sealants.
2. Test Method: Manufacturer's standard test method to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
3. Specimen Quantity: Provide not fewer than number of pieces required of each kind of material, including joint substrates, shims, joint sealant backings, secondary seals, and miscellaneous materials.
4. Reports: Interpret test results and certify reports indicating requirements for primers and substrate preparation needed for adhesion or for corrective measures including use of specially formulated primers.
5. Equivalent Option to Testing: Testing may not be required if joint sealant manufacturer's joint preparation data is based on previous testing, not older than 12 months, of sealant products for adhesion to, and compatibility with, joint substrates and other materials matching those submitted.

#### C. Pre-Construction Stain Testing: Submit samples of joint substrate materials that will contact or affect urethane and silicone joint sealants to respective joint sealant manufacturers for following testing:

1. General Requirements: Test materials forming joint substrates for resistance to staining caused by joint sealants.
2. Test Method: ASTM C 1248.
3. Specimen Quantity: Provide not fewer than number of pieces required by testing laboratory of each kind of material, including joint substrates, shims, joint sealant backings, secondary seals, and miscellaneous materials.
4. Reports: Interpret test results and certify reports indicating if joint sealants stain substrate materials.
5. Equivalent Option to Testing: Testing may not be required if joint sealant manufacturer's joint preparation data is based on previous testing, not older than 12 month, of sealant products for adhesion to, and compatibility with, joint substrates and other materials matching those submitted.

### 1.4 PRE-INSTALLATION CONFERENCE

#### A. Pre-Installation Conference: Before Work begins, conduct conference at Project site.

1. Participants:
  - a. Architect.
  - b. Contractor, including superintendent.
  - c. Installer, including project manager and supervisor.
  - d. If requested, Manufacturer's qualified technical representative.
  - e. Installers of other construction interfaced with Work.
2. Minimum Agenda: Installer shall demonstrate understanding of the Work required by describing detailed procedures for preparing, installing, and cleaning the Work. Demonstration shall include, but not be limited to, following topics:
  - a. Tour representative areas of Work, inspect and discuss condition of substrate, and other preparatory work performed by other trades.
  - b. Review Contract Document requirements.
  - c. Review approved submittals.
  - d. Review inspection and testing requirements.
  - e. Review environmental conditions and procedures for coping with unfavorable conditions.
  - f. Resolve deviations or differences between Contract Documents and the manufacturer's specifications.
3. Record discussions, including decisions and agreements, and prepare report.

#### 1.5 PROJECT CONDITIONS

- A. Ambient Conditions: Install joint sealants within range of ambient and substrate temperatures and moisture conditions as recommended by manufacturer. Protect substrates from environmental conditions that affect performance. Do not apply to a damp or wet substrate or during high humidity conditions including snow, rain, fog, or mist.
- B. Weather Conditions Limitation: Proceed with Work only when existing and forecasted weather conditions will permit installation according to manufacturer's instructions and warranty requirements.

#### 1.6 COORDINATION

- A. Coordinate installation of products and systems with interfacing and adjoining construction to provide a successful installation without failure.

#### 1.7 WARRANTY

- A. Manufacturer's Warranty for Urethane Sealants: Furnish manufacturer's written material warranty for a period of 5 years from date of Substantial Completion signed by an authorized representative using manufacturer's standard form agreeing to furnish materials required to repair or replace work which exhibits material defects caused by manufacture or design of product. "Defects" is defined to include but not limited to deterioration or failure to perform as required.
- B. Manufacturer's Warranty for Silicone Sealants: Furnish manufacturer's written material for a period of 20 years from date of Substantial Completion signed by an authorized representative using manufacturer's standard form agreeing to furnish materials required to repair or replace work which exhibits material defects caused by manufacture or design of product. "Defects" is defined to include but not limited to deterioration or failure to perform as required.

- C. **Installer's Warranty:** Furnish installer's written warranty for a period of 2 years from date of Substantial Completion signed by an authorized representative using installer's standard form agreeing to provide labor required to repair or replace work which exhibits workmanship defects. "Defects" is defined to include but not limited to deterioration or failure to perform as required.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS AND PRODUCTS

- A. **Acceptable Manufacturers and Products:** Subject to compliance with requirements of Contract Documents as judged by the Architect, provide product by one of manufacturers listed. If not listed, submit as substitution according to Conditions of the Contract and Division 01 Section "Substitution Procedures".
- B. **Basis of Design (Product Standard):** Contract Documents are based on products and systems specified to establish a standard of quality. Other available manufacturers offering products having equivalent characteristics may be considered, provided deviations are minor and comply with requirements of Contract Documents as judged by the Architect.

### 2.2 MATERIALS, GENERAL

- A. **Single Source Responsibility:** Furnish each type of product from single manufacturer. Provide secondary materials only as recommended by manufacturer of primary materials.
- B. **Compatibility:** Joint sealants, backings, and other related materials shall be compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint sealant manufacturer based on testing and field experience.
- C. **Volatile Organic Compounds (VOC) Content of Interior Sealants:** Sealants and primers for use inside weatherproofing system shall comply with following limits for VOC content when calculated according to 40 CFR 59, Part 59, Subpart D (EPA Method 24):
  - 1. Elastomeric Sealants: 250 g/L.
  - 2. Primers for Non-Porous Substrates: 250 g/L.
  - 3. Primers for Porous Substrates: 775 g/L.
- D. **Suitability for Contact with Food:** Comply with authorities having jurisdiction for joints in repeated contact with food.

### 2.3 EXTERIOR ELASTOMERIC SEALANTS

- A. **Exterior Pourable Urethane Sealant:**
  - 1. **Product Quality Standard:** ASTM C 920, Type M, Grade P, Class 25, Use T.
  - 2. **Description:** Multi-component, pourable, moisture curing, polyurethane sealant; rated for incline when used on sloped surfaces.
  - 3. **Joint Movement Capability:** Plus 25 percent, minus 25 percent.
  - 4. **Primers:** Product provided by sealant manufacturer if required by conditions.
  - 5. **Manufacturers and Products:**
    - a. BASF; MasterSeal SL 2 (Formerly Sonolastic SL 2).
    - b. Pecora Corp.; Urexpan NR-200.

- c. Sika Corp., Construction Products Div.; Sikaflex 2c SL.
  - d. Tremco Commercial Sealants & Waterproofing; THC-900/THC-901 or Vulkem 445SSL.
6. Color: As selected by Architect from manufacturer's standard colors.

B. Exterior Non-sag Silicone Sealant:

- 1. Product Quality Standard: ASTM C 920, Type S, Grade NS, Class 50 or 100/50.
- 2. Description: Single component, non-sag, neutral cure, non-staining as determined by pre-construction stain testing, and non-bleeding, silicone sealant.
- 3. Joint Movement Capability:
  - a. Class 50: Plus 50 percent, minus 50 percent.
  - b. Class 100/50: Plus 100 percent, minus 50 percent.
- 4. Primers: Product provided by sealant manufacturer if required by conditions.
- 5. Manufacturers and Products:
  - a. Class 50:
    - 1) Dow Corning; 795 Silicone Building Sealant.
    - 2) Momentive Performance Materials, GE Silicones; Silpruf SCS2000.
    - 3) Pecora Corp.; 864NST.
    - 4) Sika Corp., Construction Products Div.; Sikasil WS-295.
    - 5) Tremco Commercial Sealants & Waterproofing; Spectrem 3.
  - b. Class 100/50:
    - 1) Dow Corning; 790 Silicone Building Sealant.
    - 2) Momentive Performance Materials, GE Silicones; Silpruf LM SCS2700.
    - 3) Pecora Corp.; 890NST.
    - 4) Sika Corp., Construction Products Div.; Sikasil WS-290.
    - 5) Tremco Commercial Sealants & Waterproofing; Spectrem 1.
- 6. Color: As selected by Architect from manufacturer's standard colors.

2.4 INTERIOR ELASTOMERIC SEALANTS

A. Interior Non-sag Silicone Sealant:

- 1. Product Quality Standard: ASTM C 920, Type S, Grade NS, Class 25.
- 2. Description: Single component, non-sag, moisture curing, silicone sealant specially formulated with fungicide for use in sanitary non-porous applications.
- 3. Manufacturers and Products:
  - a. Dow Corning; 786 Silicone Sealant.
  - b. Momentive Performance Materials, GE Silicones; Sanitary SCS1700.
  - c. Pecora Corp.; 898.
  - d. Sika Corp., Construction Products Div.; Sikasil GP
  - e. Tremco Commercial Sealants & Waterproofing; Tremsil 200.
- 4. Color: As selected by Architect from manufacturer's standard colors.

B. Interior Non-sag Urethane Sealant:

1. Product Quality Standard: ASTM C 920, Type S, Grade NS, Class 25 or 35.
2. Description: Single component, non-sag, moisture curing, non-staining as determined by pre-construction stain testing if exposed, polyurethane sealant.
3. Joint Movement Capability: Plus 25 percent, minus 25 percent, or plus 35 percent, minus 35 percent.
4. Primers: Product provided by sealant manufacturer if required by conditions.
5. Manufacturers and Products:
  - a. BASF; MasterSeal NP 1 (Formerly Sonolastic NP 1).
  - b. Pecora Corp.; Dynatrol I-XL.
  - c. Sika Corp., Construction Products Div.; Sikaflex 1a or Sikaflex Textured Sealant.
  - d. Tremco Commercial Sealants & Waterproofing; Dymonic or Vulkem 116.
6. Color: As selected by Architect from manufacturer's standard colors.

C. Interior Non-sag Acrylic Latex Sealant:

1. Product Quality Standard: ASTM C 834, Type and Grade as required by conditions.
2. Description: Single component, non-sag, moisture curing, general purpose, paintable, siliconized acrylic latex sealant.
3. Joint Movement Capability: Plus 7.5 percent, minus 7.5 percent
4. Manufacturers and Products:
  - a. Pecora Corp.; AC 20+.
  - b. Tremco Commercial Sealants & Waterproofing; Tremflex 834.
5. Color: As selected by Architect from manufacturer's standard colors.

D. Sprayed Foam Insulating Gap Filler:

1. Description: Low pressure, one-component, expanding, closed-cell polyurethane insulating foam gap filler; applied with professional hand-held dispensing gun; CFC and HCFC free.
2. Performance Requirements: Class 1 Fire-Retardant per ASTM E 84.
3. Manufacturers and Products:
  - a. Convenience Products; Touch N' Foam, Easy Fill Latex Foam Sealant.
  - b. DAP Products, Inc.; DAPtex Plus.

E. Acoustical Sealants: As specified in Division 09 Section "Gypsum Board Assemblies".

2.5 JOINT SEALANT BACKING

A. Foam Backer Rods:

1. Product Quality Standard: ASTM C 1330, Type C, Type O, Type B.
2. Description: Extruded polyethylene, polyurethane, or polyolefin in either closed cell structure (Type C), open cell structure (Type O), or bicellular structure with surface skin (Type B) as defined by ASTM Terminology C 717.
3. Size: Diameter approximately 25 percent larger than joint width, unless otherwise directed by manufacturer.

4. Manufacturers and Products:

a. Type C:

- 1) BASF; MasterSeal 920 (Formerly Sonneborn, Closed-Cell Backer Rod).
- 2) Nomaco Inc.; Green Rod or HBR.

b. Type O:

- 1) Backer Rod Mfg. Inc.; Denver Foam.
- 2) Nomaco Inc.; Foam-Pak II.

c. Type B:

- 1) BASF; MasterSeal 921 (Formerly Sonneborn, Soft Backer Rod).
- 2) Nomaco Inc.; Dual-Rod or Sof-Rod.

- B. Bond-Breaker Tape: Polyethylene tape or other 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.

2.6 ACCESSORIES

- A. Cleaners for Non-porous 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 non-porous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
- B. Masking Tape: Non-staining, non-absorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Acceptance of Surfaces and Conditions: Examine substrate surfaces to receive products and systems and associated Work for compliance with requirements and other conditions affecting performance. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents. Starting Work within a particular area will be construed as acceptance of surface conditions.

3.2 INSTALLATION, GENERAL

- A. Installation Quality Standards: In addition to standards listed elsewhere, perform Work according to following, unless otherwise specified:
1. Respective manufacturer's written installation instructions.
  2. Accepted submittals.
  3. Contract Documents.

### 3.3 PREPARATION

- A. General: Comply with manufacturer's instructions, recommendations, and specifications for cleaning and surface preparation. Surfaces shall have no defects, contaminants, or errors which would result in poor or potentially defective installation or would cause latent defects in Work.
- B. Cleaning of Joints: Clean out joints immediately before installing joint backings and sealants to comply with joint sealant manufacturer's written instructions and following requirements:
  - 1. Remove foreign material that could interfere with adhesion of joint sealant, including, but not limited to, dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
  - 2. Clean porous joint substrate surfaces by brushing, grinding, 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 after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air.
  - 3. Remove laitance and form-release agents from concrete.
  - 4. Clean non-porous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.
  - 5. Substrate material allowed by sealant's ASTM C 920 Use Classification.
- C. Joint Priming: Prime joint substrates where recommended by joint sealant manufacturer, or as indicated by prior experience, or as required by pre-construction compatibility and adhesion testing. 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.
- D. Masking Tape: Use masking tape where required to prevent contact of sealant or primer 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.

### 3.4 INSTALLATION

- A. Joint Sealant Backings: Install type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
  - 1. Do not leave gaps between ends of sealant backings.
  - 2. Do not stretch, twist, puncture, or tear backings.
  - 3. Remove absorbent sealant backings that have become wet or damaged before sealant application and replace with dry materials.
  - 4. Install bond-breaker tape behind sealants where backings are not used between sealants and backs of joints.
- B. Joint Sealants: Install at same time as backings using proven techniques that comply with following:
  - 1. Place sealants so they directly contact and fully wet joint substrates.
  - 2. Completely fill recesses in each joint configuration.
  - 3. Produce uniform, cross sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

4. Use open cell backer rod at interior line of sealant for double sealed condition.
  5. Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
    - a. Remove excess sealant from surfaces adjacent to joints.
    - b. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
    - c. Use masking tape to protect surfaces adjacent to recessed tooled joints.
  6. Install joint sealants in accordance with ASTM C 1193 as applicable to materials, applications, conditions indicated, and with the following profile configurations:
    - a. Fillet: Figure 5.
    - b. Bridge: Figure 6.
    - c. Butt: Figure 8A (concave tooling), generally hour-glass shape with 2:1 width-to-depth ratio.
- C. Sprayed Foam Insulating Gap Filler: Apply sprayed foam insulating gap filler within exterior wall assemblies using professional hand-held dispensing gun in accordance with manufacturer's written instructions.
1. Prior to installation of wall finish systems, apply sprayed foam insulating gap filler to gaps, cracks, cavities, openings, and voids in exterior wall back-up, including annular space around piping, ducts, conduits, wiring, and electrical outlets to seal off potential air drafts.
  2. After sprayed foam sealant is applied, make flush with face of adjacent wall by using method recommended by manufacturer.

### 3.5 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Manufacturer's qualified technical representative shall periodically inspect Work to ensure installation is proceeding in accordance with manufacturer's designs, recommendations, instructions, and warranty requirements. Representative shall submit written reports of each visit indicating observations, findings, and conclusions of inspection.
1. Manufacturer's Technical Representative Qualifications: Direct employee of technical services department of manufacturer with experience in providing recommendations, observations, evaluations, and problem diagnostics.
- B. Field Adhesion Testing: Before installation, field test urethane and silicone sealant adhesion to joint substrates as follows:
1. General Requirements:
    - a. Locate test joints where indicated or, if not indicated, as directed by Architect.
    - b. Conduct field tests for each kind of urethane and silicone sealants and joint substrates indicated.
    - c. Notify Architect 7 days in advance of dates and times when test joints will be erected.
  2. Test Frequency: Perform 1 test for each 1000 ft of joint length thereafter or 1 test for each floor at each elevation.



3. Test Methods: Joint sealant manufacturer's technical representative shall conduct following tests:
  - a. When Joint Substrates are Identical: Test joint sealants according to ASTM C 1193, Method A (field-applied sealant joint hand pull tab) described below:
    - 1) Conduct one test and one additional test for each 1000 ft of kind of joint sealant material and substrate conditions.
    - 2) Install 24 in long test specimens using same materials, methods for joint preparation, and joint sealant installation required for Work. Allow sealants to cure fully before testing.
    - 3) Make horizontal knife cut across width of sealant joint from one substrate to other substrate.
    - 4) Make 2 vertical cuts at both sides of substrates, downward starting at horizontal cut, approximately 3 in long.
    - 5) Grasp 3 in long piece of sealant tab firmly 1 in from its bonded edge and pull at not less than 90 degree angle.
    - 6) Substrate adhesion is acceptable if sealant tears cohesively within itself or elongates to a manufacturer determined extension value from 1 in gauge length before releasing from substrate adhesively.
  - b. When Joint Substrates are Different: Test joint sealants according to ASTM C 1193, Method C (field-applied sealant joint hand pull flap) described below:
    - 1) Conduct one test and one additional test for each 1000 ft of kind of joint sealant material and substrate conditions.
    - 2) Install 24 in long test specimens using same materials, methods for joint preparation, and joint sealant installation required for Work. Allow sealants to cure fully before testing.
    - 3) Make first horizontal knife cut across width of sealant joint from one substrate to other substrate.
    - 4) Make one vertical cut along one side of substrate, downward starting at horizontal cut, approximately 3 in long.
    - 5) Make second horizontal knife cut across width of sealant joint from one substrate to other substrate at opposite end of 3 in long first cut.
    - 6) Grasp 3 in long piece of sealant flap firmly and pull at not less than 90 degree angle.
    - 7) Substrate adhesion is acceptable if sealant tears cohesively within itself or elongates to a manufacturer determined extension value from 1 in gauge length before releasing from substrate adhesively.
4. Reports: Report which sealants and joint preparation methods resulted in optimum adhesion to joint substrates or whether sealant failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each specimen. For sealants that fail adhesively, retest until satisfactory adhesion is obtained.
5. Evaluation of Test Results: Sealants not evidencing adhesive failure from testing, in absence of other indications of non-compliance with requirements, will be considered satisfactory. Sealants failing to adhere to joint substrates during testing are not acceptable.

### 3.6 CLEANING

- A. In-Progress Cleaning: Remove excess sealant 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.

### 3.7 PROTECTION

- A. General Requirements: Protect during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original Work.

### 3.8 JOINT SEALANT SCHEDULE

#### A. Exterior Elastomeric Sealant Applications:

- 1. Exterior Pourable Urethane Sealant:
  - a. Moving joints in exterior concrete walks and drives.
- 2. Exterior Non-sag Silicone Sealant:
  - a. Moving joints on exterior side of exterior walls.

#### B. Interior Elastomeric Sealant Applications:

- 1. Interior Non-sag Silicone Sealant:
  - a. Non-moving joints in moist or damp areas which are susceptible to mildew.
  - b. Non-moving joints in kitchens, labs, and toilet rooms.
- 2. Interior Non-sag Urethane Sealant:
  - a. Building joints on interior side of exterior walls where joint movement is anticipated.
- 3. Interior Non-sag Acrylic Latex Sealant:
  - a. Non-moving joints where another type of sealant is not otherwise specified or scheduled.
  - b. Minimal moving joints due to temperature change.

#### C. Sprayed Foam Insulating Gap Filler Applications:

- 1. Exterior non-moving gaps around windows, doors, and penetrations beneath weather-resistant coverings.
- 2. Interior non-moving gaps around windows, doors, and penetrations.

END OF SECTION

## SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section includes:
  - 1. Interior standard steel doors and frames.
  - 2. Exterior standard steel doors and frames.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Sustainable Design Submittals:
  - 1. Product Data: For recycled content, indicating postconsumer and pre-consumer recycled content and cost.
- C. Shop Drawings: Include the following:
  - 1. Elevations of each door type.
  - 2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
  - 3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
- D. Product Schedule: For hollow-metal doors and frames, prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final door hardware schedule.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Product test reports.
- B. Field quality control reports.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Record Documents: For fire-rated doors, list of door numbers and applicable room name and number to which door accesses.

## 1.6 QUALITY ASSURANCE

- A. Fire-Rated Door Inspector Qualifications: Inspector for field quality control inspections of fire-rated door assemblies shall meet the qualifications set forth in NFPA 80, Section 5.2.3.1 and the following:
  - 1. Door and Hardware Institute Fire and Egress Door Assembly Inspector (FDAI) certification.
- B. Egress Door Inspector Qualifications: Inspector for field quality control inspections of egress door assemblies shall meet the qualifications set forth in NFPA 101, Section 7.2.1.15.4 and the following:
  - 1. Door and Hardware Institute Fire and Egress Door Assembly Inspector (FDAI) certification.
- C. Wind Pressures Requirements: Submit documentation stating Exterior Door and Frame system has been designed to meet the project wind pressure as defined by the structural engineer.
- D. Windstorm Certification: Door, Frame and all Hardware components must be a tested assembly. Provide TDI Report or 3<sup>rd</sup> Party testing reports that show products meet project wind pressures indicated for Project.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Basis of Design: Steelcraft; an Allegion brand

### 2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings indicated on Drawings, based on testing at positive pressure according to NFPA 252 or UL 10C.
  - 1. Smoke- and Draft-Control Door Assemblies: Listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing according to UL 1784 and installed in compliance with NFPA 105.
  - 2. Temperature-Rise Limit: Where indicated on drawings provide doors that have a maximum transmitted temperature end point of not more than 450 deg F above ambient after 30 minutes of standard fire-test exposure.
- B. Fire-Rated, Borrowed-Lite Assemblies: Assemblies complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 257 or UL 9.

- C. Thermally Rated Door Assemblies: Provide door assemblies with U-factor of not more than 0.50 deg Btu/F x h x sq. ft. 0.40 deg Btu/F x h x sq. ft. 0.38 deg Btu/F x h x sq. ft. when tested according to ASTM C518.

## 2.3 INTERIOR STANDARD STEEL DOORS AND FRAMES

- A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Standard-Duty Doors and Frames: ANSI/SDI A250.8, Level 1; ANSI/SDI A250.4, Level C. At all Interior Locations.
  - 1. Doors:
    - a. Type: As indicated in the Door and Frame Schedule.
    - b. Thickness: 1-3/4 inches
    - c. Gauge: 16ga
    - d. Face: Uncoated steel sheet, minimum thickness of 0.032 inch.
    - e. Edge Construction: Model 1, Full Flush.
    - f. Core: Manufacturer's standard.
    - g. Fire-Rated Core: Manufacturer's standard core for fire-rated doors.
  - 2. Frames:
    - a. Materials: Uncoated steel sheet, minimum thickness of 0.042 inch.
    - b. Sidelite and Transom Frames: Fabricated from same thickness material as adjacent door frame.
    - c. Construction: Full profile welded.

## 2.4 EXTERIOR STANDARD STEEL DOORS AND FRAMES

- A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Extra-Heavy-Duty Doors and Frames: ANSI/SDI A250.8, Level 3; ANSI/SDI A250.4, Level A. At all Exterior Door Locations.
  - 1. Doors: Basis of Design – Steelcraft Storm Resistant “H” Series.
    - a. Type: As indicated in the Door and Frame Schedule.
    - b. Thickness: 1-3/4 inches.
    - c. Gauge: 14ga
    - d. Face: Metallic-coated steel sheet, minimum thickness of 0.053 inch, with minimum A60 coating.
    - e. Edge Construction: Model 1, Full Flush
    - f. Top Edge Closures: Close top edges of doors with flush closures of same material as face sheets. Seal joints against water penetration.

- g. Bottom Edges: Close bottom edges of doors with end closures or channels of same material as face sheets. Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape.
- h. Core: Manufacturer's standard.
- i. Fire-Rated Core: Manufacturer's standard core for fire-rated doors.

2. Frames:

- a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch, with minimum A60 coating.
- b. Construction: Full profile welded.

## 2.5 BORROWED LITES

- A. Fabricate of uncoated steel sheet, minimum thickness of 0.053 inch.
- B. Construction: Full profile welded.
- C. Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as metal as frames.
- D. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.

## 2.6 FRAME ANCHORS

- A. Jamb Anchors:
  - 1. Type: Anchors of minimum size and type required by applicable door and frame standard, and suitable for performance level indicated.
  - 2. Quantity: Minimum of three anchors per jamb, with one additional anchor for frames with no floor anchor. Provide one additional anchor for each 24 inches of frame height above 7 feet.
  - 3. Post-installed Expansion Anchor: Minimum **3/8-inch** diameter bolts with expansion shields or inserts, with manufacturer's standard pipe spacer.
- B. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor.
- C. Floor Anchors for Concrete Slabs with Underlayment: Adjustable-type anchors with extension clips, allowing not less than 2-inch height adjustment. Terminate bottom of frames at top of underlayment.
- D. Material: ASTM A879/A879M, Commercial Steel (CS), 04Z coating designation; mill phosphatized.
  - 1. For anchors built into exterior walls, steel sheet complying with ASTM A1008/A1008M or ASTM A1011/A1011M; hot-dip galvanized according to ASTM A153/A153M, Class B.

## 2.7 MATERIALS

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- B. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- C. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- D. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B.
- E. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A153/A153M.
- F. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.
- G. Mineral-Fiber Insulation: ASTM C665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E136 for combustion characteristics.
- H. Glazing: Comply with requirements in Section 088000 "Glazing."

## 2.8 FABRICATION

- A. Door Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch beyond edge of door on which astragal is mounted or as required to comply with published listing of qualified testing agency.
- B. Hollow-Metal Frames: Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as frames.
  - 1. Sidelite and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by welding.
  - 2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
  - 3. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.
    - a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
    - b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.

- C. Hardware Preparation: Factory prepare hollow-metal doors and frames to receive templated mortised hardware, and electrical wiring; include cutouts, reinforcement, mortising, drilling, and tapping according to ANSI/SDI A250.6, the Door Hardware Schedule, and templates.
  - 1. Reinforce doors and frames to receive non-templated, mortised, and surface-mounted door hardware.
  - 2. Comply with BHMA A156.115 for preparing hollow-metal doors and frames for hardware.
- D. Glazed Lites: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints.
  - 1. Provide stops and moldings flush with face of door, and with beveled stops unless otherwise indicated.
  - 2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
  - 3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames. Provide loose stops and moldings on inside of hollow-metal doors and frames.
  - 4. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.
  - 5. Provide stops for installation with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner.

## 2.9 STEEL FINISHES

- A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.
  - 1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI/SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces. Touch up factory-applied finishes where spreaders are removed.
- B. Drill and tap doors and frames to receive non-templated, mortised, and surface-mounted door hardware.

### 3.2 INSTALLATION

- A. Hollow-Metal Frames: Comply with ANSI/SDI A250.11.



1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces without damage to completed Work.
    - a. Where frames are fabricated in sections, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces. Touch-up finishes.
    - b. Install frames with removable stops located on secure side of opening.
  2. Fire-Rated Openings: Install frames according to NFPA 80.
  3. Floor Anchors: Secure with post-installed expansion anchors.
    - a. Floor anchors may be set with power-actuated fasteners instead of post-installed expansion anchors if so indicated and approved on Shop Drawings.
  4. Solidly pack mineral-fiber insulation inside frames.
  5. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout or mortar.
  6. In-Place Concrete or Masonry Construction: Secure frames in place with post-installed expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
  7. Installation Tolerances: Adjust hollow-metal frames to the following tolerances:
    - a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
    - b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
    - c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
    - d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.
- B. Hollow-Metal Doors: Fit and adjust hollow-metal doors accurately in frames, within clearances specified below.
1. Non-Fire-Rated Steel Doors: Comply with ANSI/SDI A250.8.
  2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
  3. Smoke-Control Doors: Install doors according to NFPA 105.
- C. Glazing: Comply with installation requirements in Section 088000 "Glazing" and with hollow-metal manufacturer's written instructions.

### 3.3 FIELD QUALITY CONTROL

- A. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.
- B. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.

### 3.4 REPAIR

- A. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.
- B. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.
- C. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

END OF SECTION 081113

## SECTION 082110 - PREFINISHED FLUSH WOOD DOORS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes: Prefinished flush wood doors and supplementary items necessary for installation.

#### 1.2 SUBMITTALS

- A. Product Data: Manufacturer's technical literature for each product and system indicated.
  - 1. Include manufacturer's specifications for materials, finishes, construction details, installation instructions, and recommendations for maintenance.
  - 2. Include details of core and edge construction, light frames, and trim for openings.
  - 3. Include factory-finishing specifications.
  - 4. Include manufacturer's surface preparation instructions.
- B. Shop Drawings: Show details of fabrication and installation, including plans, elevations, sections, details of components and attachments to other work. Distinguish between shop and field-assembled work. Provide dimensioned drawings indicating location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; location and extent of hardware blocking; and other pertinent data.
  - 1. Indicate dimensions and locations of mortises and holes for hardware.
  - 2. Indicate dimensions and locations of cutouts.
  - 3. Indicate requirements for door face matching.
  - 4. Indicate doors to be factory finished and finish requirements.
- C. Samples for Verification Purposes: For each type of exposed finish required, prepared on Samples of size indicated below.
  - 1. Wood Veneer Doors: Wood veneer factory finishes applied to actual door face materials, approximately 8 in by 10 in (200 mm by 250 mm), for each material and finish. For each wood species and transparent finish, provide set of 3 samples showing typical range of color and grain to be expected in finished work.
  - 2. Corner sections of doors, approximately 8 in by 10 in (200 mm by 250 mm), with door faces and edges representing actual materials to be used.
    - a. Wood Veneer Doors: Samples for each species of wood veneer and solid lumber required.
    - b. Finish door facing samples with same materials proposed for factory-finished doors.
- D. Product Test Reports: Written reports based on evaluation of comprehensive tests performed by qualified testing agency indicating that each product complies with requirements.
- E. Warranty: Sample of warranty.

1. Provide manufacturer's written warranty covering materials and installation (labor) stating obligations, remedies, limitations and exclusions.

F. Maintenance Data: To include in maintenance manuals.

### 1.3 PRE-INSTALLATION CONFERENCE

A. Pre-Installation Conference: Before Work begins, conduct conference at Project site to comply with requirements of applicable Division 01 Sections.

1. Required Attendees:

- a. Owner.
- b. Architect.
- c. Contractor, including superintendent.
- d. Installer, including project manager and supervisor.
- e. Installers of other construction interfaced with Work.

2. Minimum Agenda: Installer shall demonstrate understanding of the Work required by describing detailed procedures for preparing, installing, and cleaning the Work. Demonstration shall include, but not be limited to, following topics:

- a. Tour representative areas of Work, inspect and discuss condition of substrate, and other preparatory work performed by other trades.
- b. Review Work requirements (Drawings, Specifications, and other Contract Documents).
- c. Review required submittals, both completed and yet to be completed.
- d. Review and finalize construction schedule related to Work and verify availability of materials, installer's personnel, equipment, and facilities needed to make progress and avoid delays.
- e. Review required inspection, testing, certifying, and material usage accounting procedures.
- f. Review environmental conditions and procedures for coping with unfavorable conditions.
- g. Resolve deviations or differences between Contract Documents and the manufacturer's specifications.

3. Contractor shall record discussions of conference, including decisions and agreements reached, and furnish copy of record to each party attending. If substantial disagreements exist at conclusion of conference, determine how disagreements will be resolved and set date for reconvening conference.

### 1.4 DELIVERY, STORAGE, AND HANDLING

A. General: Comply with requirements of referenced quality standards and manufacturer's written instructions.

1. Package doors individually.
2. Protect doors during transit, storage and handling to prevent damage, soiling and deterioration.
3. Mark each door on top and bottom rail with opening number used on Shop Drawings.

## 1.5 PROJECT CONDITIONS

- A. Environmental Limitations: Deliver and install doors only when spaces are enclosed and weathertight, wet work in spaces is complete and dry, and HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during remainder of construction period.

## 1.6 COORDINATION

- A. Coordinate installation of products and systems with interfacing and adjoining construction to provide a successful installation without failure.

## 1.7 WARRANTY

- A. Manufacturer's Warranty: Furnish manufacturer's written material and labor warranty signed by an authorized representative using manufacturer's standard form agreeing to furnish materials and labor required to repair or replace work which exhibits material defects caused by manufacture or design and installation of product. Warranty shall also include finishing that may be required due to repair or replacement of defective doors. "Defects" is defined to include but not limited to deterioration or failure to perform as required.

1. Defects include, but are not limited to, the following:
  - a. Warping (Bow, Cup, or Twist): Not more than 1/4 in (6 mm) in a 42 by 84 in (1050 by 2100 mm) section.
  - b. Telegraphing of Core Construction: Not more than 0.01 in in a 3 in (0.25 mm in a 75 mm) span in face veneers.
2. Warranty Period: Manufacturer shall warrant the products to be free from material and labor Defects for a period as follows:
  - a. Warranty Period for Solid-Core Interior Doors: Life of installation.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Acceptable Manufacturers: Subject to compliance with requirements of Contract Documents as judged by the Architect, provide product by one of manufacturers listed. If not listed, submit as substitution according to the Conditions of the Contract and Division 01 Section "Substitution Procedures".

1. Algoma Hardwoods, Inc.
2. Eggers Industries.
3. Marshfield Door Systems, Inc.
4. Mohawk Flush Doors, Inc.; a Masonite Company.
5. Oshkosh Architectural Door Company.
6. VT Industries Inc.

### 2.2 MATERIALS, GENERAL

- A. Single Source Responsibility: Furnish each type of product from single manufacturer. Provide secondary materials only as recommended by manufacturer of primary materials.

## 2.3 DOOR CONSTRUCTION, GENERAL

- A. Product Quality Standard: In addition to standard listed elsewhere, comply with following, unless otherwise specified, for construction, finishes, installation, and other requirements:
  - 1. Standard: AWI's "Architectural Woodwork Quality Standards".
- B. Low-Emitting Materials: Provide doors made with adhesives and composite wood products that do not contain urea formaldehyde.
- C. Particleboard Core Doors:
  - 1. Particleboard: ANSI A208.1, Grade LD-2.
  - 2. Blocking: Solid wood blocking as needed to eliminate through-bolting hardware and as follows:
    - a. Top Rail: 5 in (125 mm).
    - b. Bottom Rail: 5 in (125 mm).
    - c. Mid Rail: 5 in (125 mm), in doors indicated to have exit devices.
    - d. Lock Blocks: 5 in by 10 in (125 mm by 250 mm), one for lock and two for exit devices.

## 2.4 WOOD VENEER FACED DOORS FOR TRANSPARENT FINISH

- A. Interior Solid-Core Doors:
  - 1. Grade: Premium, with Grade A wood veneer faces.
  - 2. Species and Cut Selection: Red Oak, Plain-Sliced.
    - a. Matching of Adjacent Veneer Leaves: Book or Slip match.
    - b. Assembly of Veneer Leaves on Door Faces: Balance or Center-Balance match.
    - c. Room Match: Match door faces within each separate room or area of building. Corridor door faces do not need to match where they are separated by not less than 20 ft (6 m) or more.
    - d. Pair and Set Match: For doors hung in same opening or separated only by mullions.
  - 3. Exposed Vertical Edges: Same wood veneer as face veneer with sanded eased edges.
  - 4. Horizontal Edges: Unfaced, sanded smooth, with factory applied seal coat.
  - 5. Core: Particleboard or mineral core as required by application.
  - 6. Construction: 5 plies.
    - a. Stiles and rails bonded to core.
    - b. Entire unit abrasive planed before veneering.
    - c. Faces bonded to core using a hot press.

## 2.5 LIGHT FRAMES

- A. Wood Beads for Light Openings in Wood Doors:
  - 1. Description: Manufacturer's standard wood beads and profile. At wood-core doors with 20-minute fire protection ratings, provide wood beads and metal glazing clips approved for such use.
  - 2. Material and Finish: Same veneer species and finish as door faces.

3. Glass: As specified in Division 08 Section "Glazing".

## 2.6 FABRICATION OF PREFINISHED FLUSH WOOD DOORS

- A. Fabrication Quality Standards: In addition to standards listed elsewhere, comply with following, unless otherwise specified:
  1. DHI-WDHS-3 and DHI A115-W series standards for hardware.
- B. Factory Fitting: Factory fit doors to suit frame opening sizes indicated according to installation quality standards. Do not trim stiles and rails in excess of limits permitted for fire-rated doors. Machine doors for hardware. Seal edges of doors, edges of cutouts, and mortises after fitting and machining with seal coat.
  1. Maximum Clearances for non-rated doors:
    - a. Head, Jambs, and Between Pairs of Doors: 1/8 in (3 mm).
    - b. Bottom to Top of Floor Coverings: 1/2 in (12 mm).
    - c. Bottom to Top of Raised Threshold: 3/8 in (10 mm).
  2. Bevel (Doors without Replaceable Secondary Door Stiles): 1/8 in in 2 in (3 mm in 50 mm) (3-1/2 deg) at lock and hinge edges.
- C. Hardware:
  1. Factory machine doors for hardware that is not surface applied according to installation quality standards.
  2. Coordinate with hardware mortises in metal frames to verify dimensions and alignment before factory machining.
- D. Openings: Cut and trim openings through doors in factory.

## 2.7 FACTORY FINISHING OF DOORS

- A. General:
  1. Comply with referenced quality standard for factory finishing.
  2. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.
  3. Finish faces, all four edges, edges of cutouts, and mortises. Stains and fillers may be omitted on edges of cutouts and mortises.
- B. Grade: Provide finishes of same grades as items to be finished.
- C. Wood Veneer Faced Doors for Transparent Finish: Match Architects sample.
- D. Factory Finish:
  1. AWI Section 1500 System TR6 - Catalyzed Polyurethane
  2. Grade: Premium
  3. Stain: Clear finish - as selected from submitted samples.
  4. Effect: Semi-filled if open grain
  5. Sheen: Satin, 30-50 gloss

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Acceptance of Surfaces and Conditions: Examine substrates to receive products and systems and associated work for compliance with requirements and other conditions affecting performance. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents. Starting work within a particular area will be construed as acceptance of surface conditions.
  - 1. Verify that 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.

### 3.2 INSTALLATION, GENERAL

- A. Installation Quality Standards: In addition to standards listed elsewhere, perform Work according to following, unless otherwise specified:
  - 1. Respective manufacturer's written installation instructions.
  - 2. Accepted submittals.
  - 3. Contract Documents.

### 3.3 PREPARATION

- A. General: Comply with manufacturer's instructions, recommendations, and specifications for cleaning and surface preparation. Surfaces shall have no defects, contaminants, or errors which would result in poor or potentially defective installation or would cause latent defects in Work.

### 3.4 INSTALLATION OF FLUSH WOOD DOORS

- A. Factory-Fitted Door Clearances: Fit accurately in frames, within following clearances for all doors (smoke control, fire-rated, and non-fire-rated):
  - 1. Jambs and Head: 1/8 in (3 mm) maximum.
  - 2. Between Edges of Pairs of Doors: 1/8 in (3 mm) maximum.
  - 3. Between Bottom of Door and Top of Threshold: Maximum 3/8 in (10 mm).
  - 4. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch (20 mm).
- B. Hardware: As specified in Division 08 Section "Door Hardware".
- C. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

### 3.5 ADJUSTING

- A. Operation: Rehang or replace doors that do not swing or operate freely.
- B. Finished Doors: Replace doors that are damaged or that do not comply with requirements. Doors may be repaired or refinished if Work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION



## SECTION 083300 SECURITY GRILLES

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Side Folding Security Grilles, manually operated.

#### 1.2 RELATED SECTIONS

- A. Section 05500 - Metal Fabrications: Support framing and framed opening.
- B. Section 06200 - Finish Carpentry: Wood jamb and head trim.
- C. Section 08332 - Overhead Coiling Counter Doors.
- D. Section 08710 - Door Hardware: Product Requirements for cylinder core and keys.
- E. Section 16130 - Raceway and Boxes: Conduit from electric circuit to grille operator and from grille operator to control station.
- F. Section 16150 - Wiring Connections: Power to disconnect.

#### 1.3 REFERENCES

- A. ASTM A 653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- B. ASTM A 666 - Standard Specification for Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
- C. ASTM A 924 - Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
- D. ASTM B 221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
- E. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- F. NEMA ICS 2 - Industrial Control and Systems: Controllers, Contactors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC.
- G. NEMA MG 1 - Motors and Generators.

#### 1.4 SUBMITTALS

- A. Submit under provisions of Section 01300.
- 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.
- C. Shop Drawings: Include detailed plans, elevations, details of framing members, required clearances, anchors, and accessories. Include relationship with adjacent materials.

- D. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.
- E. Verification Samples: For each finish product specified, two samples, representing actual product, color, and patterns.
- F. Manufacturer's Certificates: Certify products meet or exceed specified requirements.

#### 1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in performing Work of this section with a minimum of five years experience in the fabrication and installation of security closures.
- B. Installer Qualifications: Company specializing in performing Work of this section with minimum three years and approved by manufacturer.
- C. Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.
  - 1. Install in areas designated by Architect.
  - 2. Do not proceed with remaining work until workmanship and installation is approved by Architect.
  - 3. Refinish mock-up area as required to produce acceptable work.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Protect materials from exposure to moisture. Do not deliver until after wet work is complete and dry.
- C. Store materials in a dry, warm, ventilated weathertight location.

#### 1.7 COORDINATION

- A. Coordinate Work with other operations and installation of adjacent finish materials to avoid damage to installed materials.

### PART 2 PRODUCTS

#### 2.1 MANUFACTURERS

- A. Basis of Design: Overhead Door Corp.  
Clopay  
Cookson

#### 2.2 SIDE FOLDING SECURITY GRILLES

- A. Side-Folding Aluminum Panel Grilles: Overhead Door Corporation Model 679.
  - 1. Curtain: Aluminum 18 gauge (1.27 mm), full height, panels.
    - a. Panel Width: Standard 7 inch (178 mm).
    - b. Frame: Truss like aluminum frame, minimum 4 inch (102 mm) high bottom and 5-1/4 inch (133 mm) high top plates.
    - c. Grilled height is 9'-0". Refer to plans for location.

2. Finish:
  - a. Duracron acrylic or powder coat paint. (2) Color selections. Color as selected by Architect.
3. Track:
  - a. Trolley assemblies shall be 1-1/8 inch (29 mm) and adjustable 1 inch (25 mm) upward or downward without the removal of the curtain.
  - b. Track shall be heavy extruded aluminum 1-3/8 inch (35 mm) wide by 1-5/8 inch (41 mm) high.
  - c. Curves:
    - 1) 90 degrees.
    - 2) 120 degrees.
    - 3) 135 degrees.
    - 4) 150 degrees.
    - 5) Radius: 14 inch (356 mm) for standard models.
4. Locking:
  - a. Provide lead post with a concealed a hook bolt lock activated by a keyed cylinder or thumb turn that engages a full height wall channel. Where required, provide a top and bottom spring loaded locking post with interior thumb turn and protection or keyed cylinder and dustproof floor sockets for all drop bolts. Provide rubber bumper at the edge of locking post.
  - b. Traveling end post shall have an attached full height protection plate and shall be self locking into a steel V-stop. End post are fixable to a wall when stacked in the opening using top and bottom locking posts.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify opening sizes, tolerances and conditions are acceptable.
- B. Examine conditions of substrates, supports, and other conditions under which this work is to be performed.
- C. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

### 3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

### 3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Use anchorage devices to securely fasten assembly to wall construction and building framing without distortion or stress.
- C. Securely and rigidly brace components suspended from structure. Secure guides to structural members only.

- D. Fit and align assembly including hardware; level and plumb, to provide smooth operation.
- E. Coordinate installation of electrical service with Section 16150. Complete wiring from disconnect to unit components.
- F. Coordinate installation of sealants and backing materials at frame perimeter as specified in Section 07900.
- G. Install perimeter trim and closures.

#### 3.4 ADJUSTING

- A. Test security grilles for proper operation and adjust as necessary to provide proper operation without binding or distortion.
- B. Adjust hardware and operating assemblies for smooth and noiseless operation.

#### 3.5 CLEANING

- A. Clean curtain and components using non-abrasive materials and methods recommended by manufacturer.
- B. Remove labels and visible markings.
- C. Touch-up, repair or replace damaged products before Substantial Completion.

#### 3.6 PROTECTION

- A. Protect installed products until completion of project.

END OF SECTION

## SECTION 083323 - OVERHEAD COILING DOORS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Insulated service doors.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for miscellaneous steel supports, door-opening framing, corner guards, and bollards.

#### 1.2 ACTION SUBMITTALS

A. Product Data: For each type and size of overhead coiling door and accessory.

B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data.

1. Include points of attachment and their corresponding static and dynamic loads imposed on structure.
2. Show locations of controls, locking devices detectors or replaceable fusible links, and other accessories.
3. Include diagrams for power, signal, and control wiring.

C. Samples: For each exposed product and for each color and texture specified.

#### 1.3 INFORMATIONAL SUBMITTALS

A. Sample warranty.

#### 1.4 CLOSEOUT SUBMITTALS

A. Special warranty.

B. Maintenance data.

C. Record Documents: For fire-rated doors, list of door numbers and applicable room name and number to which door accesses.

## 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer for both installation and maintenance of units required for this Project.
- B. Fire-Rated Door Inspector Qualifications: Inspector for field quality control inspections of fire-rated door assemblies shall meet the qualifications set forth in NFPA 80, Section 5.2.3.1 and the following:
  - 1. Door and Hardware Institute Fire and Egress Door Assembly Inspector (FDAI) certification.

## 1.6 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of doors that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Two years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Accessibility Standard: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design "Retain "Structural Performance, Exterior Doors" Paragraph below for exterior doors.
- B. Structural Performance, Exterior Doors: Capable of withstanding the following design wind loads:
  - 1. Design Wind Load: As indicated on Structural Drawings.
  - 2. Testing: According to ASTM E330/E330M
- C. Windborne-Debris Impact Resistance: Provide impact-protective overhead coiling doors that pass ASTM E1886 missile-impact and cyclic-pressure tests according to ASTM E1996 for Wind Zone 4 protection.
  - 1. Large-Missile Test: For overhead coiling doors located within 30 ft. of grade.

### 2.2 DOOR ASSEMBLY

- A. Insulated Service Door: Overhead coiling door formed with curtain of interlocking metal slats.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Clipay Building Products.

- b. Cornell.
  - c. Overhead Door Corporation.
- B. Operation Cycles: Door components and operators capable of operating for not less than 20,000.
  - C. Insulated Door Curtain R-Value: 4.5 deg F x h x sq. ft./Btu.
  - D. Insulated Door Assembly U-Factor: 0.90 Btu/deg F x h x sq. ft.
  - E. Door Curtain Material: Galvanized steel.
  - F. Door Curtain Slats: Flat profile slats of 3-1/4-inch center-to-center height.
  - G. Bottom Bar: Two angles, each not less than 1-1/2 by 1-1/2 by 1/8 inch thick; fabricated from hot-dip galvanized steel and finished to match door.
  - H. Curtain Jamb Guides: Galvanized steel with exposed finish matching curtain slats.
  - I. Hood: Match curtain material and finish.
    - 1. Mounting: Face of wall.
  - J. Locking Devices: Equip door with locking device assembly and chain lock keeper.
    - 1. Locking Device Assembly: Single-jamb side locking bars, operable from inside and outside with cylinders.
  - K. Manual Door Operator: Manufacturer's standard crank operator.
  - L. Curtain Accessories: Equip door with weather seals and astragal.
  - M. Door Finish:
    - 1. Factory Prime Finish: Gray
    - 2. Interior Curtain-Slat Facing: Match finish of exterior curtain-slat face.
- 2.3 MATERIALS, GENERAL
- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- 2.4 DOOR CURTAIN MATERIALS AND CONSTRUCTION
- A. Door Curtains: Fabricate overhead coiling-door curtain of interlocking metal slats, designed to withstand wind loading indicated, in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated, and as follows:

1. Vision-Panel Glazing: Manufacturer's standard clear glazing, fabricated from transparent acrylic sheet or fire-protection-rated glass as required for type of door; set in glazing channel secured to curtain slats.
  2. Insulation: Fill slats for insulated doors with manufacturer's standard thermal insulation complying with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E84 or UL 723. Enclose insulation completely within slat faces.
  3. Metal Interior Curtain-Slat Facing: Match metal of exterior curtain-slat face, with minimum steel thickness of 0.010 inch.
- B. Curtain Jamb Guides: Manufacturer's standard angles or channels and angles of same material and finish as curtain slats unless otherwise indicated, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent overtravel of curtain.

## 2.5 HOODS

- A. General: 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. Include automatic drop baffle on fire-rated doors to guard against passage of smoke or flame.
  2. Exterior-Mounted Doors: Fabricate hood to act as weather protection and with a perimeter sealant-joint-bead profile for applying joint sealant.

## 2.6 LOCKING DEVICES

- A. Slide Bolt: Fabricate with side-locking bolts to engage through slots in tracks for locking by padlock, located on both left and right jamb sides, operable from coil side.
- B. 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: As specified in Section 087100 "Door Hardware"
  2. Keys: Three for each cylinder.
- C. Chain Lock Keeper: Suitable for padlock.
- D. Safety Interlock Switch: Equip power-operated doors with safety interlock switch to disengage power supply when door is locked.



## 2.7 CURTAIN ACCESSORIES

- A. Smoke Seals: Equip each fire-rated door with replaceable smoke-seal perimeter gaskets or brushes for smoke and draft control as required for door listing and labeling by a qualified testing agency.
- B. Weatherseals for Exterior Doors: Equip each exterior door with weather-stripping gaskets fitted to entire exterior perimeter of door for a weather-resistant installation unless otherwise indicated.
- C. Astragal for Interior Doors: Equip each door bottom bar with a replaceable, adjustable, continuous, compressible gasket of flexible vinyl, rubber, or neoprene as a cushion bumper.
- D. Push/Pull Handles: Equip each push-up-operated or emergency-operated door with lifting handles on each side of door, finished to match door.
- E. Pull-Down Strap: Provide pull-down straps for doors more than 84 inches high.
- F. Automatic-Closing Device: Equip each fire-rated door with an automatic-closing device or holder-release mechanism and governor unit complying with NFPA 80 and an easily tested and reset release mechanism. Testing for manually operated doors shall allow resetting by opening the door without retensioning the counterbalance mechanism. Automatic-closing device shall be designed for activation by the following:
  - 1. Replaceable fusible links with temperature rise and melting point of 165 deg F interconnected and mounted on both sides of door opening.
  - 2. Manufacturer's standard UL-labeled smoke detector and door-holder-release devices.
  - 3. Manufacturer's standard UL-labeled heat detector and door-holder-release devices.
  - 4. Building fire-detection, smoke-detection, and -alarm systems.

## 2.8 COUNTERBALANCE MECHANISM

- A. General: Counterbalance doors by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.
- B. Brackets: Manufacturer's standard mounting brackets of either cast iron or cold-rolled steel plate.

## 2.9 MANUAL DOOR OPERATORS

- A. General: Equip door with manual door operator by door manufacturer.
- B. Push-up Door Operation: Lift handles and pull rope for raising and lowering doors, with counterbalance mechanism designed so that required lift or pull for door operation does not exceed 25 lbf.

- C. Chain-Hoist Operator: Consisting of endless steel hand chain, chain-pocket wheel and guard, and gear-reduction unit with a maximum 25-lbf force for door operation. Provide alloy-steel hand chain with chain holder secured to operator guide.
- D. Crank Operator: Consisting of crank and crank gearbox, steel crank drive shaft, and gear-reduction unit, of type indicated. Size gears to require not more than 25-lbf force to turn crank. Fabricate gearbox to be oiltight and to completely enclose operating mechanism. Provide manufacturer's standard crank-locking device.

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Install overhead coiling doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.
- B. Fire-Rated Doors: Install according to NFPA 80.
- C. Smoke-Control Doors: Install according to NFPA 80 and NFPA 105.

### 3.2 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
  - 1. Test door release, closing, and alarm operations when activated by smoke detector or building's fire-alarm system. Test manual operation of closed door. Reset door-closing mechanism after successful test.
  - 2. Fire-Rated Door Inspections: Inspect each fire-rated door in accordance with NFPA 80, Section 5.2.
- B. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.
- C. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.

### 3.3 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain overhead coiling doors.

END OF SECTION 083323

## SECTION 084213 - ALUMINUM-FRAMED ENTRANCES

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Aluminum-framed entrance door systems.

#### 1.2 PREINSTALLATION MEETINGS

- ##### A. Preinstallation Conference: Conduct conference at Project site.

#### 1.3 ACTION SUBMITTALS

- ##### A. Product Data: For each type of product.

- ##### B. Sustainable Design Submittals:

- ##### C. Shop Drawings: Include plans, elevations, sections, full-size details, and attachments to other work.

1. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.
2. Include point-to-point wiring diagrams.

- ##### D. Samples: For each type of exposed finish required.

- ##### E. Entrance Door Hardware Schedule: Prepared by or under supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams.

#### 1.4 INFORMATIONAL SUBMITTALS

- ##### A. Energy Performance Certificates: NFRC-certified energy performance values from manufacturer.

- ##### B. Product test reports.

- ##### C. Field quality-control reports.

- ##### D. Sample warranties.

## 1.5 CLOSEOUT SUBMITTALS

- A. Maintenance data.

## 1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- B. Testing Agency Qualifications: Qualified according to ASTM E699 for testing indicated and accredited by the International Accreditation Service or the International Laboratory Accreditation Cooperation Mutual Recognition Arrangement as complying with ISO/IEC 17025 and acceptable to Owner and Architect.

## 1.7 WARRANTY

- A. Special Warranty: Installer agrees to repair or replace components of aluminum-framed storefronts that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Two years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Provide one of the following manufacturers:
  - 1. Kawneer Architectural Aluminum Storefront Systems – 350 IR Swing Door; Medium stile, 3-1/2" vertical face dimension, 1-3/4" depth.
  - 2. Oldcastle Building Products

### 2.2 PERFORMANCE REQUIREMENTS

- A. General Performance: Comply with performance requirements specified, as determined by testing of aluminum-framed entrances representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.
- B. Structural Loads:
  - 1. Wind Loads: As indicated on Structural Drawings.
  - 2. Other Design Loads: As indicated on Structural Drawings.
- C. Structural: Test according to ASTM E330/E330M as follows:
  - 1. When tested at positive and negative wind-load design pressures, storefront assemblies do not evidence deflection exceeding specified limits.

2. When tested at 150 percent of positive and negative wind-load design pressures, storefront assemblies, including anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding 0.2 percent of span.
  3. Test Durations: As required by design wind velocity, but not less than 10 seconds.
- D. Water Penetration under Static Pressure: Test according to ASTM E331 as follows:
1. No evidence of water penetration through fixed glazing and framing areas of entrance doors when tested according to a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 10 lbf/sq. ft.
- E. Energy Performance: Certified and labeled by manufacturer for energy performance as follows:
1. Thermal Transmittance (U-factor):
    - a. Fixed Glazing and Framing Areas: U-factor for the system of not more than 0.41 Btu/sq. ft. x h x deg F as determined according to NFRC 100.
    - b. Entrance Doors: U-factor of not more than 0.68 Btu/sq. ft. x h x deg F as determined according to NFRC 100.
  2. Solar Heat-Gain Coefficient (SHGC):
    - a. Fixed Glazing and Framing Areas: SHGC for the system of not more than 0.25 as determined according to NFRC 200.
    - b. Entrance Doors: SHGC of not more than 0.25 as determined according to NFRC 200.
  3. Air Leakage:
    - a. Fixed Glazing and Framing Area - Air Leakage: The test specimen shall be tested in accordance with ASTM E 283. Air Leakage rate shall not exceed 0.06 cfm/ft<sup>2</sup> (0.3 l/s · m<sup>2</sup>) at a static air pressure differential of 6.2 psf (300 Pa) with interior seal, or, rate shall not exceed 0.06 cfm/ft<sup>2</sup> (0.3 l/s · m<sup>2</sup>) at a static air pressure differential of 1.6 psf (75 Pa) without interior seal.
    - b. Entrance Doors: Air leakage of not more than 1.0 cfm/sq. ft. at a static-air-pressure differential of 1.57 lbf/sq. ft.
  4. Condensation Resistance Factor (CRF):
    - a. Fixed Glazing and Framing Areas: CRF for the system of not less than 55 as determined according to AAMA 1503.
    - b. Entrance Doors: CRF of not less than 57 as determined according to AAMA 1503.
- F. Windborne-Debris Impact Resistance: Pass missile-impact and cyclic-pressure tests according to ASTM E1996 for Wind Zone 4.
1. Large-Missile Test: For glazed openings located within 30 feet of grade.
- G. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

## 2.3 ALUMINUM-FRAMED ENTRANCE DOOR SYSTEMS

- A. Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing or automatic operation.
  1. Door Construction: 1-3/4-inch overall thickness, with minimum 0.125-inch thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.
    - a. Thermal Construction: High-performance plastic connectors separate aluminum members exposed to the exterior from members exposed to the interior.
  2. Door Design: Medium stile; 3-1/2-inch nominal width.
  3. Glazing Stops and Gaskets: Square Snap-On, extruded-aluminum stops and preformed gaskets.
    - a. Provide nonremovable glazing stops on outside of door.
  4. Door Finish: Clear anodic finish.
- B. Framing Members: Manufacturer's standard extruded aluminum, minimum 0.125-inch-thick and reinforced as required to support imposed loads.
  1. Nominal Size: Match Storefront System
  2. Exterior Framing Construction: Nonthermal.
  3. Interior Vestibule Framing Construction: Nonthermal.
  4. Finish: Match door finish.
- C. Backer Plates: Manufacturer's standard, continuous backer plates for framing members, if not integral, where framing abuts adjacent construction.
- D. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with non-staining, nonferrous shims for aligning system components.
- E. Materials:
  1. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
    - a. Sheet and Plate: ASTM B209.
    - b. Extruded Bars, Rods, Profiles, and Tubes: ASTM B221.
    - c. Extruded Structural Pipe and Tubes: ASTM B429/B429M.
    - d. Structural Profiles: ASTM B308/B308M.
  2. Steel Reinforcement:
    - a. Structural Shapes, Plates, and Bars: ASTM A36/A36M.
    - b. Cold-Rolled Sheet and Strip: ASTM A1008/A1008M.

- c. Hot-Rolled Sheet and Strip: ASTM A1011/A1011M.
- 3. Steel Reinforcement Primer: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM, and prepare surfaces according to applicable SSPC standard.

## 2.4 ENTRANCE DOOR HARDWARE

- A. Entrance Door Hardware: Hardware not specified in this Section is specified in Section 087100 "Door Hardware."
- B. General: Provide entrance door hardware and entrance door hardware sets indicated in "Entrance Door Hardware Sets" Article for each entrance door, to comply with requirements in this Section.
  - 1. Entrance Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and named manufacturers' products.
  - 2. Sequence of Operation: Provide electrified door hardware function, sequence of operation, and interface with other building control systems indicated.
  - 3. Opening-Force Requirements:
    - a. Egress Doors: Not more than 15 lbf to release the latch and not more than 30 lbf to set the door in motion and not more than 15 lbf to open the door to its minimum required width.
    - b. Accessible Interior Doors: Not more than 5 lbf to fully open door.
- C. Designations: Requirements for design, grade, function, finish, quantity, size, and other distinctive qualities of each type of entrance door hardware are indicated in "Entrance Door Hardware Sets" Article. Products are identified by using entrance door hardware designations as follows:
  - 1. Named Manufacturers' Products: Manufacturer and product designation are listed for each door hardware type required for the purpose of establishing minimum requirements. Manufacturers' names are abbreviated in "Entrance Door Hardware Sets" Article.
  - 2. References to BHMA Standards: Provide products complying with these standards and requirements for description, quality, and function.
- D. Pivot Hinges: BHMA A156.4, Grade 1.
  - 1. Offset-Pivot Hinges: Provide top, bottom, and intermediate offset pivots at each door leaf.
- E. Butt Hinges: BHMA A156.1, Grade 1, radius corner.
  - 1. Nonremovable Pins: Provide setscrew in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while entrance door is closed.

2. Exterior Hinges: Stainless steel, with stainless-steel pin. Retain "Quantities" Subparagraph below only if quantities are not indicated in "Entrance Door Hardware Sets" Article.
  3. Quantities:
    - a. For doors up to 87 inches high, provide three hinges per leaf.
    - b. For doors more than 87 and up to 120 inches high, provide four hinges per leaf.
- F. Continuous-Gear Hinges: BHMA A156.26.
- G. Mortise Auxiliary Locks: BHMA A156.5, Grade 1.
- H. Manual Flush Bolts: BHMA A156.16, Grade 1.
- I. Automatic and Self-Latching Flush Bolts: BHMA A156.3, Grade 1.
- J. Panic Exit Devices: BHMA A156.3, Grade 1, listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing according to UL 305.
- K. Cylinders:
  1. As specified in Section 087100 "Door Hardware."
  2. BHMA A156.5, Grade 1.
    - a. Keying: Master key system. Permanently inscribe each key with a visual key control number and include notation "DO NOT DUPLICATE"
- L. Strikes: Provide strike with black-plastic dust box for each latch or lock bolt; fabricated for aluminum framing.
- M. Operating Trim: BHMA A156.6.
- N. Removable Mullions: BHMA A156.3 extruded aluminum.
  1. When used with panic exit devices, provide **keyed** removable mullions listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing according to UL 305. Use only mullions that have been tested with exit devices to be used.
- O. Closers: BHMA A156.4, Grade 1, with accessories required for a complete installation, sized as required by door size, exposure to weather, and anticipated frequency of use; adjustable to comply with field conditions and requirements for opening force.
- P. Concealed Overhead Holders and Stops: BHMA A156.8, Grade 1.
- Q. Door Stops: BHMA A156.16, Grade 1, floor or wall mounted, as appropriate for door location indicated, with integral rubber bumper.
- R. Weather Stripping: Manufacturer's standard replaceable components.



1. Compression Type: Made of ASTM D2000 molded neoprene or ASTM D2287 molded PVC.
  2. Sliding Type: AAMA 701/702, made of wool, polypropylene, or nylon woven pile with nylon-fabric or aluminum-strip backing.
- S. Weather Sweeps: Manufacturer's standard exterior-door bottom sweep with concealed fasteners on mounting strip.
- T. Thresholds: BHMA A156.21 raised thresholds beveled with a slope of not more than 1:2, with maximum height of 1/2 inch.
- U. Finger Guards: Manufacturer's standard collapsible neoprene or PVC gasket anchored to frame hinge-jamb at center-pivoted doors.

## 2.5 GLAZING

- A. Glazing: Comply with Section 088000 "Glazing."
- B. Glazing Gaskets: Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers.
- C. Glazing Sealants: As recommended by manufacturer.

## 2.6 FABRICATION

- A. Form or extrude aluminum shapes before finishing.
- B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
- C. Fabricate components that, when assembled, have the following characteristics:
  1. Profiles that are sharp, straight, and free of defects or deformations.
  2. Accurately fitted joints with ends coped or mitered.
  3. Physical and thermal isolation of glazing from framing members.
  4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
  5. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
- D. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.
- E. Entrance Doors: Reinforce doors as required for installing entrance door hardware.
- F. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.

- G. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

## 2.7 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, or thicker.

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Comply with manufacturer's written instructions.
- B. Do not install damaged components.
- C. Fit joints to produce hairline joints free of burrs and distortion.
- D. Rigidly secure nonmovement joints.
- E. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
- F. Seal perimeter and other joints watertight unless otherwise indicated.
- G. Metal Protection:
  - 1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with materials recommended by manufacturer for this purpose or installing nonconductive spacers.
  - 2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
- H. Set continuous sill members and flashing in full sealant bed, as specified in Section 079200 "Joint Sealants," to produce weathertight installation.
- I. Install joint filler behind sealant as recommended by sealant manufacturer.
- J. Install components plumb and true in alignment with established lines and grades.

### 3.2 INSTALLATION OF GLAZING

- A. Install glazing as specified in Section 088000 "Glazing."

### 3.3 INSTALLATION OF ENTRANCE DOORS

- A. Install entrance 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.

#### 3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Field Quality-Control Testing: Perform the following test on aluminum-framed entrances.
  1. Water-Spray Test: Before installation of interior finishes has begun, areas designated by Architect shall be tested according to AAMA 501.2 and shall not evidence water penetration.
  2. Air Leakage: ASTM E783 at 1.5 times the rate specified for laboratory testing in "Performance Requirements" Article but not more than 0.09 cfm/sq. ft. at a static-air-pressure differential of 1.57 lbf/sq. ft.
  3. Water Penetration: ASTM E1105 at a minimum uniform static-air-pressure differential of 0.67 times the static-air-pressure differential specified for laboratory testing in "Performance Requirements" Article, but not less than 6.24 lbf/sq. ft., and shall not evidence water penetration.
- C. Aluminum-framed entrances will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

#### 3.5 ENTRANCE DOOR HARDWARE SETS

- A. Refer to Hardware Schedule.

END OF SECTION 084213

## SECTION 084313 - ALUMINUM-FRAMED STOREFRONTS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Aluminum-framed storefront systems.

#### 1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

- B. Shop Drawings: For aluminum-framed storefronts. Include plans, elevations, sections, full-size details, and attachments to other work.

1. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.

- C. Samples: For each type of exposed finish required.

- D. Delegated-Design Submittal: For aluminum-framed storefronts indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Energy Performance Certificates: NFRC-certified energy performance values from manufacturer.

- B. Product test reports.

- C. Source quality-control reports.

- D. Field quality-control reports.

- E. Sample warranties.

## 1.5 CLOSEOUT SUBMITTALS

- A. Maintenance data.

## 1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- B. Testing Agency Qualifications: Qualified in accordance with ASTM E699 for testing indicated and accredited by IAS or ILAC Mutual Recognition Arrangement as complying with ISO/IEC 17025 and acceptable to Owner and Architect.
- C. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.
  - 1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

## 1.7 WARRANTY

- A. Special Warranty: Installer agrees to repair or replace components of aluminum-framed storefronts that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Two years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Provide one of the following manufacturers:
  - 1. Kawneer Architectural Aluminum Storefront Systems – IR 501 Framing – 2-1/2" x 5" (63.5 mm x 127 mm) nominal dimension; Non-Thermal; Center Plane for 1-5/16" (33.4 mm) Impact Resistant Glazing.
  - 2. Oldcastle Building Products

### 2.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design aluminum-framed storefronts.

- B. General Performance: Comply with performance requirements specified, as determined by testing of aluminum-framed storefronts representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.
1. Aluminum-framed storefronts shall withstand movements of supporting structure, including, but not limited to, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
  2. Failure also includes the following:
    - a. Thermal stresses transferring to building structure.
    - b. Glass breakage.
    - c. Noise or vibration created by wind and thermal and structural movements.
    - d. Loosening or weakening of fasteners, attachments, and other components.
    - e. Failure of operating units.
- C. Structural Loads:
1. Wind Loads: As indicated on Structural Drawings.
  2. Other Design Loads: As indicated on Structural Drawings.
- D. Deflection of Framing Members: At design wind pressure, as follows:
1. Deflection Normal to Wall Plane: Limited to edge of glass in a direction perpendicular to glass plane not exceeding 1/175 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, whichever is less.
  2. Deflection Parallel to Glazing Plane: Limited to 1/360 of clear span or 1/8 inch whichever is smaller].
  3. Cantilever Deflection: Where framing members overhang an anchor point, as follows:
    - a. Perpendicular to Plane of Wall: No greater than 1/240 of clear span plus 1/4 inch for spans greater than 11 feet 8-1/4 inches or 1/175 times span, for spans less than 11 feet 8-1/4 inches.
- E. Structural: Test in accordance with ASTM E330/E330M as follows:
1. When tested at positive and negative wind-load design pressures, storefront assemblies do not evidence deflection exceeding specified limits.
  2. When tested at 150 percent of positive and negative wind-load design pressures, storefront assemblies, including anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding 0.2 percent of span.
  3. Test Durations: As required by design wind velocity, but not less than 10 seconds.
- F. Water Penetration under Static Pressure: Test in accordance with ASTM E331 as follows: There shall be no leakage at a minimum static air pressure differential of 12 psf (575 Pa) as defined in AAMA 501.
- G. Energy Performance: Certified and labelled by manufacturer for energy performance as follows:

1. Thermal Transmittance (U-factor):
    - a. Fixed Glazing and Framing Areas: U-factor for the system of not more than 0.41 Btu/sq. ft. x h x deg F as determined in accordance with NFRC 100.
  2. Solar Heat Gain Coefficient (SHGC):
    - a. Fixed Glazing and Framing Areas: SHGC for the system of not more than 0.25 as determined in accordance with NFRC 200.
  3. Air Leakage:
    - a. Fixed Glazing and Framing Area - Air Leakage: The test specimen shall be tested in accordance with ASTM E 283. Air Leakage rate shall not exceed 0.06 cfm/ft<sup>2</sup> (0.3 l/s · m<sup>2</sup>) at a static air pressure differential of 6.2 psf (300 Pa) with interior seal, or, rate shall not exceed 0.06 cfm/ft<sup>2</sup> (0.3 l/s · m<sup>2</sup>) at a static air pressure differential of 1.6 psf (75 Pa) without interior seal.
  4. Condensation Resistance Factor (CRF):
    - a. Fixed Glazing and Framing Areas: CRF for the system of not less than 55 as determined in accordance with AAMA 1503.
- H. Windborne-Debris Impact Resistance: Passes ASTM E1886 missile-impact and cyclic-pressure tests in accordance with ASTM E1996 for Wind Zone 4 – Level D.
1. Large-Missile Test: For glazing located within 30 feet of grade.
- I. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes.
1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

## 2.3 ALUMINUM-FRAMED STOREFRONT SYSTEMS

- A. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.
1. Exterior Framing Construction: Nonthermal
  2. Interior Vestibule Framing Construction: Nonthermal.
  3. Glazing System: Retained mechanically with gaskets on four sides
  4. Glazing Plane: Front.
  5. Finish: Clear anodic finish.
  6. Fabrication Method: Field-fabricated stick system.
  7. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
  8. Steel Reinforcement: As required by manufacturer.
- B. Backer Plates: Manufacturer's standard, continuous backer plates for framing members, if not integral, where framing abuts adjacent construction.

- C. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with non-staining, nonferrous shims for aligning system components.

## 2.4 GLAZING

- A. Glazing: Comply with Section 088000 "Glazing."
- B. Glazing Gaskets: Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers.
- C. Glazing Sealants: As recommended by manufacturer.

## 2.5 MATERIALS

- A. Sheet and Plate: ASTM B209.
- B. Extruded Bars, Rods, Profiles, and Tubes: ASTM B221.
- C. Extruded Structural Pipe and Tubes: ASTM B429/B429M.
- D. Structural Profiles: ASTM B308/B308M.
- E. Steel Reinforcement:
  - 1. Structural Shapes, Plates, and Bars: ASTM A36/A36M.
  - 2. Cold-Rolled Sheet and Strip: ASTM A1008/A1008M.
  - 3. Hot-Rolled Sheet and Strip: ASTM A1011/A1011M.
- F. Steel Reinforcement Primer: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods in accordance with recommendations in SSPC-SP COM, and prepare surfaces in accordance with applicable SSPC standard.

## 2.6 FABRICATION

- A. Form or extrude aluminum shapes before finishing.
- B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
- C. Fabricate components that, when assembled, have the following characteristics:
  - 1. Profiles that are sharp, straight, and free of defects or deformations.
  - 2. Accurately fitted joints with ends coped or mitered.
  - 3. Physical and thermal isolation of glazing from framing members.
  - 4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
  - 5. Provisions for field replacement of glazing from interior.



- 6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
- D. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.
- E. After fabrication, clearly mark components to identify their locations in Project in accordance with Shop Drawings.

## 2.7 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, Class II, or thicker.

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Comply with manufacturer's written instructions.
- B. Do not install damaged components.
- C. Fit joints to produce hairline joints free of burrs and distortion.
- D. Rigidly secure nonmovement joints.
- E. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
- F. Seal perimeter and other joints watertight unless otherwise indicated.
- G. Metal Protection:
  - 1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with materials recommended by manufacturer for this purpose or by installing nonconductive spacers.
  - 2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
- H. Set continuous sill members and flashing in full sealant bed, as specified in Section 079200 "Joint Sealants," to produce weathertight installation.
- I. Install joint filler behind sealant as recommended by sealant manufacturer.
- J. Install components plumb and true in alignment with established lines and grades.

### 3.2 INSTALLATION OF GLAZING

- A. Install glazing as specified in Section 088000 "Glazing."

### 3.3 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Field Quality-Control Testing: Perform the following test on representative areas of aluminum-framed storefronts.
  - 1. Water-Spray Test: Before installation of interior finishes has begun, areas designated by Architect shall be tested in accordance with AAMA 501.2 and shall not evidence water penetration.
    - a. Perform a minimum of three tests in areas as directed by Architect.
  - 2. Air Leakage: ASTM E783 at 1.5 times the rate specified for laboratory testing in "Performance Requirements" Article but not more than 0.09 cfm/sq. ft. at a static-air-pressure differential of 1.57 lbf/sq. ft..
    - a. Perform a minimum of **two** tests in areas as directed by Architect.
  - 3. Water Penetration: ASTM E1105 at a minimum uniform static-air-pressure differential of 0.67 times the static-air-pressure differential specified for laboratory testing in "Performance Requirements" Article, but not less than 6.24 lbf/sq. ft. and shall not evidence water penetration.
- C. Aluminum-framed storefronts will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports and distribute to Architect.

END OF SECTION 084313

## **SECTION 084523 - INSULATED TRANSLUCENT FIBERGLASS SANDWICH PANEL**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. Section includes the insulated translucent sandwich panel system and accessories, factory unitized, as shown and specified. Work includes providing and installing:
  - 1. Flat factory prefabricated structural insulated translucent sandwich panels
  - 2. Aluminum installation system
  - 3. Aluminum sill flashing
  
- B. Related Sections:
  - 1. Structural Steel Section 05120
  - 2. Masonry: Section 074213.23 Metal Composite Material Wall Panels
  - 3. Flashing and Sheet Metal: 076200
  - 4. Sealants: Section 079200

#### **1.2 SUBMITTALS**

- A. Submit manufacturer's product data. Include construction details, material descriptions, profiles and finishes of components.
  
- B. Submit shop drawings. Include elevations and details.
  
- C. Submit manufacturer's color charts showing the full range of colors available for factory-finished aluminum.
  - 1. When requested, submit samples for each exposed finish required, in same thickness and material indicated for the work and in size indicated below. If finishes involve normal color variations, include sample sets consisting of two or more units showing the full range of variations expected.
    - a. Sandwich panels: 14" x 28" units
    - b. Factory finished aluminum: 5" long sections
  
- D. Submit Installer Certificate, signed by installer, certifying compliance with project qualification requirements.
  
- E. Submit product reports from a qualified independent testing agency indicating each type and class of panel system complies with the project performance requirements, based on comprehensive testing of current products. Previously completed reports will be acceptable if for current manufacturer and indicative of products used on this project.
  - 1. Reports required are:
    - a. International Building Code Evaluation Report
    - b. Flame Spread and Smoke Developed (UL 723) – Submit UL Card
    - c. Burn Extent (ASTM D 635)
    - d. Color Difference (ASTM D 2244)
    - e. Impact Strength (UL 972)
    - f. Bond Tensile Strength (ASTM C 297 after aging by ASTM D 1037)
    - g. Bond Shear Strength (ASTM D 1002)

- h. Beam Bending Strength (ASTM E 72)
- i. Insulation U-Factor (NFRC 100)
- j. NFRC System U-Factor Certification (NFRC 700)
- k. Solar Heat Gain Coefficient (NFRC or Calculations)
- l. Condensation Resistance Factor (AAMA 1503)
- m. Air Leakage (ASTM E 283)
- n. Structural Performance (ASTM E 330)
- o. Water Penetration (ASTM E 331)
- p. 1200°F Fire Resistance (SWRI)
- q. ASTM E1886/1996 or TAS 201, 202 and 203
- r. Performance for Windows (AAMA/WDMA/CSA-101/I.S.2/A440-05)
- s. Daylight Autonomy

### 1.3 QUALITY ASSURANCE

#### A. Manufacturer's Qualifications

1. Material and products shall be manufactured by a company continuously and regularly employed in the manufacture of specified materials for a period of at least ten consecutive years and which can show evidence of those materials being satisfactorily used on at least six projects of similar size, scope and location. At least three of the projects shall have been in successful use for ten years or longer.
2. Panel system must be listed by an ANSI accredited Evaluation Service, which requires quality control inspections and fire, structural and water infiltration testing of sandwich panel systems by an accredited agency.
3. Quality control inspections shall be conducted at least once each year and shall include manufacturing facilities, sandwich panel components and production sandwich panels for conformance with AC177 "Translucent Fiberglass Reinforced Plastic (FRP) Faced Panel Wall, Roof and Skylight Systems" as issued by the ICC-ES.

- B. Installer's Qualifications: Installation shall be by an experienced installer, which has been in the business of installing specified panel systems for at least two consecutive years and can show evidence of satisfactory completion of projects of similar size, scope and type.

### 1.4 PERFORMANCE REQUIREMENTS

- A. The manufacturer shall be responsible for the configuration and fabrication of the complete unitized panel system.

1. When requested, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
2. Standard panel system shall have less than 0.01 cfm/ft<sup>2</sup> air leakage by ASTM E 283 at 6.24 PSF (50 mph) and no water penetration by ASTM E 331 at 15 PSF; and structural testing by ASTM E 330.
3. Structural Loads; Provide system capable of handling the following loads:
  - a. Positive Wind Load: Refer to Structural Drawings.
  - b. Negative Wind Load: Refer to Structural Drawings.

#### B. Windborne Debris Impact Resistance Performance

1. Translucent panels must be impact-resistant meeting the requirements of an approved impact-resisting standard: ASTM E 1996 and ASTM E 1886 or TAS 201, 202 and 203.
2. Panel System designed to meet Missile Level D per ASTM E 1996.

### 1.5 DELIVERY STORAGE AND HANDLING

- A. Deliver panel system, components and materials in manufacturer's standard protective packaging.
- B. Store panels on the long edge; several inches above the ground, blocked and under cover in accordance with manufacturer's storage and handling instructions.

## 1.6 WARRANTY

- A. Submit manufacturer's and installer's written warranty agreeing to repair or replace panel system work, which fails in materials or workmanship within one year of the date of delivery. Failure of materials or workmanship shall include leakage, excessive deflection, deterioration of finish on metal in excess of normal weathering, defects in accessories, insulated translucent sandwich panels and other components of the work.
- B. Extended Warranty: 10 Years.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURER

- A. The basis for this specification is for products manufactured by Kalwall Corporation. Other manufacturers may bid this project provided they comply with all of the performance requirements of this specification and submit evidence thereof. Listing other manufacturers' names in this specification does not constitute approval of their products or relieve them of compliance with all the performance requirements contained herein.
- B. Kalwall Corporation, Tel: (800) 258-9777 – Fax: (603) 627-7905 – Email: [info@kalwall.com](mailto:info@kalwall.com)

### 2.2 PANEL COMPONENTS

- A. Face Sheets
  - 1. Translucent faces: Manufactured from glass fiber reinforced thermoset resins, formulated specifically for architectural use.
    - a. Thermoplastic (e.g. polycarbonate, acrylic) faces are not acceptable.
    - b. Face sheets shall not deform, deflect or drip when subjected to fire or flame.
  - 2. Interior face sheets:
    - a. Flame spread: Underwriters Laboratories (UL) listed, which requires periodic unannounced retesting, with flame spread rating no greater than 50 and smoke developed no greater than 250 when tested in accordance with UL 723.
    - b. Burn extent by ASTM D 635 shall be no greater than 1”.
  - 3. Exterior face sheets:
    - a. Color stability: Full thickness of the exterior face sheet shall not change color more than 3 CIE Units DELTA E by ASTM D 2244 after 5 years outdoor South Florida weathering at 5° facing south, determined by the average of at least three white samples with and without a protective film or coating to ensure long-term color stability. Color stability shall be unaffected by abrasion or scratching.
    - b. Strength: Exterior face sheet shall be uniform in strength, with panel meeting ASTM E1996 and ASTM E1886 or TAS 201, 202 and 203.
  - 4. Appearance:

- a. Exterior face sheets: Smooth .060" thick and white in color.
- b. Interior face sheets: Smooth .045" thick and white in color.
- c. Face sheets shall not vary more than  $\pm 10\%$  in thickness and be uniform in color.

B. Grid Core

1. Aluminum I-beam grid core shall be of 6063-T6 or 6005-T5 alloy and temper with provisions for mechanical interlocking of muntin-mullion and perimeter. Width of I-beam shall be no less than 7/16".
2. I-beam Thermal break: Minimum 1", thermoset fiberglass composite.

C. Laminate Adhesive

1. Heat and pressure resin type adhesive engineered for structural sandwich panel use, with minimum 25-years field use. Adhesive shall pass testing requirements specified by the International Code Council "Acceptance Criteria for Sandwich Panel Adhesives".
2. Minimum tensile strength of 750 PSI when the panel assembly is tested by ASTM C 297 after two exposures to six cycles each of the aging conditions prescribed by ASTM D 1037.
3. Minimum shear strength of the panel adhesive by ASTM D 1002 after exposure to four separate conditions:
  - a. 50% Relative Humidity at 68° F: 540 PSI
  - b. 182° F: 100 PSI
  - c. Accelerated Aging by ASTM D 1037 at room temperature: 800 PSI
  - d. Accelerated Aging by ASTM D 1037 at 182° F: 250 PSI

## 2.3 PANEL CONSTRUCTION

- A. Provide sandwich panels of flat fiberglass reinforced translucent face sheets laminated to a grid core of mechanically interlocking I-beams. The adhesive bonding line shall be straight, cover the entire width of the I-beam and have a neat, sharp edge.
1. Thickness: 2-3/4"
  2. Light transmission: 23%
  3. Solar heat gain coefficient .30.
  4. Grid pattern: Nominal size 12" x 24; pattern Shoji.
- B. Standard panels shall deflect no more than 1.9" at 30 PSF in 10' 0" span without a supporting frame by ASTM E 72.
- C. Standard panels shall withstand 1200° F fire for minimum one hour without collapse or exterior flaming.
- D. Thermally broken panels: Minimum Condensation Resistance Factor of 80 by AAMA 1503 measured on the bond line.

## 2.4 BATTENS AND PERIMETER CLOSURE SYSTEM

- A. Closure system: Standard extruded aluminum 6063-T6 and 6063-T5 alloy and temper clamp-tite screw type closure system.
- B. Sealing tape: Manufacturer's standard, pre-applied to closure system at the factory under controlled conditions.

- C. Fasteners: 300 series stainless steel screws for aluminum closures, excluding final fasteners to the building.
- D. Finish:
  - 1. Anodized

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Installer shall examine substrates, supporting structure and installation conditions.
- B. Do not proceed with panel installation until unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. 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 recommended by manufacturer for this purpose.
  - 2. Where aluminum will contact concrete, masonry or pressure treated wood, protect against corrosion by painting contact surfaces with bituminous paint or method recommended by manufacturer.

### 3.3 INSTALLATION

- A. Install the panel system in accordance with the manufacturer's suggested installation recommendations and approved shop drawings.
  - 1. Anchor component parts securely in place by permanent mechanical attachment system.
  - 2. Accommodate thermal and mechanical movements.
  - 3. Set perimeter framing in a full bed of sealant compound, or with joint fillers or gaskets to provide weather-tight construction.
- B. Install joint sealants at perimeter joints and within the panel system in accordance with manufacturer's installation instructions.

### 3.4 CLEANING

- A. Clean the panel system interior and exterior, immediately after installation.
- B. Refer to manufacturer's written recommendations.

END OF SECTION 08 45 23

SECTION 08 7100  
DOOR HARDWARE

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

- A. Work under this section comprises of furnishing and installing hardware specified herein and noted on drawings for a complete and operational system, including any electrified hardware components, systems, controls and hardware for aluminum entrance doors. Any door shown on the drawing and not specifically referenced in the hardware sets shall be provided with identical hardware as specified on other similar openings and shall be included in the finish hardware suppliers bid. All fire rated door shall be provided with fire rated hardware as required by local code Authority as part of the hardware supplier's base bid. The hardware supplier shall verify all cylinder types specified for all special doors with locking devices furnished as a part of the door system.
- B. The General Contractor and the Hardware Supplier shall notify the Architect in writing of any discrepancies (five (5) days prior to bid date) that could and/or would result in hardware being supplied that is none functional, hardware specified and/or hardware that has not been specified that will result in any code violations and any door that is not covered in this specification. Failure of the general contractor and hardware supplier to address any such issue shall be considered acceptance of the hardware specified and all discrepancies shall be corrected at the general contractor and hardware supplier's expense and considered a part of their base bid. Change orders shall not be issued if deemed by the Architect and/or Edinburg CISD to fall under and/or be covered as a part of the contractor and supplier's base bid, due to failure to comply with this instruction notification.
- C. Items include but are not limited to the following:
1. Hinges - Pivots
  2. Flush Bolts
  3. Exit Devices
  4. Locksets and Cylinders
  5. Push Plates - Pulls
  6. Coordinators
  7. Closers
  8. Kick, Mop and Protection Plates
  9. Stops, Wall Bumpers, Overhead Controls
  10. Electrified Hold Open Devices
  11. Thresholds, Seals and Door Bottoms
  12. Silencers
  13. Miscellaneous Trim and Accessories

1.02 RELATED DOCUMENTS, drawings and general provisions of contract, including General and Supplementary Conditions, and Division 1 Specification sections, apply to this section.

1.03 RELATED WORK specified elsewhere that should be examined for its effect upon this section:

- A. Section 06 20 00 - Finish Carpentry
- B. Section 08 11 13 – Steel Doors and Frames
- C. Section 08 14 16 – Flush Wood Doors
- D. Sections within 08 31 13 – Access Doors
- E. Section within 08 41 13 – Aluminum Entrances, Storefront and Window Framing
- F. Sections within 08 80 00 – Glass and Glazing



- G. Sections within 09 91 00 – Painting
- H. Section 13 48 00 – Sound Control
- I. Division 26 – Electrical
- J. Division 28 – Access Control

1.04 REFERENCES SPECIFIED in this section subject to compliance as directed:

- A. NFPA-80- Standard for Fire Doors and Windows
- B. NFPA-101 - Life Safety Code
- C. ADA - The Americans with Disabilities Act - Title III - Public Accommodations
- D. ANSI-A 117.1 - American National Standards Institute - Accessible and Usable Buildings and Facilities
- E. ANSI-A 156.5 - American National Standards institute -Auxiliary Locks and Associated Products
- F. UFAS - Uniform Federal Accessibility Standards
- G. UL - Underwriter's Laboratories
- H. WHI - Warnock Hersey International, Testing Services
- I. State and Local Codes including Authority Having Jurisdiction
- J. UL10C – Positive Pressure
- K. IBC-2018 - International Building Code
- L. NFPA-70 – National Electrical Code

1.05 SUBMITTALS

- A. HARDWARE SCHEDULES submit copies of schedule in accordance with Division 1, General Requirements. Schedule to be in vertical format, listing each door opening, including, handing of opening, all hardware scheduled for opening or otherwise required to allow for proper function of door opening as intended, and finish of hardware. At doors with door closers or door controls include degree of door opening. Supply the schedules all Finish Hardware within two (2) weeks from date purchase order is received by the hardware supplier.
- B. Submit manufacturer's cut/catalog sheets on all hardware items and any required special mounting instructions with the hardware schedule.
- C. Certification of Compliance:
  - 1. Submit any information necessary to indicate compliance to all of these specifications as required.
  - 2. Submit a statement from the manufacturer that electronic hardware and systems being supplied comply with the operational descriptions exactly as specified.
- D. Submit any samples necessary as required by the Architect.
- E. Templates for finish hardware items to be sent to related door and frame suppliers within three (3) working days of receipt of approved hardware schedule.
- F. Electronic Security Hardware: Coordinate installation of the electronic security with the Architect and provide installation and technical data to the Architect and other related sub-contractor(s). Upon completion of the electronic security hardware installation, verify that all components are working properly and state in the required guarantee that this inspection has been performed.
- G. Wiring Diagrams: Provide complete wiring diagrams for each opening requiring electrified hardware, except openings where only magnetic hold-opens are specified. Provide a

copy with each hardware schedule submitted after approval. Supply a copy with delivery of hardware to job site and another copy to owner at time of job completion.

- H. Doors and Frames used in positive pressure opening assemblies shall meet UL10C in areas where this specification includes Seals for smoke door.

#### 1.06 QUALITY ASSURANCE

- A. Hardware supplier to be a qualified, Factory Authorized, direct distributor of the products to be furnished. In addition, the supplier to have in their regular employment an A.H.C. or person of equivalent experience who will be made available at reasonable times to consult with the Architect/Contractor and/or Edinburg CISD regarding any matters affecting the finish hardware on this project.
- B. All hardware used in labeled fire or smoke rated openings to be listed for those types of openings and bear the identifying label or mark indicating UL. (Underwriter's Laboratories) approved for fire. Exit devices in non-labeled openings to be listed for panic.

#### 1.07 DELIVERY, HANDLING AND PACKAGING

- A. Furnish all hardware with each unit clearly marked and numbered in accordance with the hardware schedule. Include door and item number for each.
- B. Pack each item of hardware completes with all necessary parts and fasteners.
- C. Properly wrap and cushion each item to prevent scratches and dents during delivery and storage.

#### 1.08 SEQUENCING AND SCHEDULING

- A. Any part of the finish hardware required by the frame or door manufacturers or other that is needed in order to produce doors or frames is to be sent to those suppliers in a timely manner, so as not to interrupt job progress.

#### 1.09 WARRANTY

- A. All finish hardware shall be supplied with a Two- (2) year warranty against defects in materials and workmanship, commencing with substantial completion of the project except as follows:
  - 1. All Closers to have a thirty-(30) year written warranty.
  - 2. All Exit Devices to have a three-(3) year written warranty.
  - 3. All Locksets to have a ten-(10) year written warranty.
  - 4. All Continuous Hinges to have a ten-(10) year written warranty.

### PART 2 – PRODUCTS

#### 2.01 FASTENERS

- A. Furnish with finish hardware all necessary screws, bolts and other fasteners of suitable size and type to anchor the hardware in position for a long life under hard use.
- B. Furnish fastenings where necessary with expansion shields, toggle bolts and other anchors designated by the Architect according to the material to which the hardware is to be applied and the recommendations of the hardware manufacturer. All closers and exit

devices on labeled wood doors shall be through bolted if required by the door manufacturer. All thresholds shall be fastened with machine screws and anchors. Where specified in the hardware sets, security type fasteners of the type called for are to be supplied.

- C. Design of all fastenings shall harmonize with the hardware as to material and finish.

## 2.02 ENVIRONMENTAL CONCERN FOR PACKAGING

- A. Hardware shipped to the project jobsite is to be packaged in biodegradable packs such as paper or cardboard boxes and wrapping.

## 2.03 HINGES

- A. All hinges to be of one manufacturer as hereafter listed for continuity and consideration of warranty. Provide one of the following manufacturers Ives, Mc Kinney or Stanley.
- B. Unless otherwise specified provide five-knuckle, heavy-duty, button tip, full mortise template type hinges with non-rising loose pins. Provide non-removable pins for out swinging doors at secured areas or as called for in this specification.
- C. Provide all exterior out-swinging door hinges of solid bronze or stainless steel with non-removable pins or security studs as called for in this specification, unless otherwise specified in 3.02 Hardware Sets.
- D. Provide interior hinges manufactured from bronze, steel, stainless steel that matches the specified finish shown on other hardware items. Furnish three (3) hinges up to 90 inches high and one (1) additional hinge for every 30 inches or fraction thereof.
- E. Provide size 4½" x 4½" for all 1¾" thick doors up to and including 36 inches wide. Doors over 1¾" through 2¼" thick, use 5" x 5" hinges. Doors over 36 inches use 5" x 4½" unless otherwise specified in 3.02 Hardware Sets.
- F. Where required to clear the trim and/or to permit the doors to swing 180 degrees furnish hinges of sufficient throw.
- G. Provide heavy weight hinges on all doors over 36 inches in width and all doors with overhead stops or holders.
- H. At labeled door's stainless steel, bearing-type hinges shall be provided. For all doors equipped with closers and all other doors provide bearing-type hinges.
- I. Finishes
  - 1. At wood doors, hinges are to be plated to match adjacent hardware or as called for in Hardware Sets.
  - 2. At hollow metal doors, hinges are to be stainless steel at exterior in-swinging and out-swinging doors, unless otherwise specified in 3.02 Hardware Sets.
- J. Continuous hinges shall be as specified and manufactured by Ives, Select or ABH Products. All exterior doors shall be prepared and receive continuous hinges as specified.
- K. Pivots shall not be used on any Edinburg C. I. S. D. projects.

2.04 LOCK AND LOCK TRIM

- A. All the locksets, latch sets, and trim to be of one manufacturer as hereafter listed for continuity of design and consideration of warranty. Provide Schlage "ND" Vandlguard series with the Rhodes lever. All locks, passage and privacy sets shall be provided in a Dull Chrome (626) finish. All locksets shall be prepared for Schlage Conventional Classic keyways as required by Edinburg C. I. S. D. All locks are to be the Vandlguard series functions as specified.
- B. Provide metal wrought box strike boxes and curved lip strikes with proper lip length to protect trim of the frame, but not to project more than 1/8 inch beyond frame trim or the inactive leaf of a pair of doors.
- C. Mechanical Locks shall meet ANSI Operational Grade 1, Series 4000 as specified.
  - 1. Hand of lock is to be easily field-reversible or non-handed.
  - 2. All lever trim is to be through bolted through the door.
  - 3. Provide all locks specified with sound and/or light seal with a 3-3/4" backset.
  - 4. Provide storeroom function lock at all Classroom doors.
  - 5. Provide the ND91PD Rhodes Entry Lock function at all office doors within the Administration area.
  - 6. Provide Schlage "L" mortise privacy set with occupancy indicator and matching lever at all single restrooms.

2.05 CYLINDERS AND KEYING

- A. Provide locks and Exit devices requiring cylinders with Schlage Everest Conventional Classic keyway (No Substitution) key system that complies with performance requirements of ANSI A156.5. All keys shall be manufactured from nickel silver material. All locks are to be keyed to the existing Schlage Everest Classic Keyway master key system as directed by Edinburg C. I. S. D.
- B. Furnish all exterior and interior locks and Exit devices with temporary keyed construction master keyed cylinders for the duration of construction. Provide ten (10) construction keys total.
- C. Cylinders shall be keyed as directed by Edinburg C. I. S. D. and the Architect (After the supplier has had a minimum of two (2) meetings on site to discuss the permanent keying). Provide four-(4) cut or blank keys per cylinder and ten-(10) cut master keys per master used. The hardware supplier and the general contractor shall meet with Edinburg C. I. S. D. Representatives to determine exactly how all the locks are to be keyed and keys supplied (Cut or Blank). The hardware supplier in the presents of the Edinburg C. I. S. D. representative installs permanent cylinders and demon-straight that the keys function and lock or exit device work properly as installed. All permanent keys shall be turned over to Edinburg C. I. S. D. with a complete bitting list of all key changes used on the project. The bitting list shall include additional bittings equal to 200% expansion of the key system.
- D. Stamp all keys "Do not duplicate" and with key symbol as directed by Edinburg C. I. S. D.

2.06 EXIT DEVICES

- A. All exit devices and trim, including electrified items, to be of one manufacturer as hereafter listed and in the hardware sets for continuity of design and consideration of warranty; electrified devices and trim to be the same series and design as mechanical devices and trim. All devices shall conform to NFPA 80 and NFPA 101 requirements.

- B. Exit Devices to be "UL" listed for life safety. All exit devices for labeled doors shall have "UL" label for "Fire Exit Hardware". All devices mounted on labeled wood doors are to be through-bolted or per the manufacturer's listing requirements.
- C. All exit devices to be of a heavy duty, chassis mounted design, with one-piece removable covers, eliminating necessity of removing the device from the door for standard maintenance and keying requirements.
- D. All trims to be through bolted to the lock stile case. Lever design shall be the same as specified with the lock sets #06.
- E. Exit Devices to be the modern push rail design.
- F. All devices shall carry a three- (3) year warranty against manufacturing defects and workmanship.
- G. Exit Devices shall be Von Duprin "99" series as specified to match existing devices used and inventoried by Edinburg CISD. All Exit Devices shall be installed with sex-nut-bolts provided by the Manufacturer.

#### 2.07 SURFACE MOUNTED DOOR CLOSERS

- A. All closers for this project shall be the products of a single manufacturer for continuity of design and consideration of warranty. All door closers shall be mounted as to achieve the maximum degree of opening (trim permitting).
- B. All closers to be heavy duty, surface-mounted, fully hydraulic, rack and pinion action with high strength cast iron cylinder to provide control throughout the entire door opening cycle.
- C. Size all closers in accordance with the manufacturer's recommendations at the factory.
- D. All closers to have adjustable spring power sizes 1 through 4 or 6 as specified and separate tamper resistant, brass, non-critical regulating screw valves for closing speed, latching speed and back-check control as a standard feature unless specified otherwise.
- E. All closer covers to be rectangular, full cover type of non-ferrous, non-corrosive material painted to match closer. Install all door closers with sex-nut-bolts as provided by the closer manufacturer.
- F. Closer to have heavy-duty arms. All closer arms shall be of sufficient length to accommodate the reveal depth and to insure proper installation
- G. Supply appropriate arm assembly for each closer so that closer body and arm are mounted on non-public side of door opening and on the interior side of exterior openings, except where required otherwise in the hardware sets.
  - 1. All parallel arm mounted closers to be factory indexed to insure proper installation.
  - 2. Furnish heavy-duty cold forged parallel arms for all parallel arm mounted closers.
- H. Provide closers with special application and heavy-duty arms as specified in the hardware sets or as otherwise called for to insure a proper operating, long lasting opening.

- I. Finish: Sprayed enamel finish shall match all other hardware.
- J. Door closer shall be LCN 1461 FC Interior and 4040XP Exterior as specified.

#### 2.08 STOPS AND HOLDERS

- A. Stops are to be furnished for every door leaf. Every door is to have a floor, wall, or an overhead stop.
- B. Place doorstops in such a position that they permit maximum door swing, but do not present a hazard of obstruction. Furnish floor strikes for floor holders of proper height to engage holders of doors.
- C. Where overhead stops and holders are specified, or otherwise required for proper door operation, they are to be heavy duty and of extruded brass, bronze or stainless steel with no plastic parts as specified.
- D. Finish: Same as other hardware where available.
- E. Acceptable Products
  - 1. Floor and wall stop as listed in hardware sets. Equivalent products as manufactured by Ives, Rockwood and Trimco are acceptable.

#### 2.09 PUSH PLATES, DOOR PULLS, AND KICKPLATES

- A. All push plates, door pull's, kick plates and other miscellaneous hardware as listed in hardware sets. Equivalent products as manufactured by Ives, Rockwood and Trimco are acceptable.
- B. Kick plates to be 10 inches high and Mop plates to be 6 inches high, both by 2 inches or 1 inch less than door width (LDW) as specified. They are to be of 16 gauge (.050 inches) thick stainless steel. For door with louvers or narrow bottom rails, kick plate height to be 1 inch less dimension shown from the bottom of the door to the bottom of the louver or glass.
- C. Where required armor plates, edge guards and other protective hardware shall be supplied in sizes as scheduled in the hardware sets.
- D. Finish: Same as other hardware where available.

#### 2.10 FLUSH BOLTS AND COORDINATORS

- A. Provide Flush bolts with Dust Proof Strikes as indicated in the individual hardware sets by Ives, Rockwood and Trimco are acceptable. Finish shall match adjacent hardware.

#### 2.11 THRESHOLDS AND GASKETING

- A. Provide materials and finishes as listed in hardware sets. Equivalent product by National Guard Products and Reese are acceptable. All thresholds must be in accordance with the requirements of the ADA and ANSI A117.1.
- B. Provide thresholds with 224 MSLA anchors. Supply all necessary anchoring devices for weather strip and sound seal. All thresholds, weather strip, door bottoms, etc. shall be provided with silicone inserts as specified. Provide all thresholds with solid fill "V3" or equal if shown with solid fill.

- C. Seals shall comply with requirements of UL10C. All inserts shall be silicone as specified.
- D. Seals shall comply with the requirements of the Wood Door Manufacturer's certification requirements.

#### 2.12 FINISHES

- A. Finishes for all hardware are as required in this specification and the hardware sets.
- B. Special care is to be taken to make uniform the finish of all various manufactured items.

#### 2.13 DOOR SILENCERS

- A. Provide door silencers at all openings without gasket. Provide two- (2) each at each pair of doors and three- (3) each for each single door (coordinate with the frame manufacturer).

#### 2.14 PROPRIETARY PRODUCTS

- A. References to specific products are used to establish quality standards of utility and performance. Unless otherwise approved provide only the specified product.
- B. All other materials, not specifically described, but required for a complete and proper finish hardware installation, are to be selected by the Contractor, subject to the approval of the Architect and Edinburg CISD.
- C. Architect and Edinburg CISD reserve the right to approve all the substitutions proposed for this specification. All requests for substitution to be made prior to bid in accordance with Division 1, General Requirements, and are to be in writing, hand delivered to the Architect. Two (2) copies of the manufacturer's brochures and a physical sample of each item in the appropriate design and finish shall accompany requests for substitution.

### PART 3 - EXECUTION

#### 3.01 INSTALLATION OF FINISH HARDWARE

- A. Hardware is to be installed by experienced finish hardware installers after a pre-installation and pre-wiring meeting between the hardware supplier, lock, exit device and closer manufacturer's representative, electrical contractor, security contractor, hollow metal supplier, wood door supplier and hardware installer. Hardware installer shall have a minimum of ten (10) years of experience in the installation of finish hardware.
- B. Check hardware against the reviewed hardware schedule upon delivery. Store the hardware in a dry and secure location to protect against loss and damage.
- C. Install finish hardware in accordance with approved hardware schedule and manufacturers' printed instructions. Pre-fit hardware before finish is applied to door; remove and reinstall after finish is complete and dry. Install and adjust hardware so that parts operate smoothly, close tightly, and do not rattle.
- D. Mortise and cutting to be done neatly, and evidence of cutting to be concealed in the finished work. Protect all Finish hardware from scratching or other damage.


#### 3.02 HARDWARE SETS:

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GMS ARCHITECTS

77565 OPT0289629-V2

HARDWARE SET # 001

Each RU door(s) to have:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	MORTISE CYLINDER	20-001		626	SCH
1	EA		BALANCE OF HARDWARE BY DOOR MFR			

COORDINATE HARDWARE REQUIREMENT WITH OVERHEAD DOOR MFR.







HARDWARE SET # 002

Each SL door(s) to have:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	SLIDING DOOR HW	ALL HARDWARE BY DOOR MFR.		626	





HARDWARE SET # 101

Each SGL door(s) to have:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	VANDL OFFICE LOCK	ND91P6D RHO		626	SCH
1	EA	SURFACE CLOSER	1461 RW/PA FC X MTG PLT/BRKT/SPCR AS REQ		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS406/407CCV		630	IVE
3	EA	SILENCER	SR64		GRY	IVE

HARDWARE SET # 103

Each SGL door(s) to have:





QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	VANDL OFFICE LOCK	ND91P6D RHO		626	SCH
1	EA	WALL STOP	WS406/407CCV		630	IVE
3	EA	SILENCER	SR64		GRY	IVE



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HARDWARE SET # 103S

Each SGL door(s) to have:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	VANDL OFFICE LOCK	ND91P6D RHO		626	SCH
1	EA	OH STOP	900S		630	GLY
			X SIZE & MOUNTING AS REQ			
3	EA	SILENCER	SR64		GRY	IVE






HARDWARE SET # 107

Each SGL door(s) to have:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	VANDL OFFICE LOCK	ND91P6D RHO		626	SCH
1	EA	OH STOP	900S		630	GLY
			X SIZE & MOUNTING AS REQ			
1	EA	SURFACE CLOSER	1461 RW/PA FC		689	LCN
			X MTG PLT/BRKT/SPCR AS REQ			
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
3	EA	SILENCER	SR64		GRY	IVE

HARDWARE SET # 201C








Each SGL door(s) to have:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	VANDL STOREROOM LOCK	ND96P6D RHO		626	SCH
1	EA	SURFACE CLOSER	1461 SCUSH FC		689	LCN
			X MTG PLT/BRKT/SPCR AS REQ			
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	GASKETING	488S PSA H & J (USE SILENCERS AT NON-RATED DOORS)		BK	ZER

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HARDWARE SET # 202S

Each PR door(s) to have:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
6	EA	HINGE	5BB1HW 4.5 X 4.5		652	IVE
2	EA	MANUAL FLUSH BOLT	FB458 (1 EA TOP/BOTTOM)		626	IVE
1	EA	DUST PROOF STRIKE	DP2		626	IVE
1	EA	VANDL STOREROOM LOCK	ND96P6D RHO		626	SCH
2	EA	OH STOP	900S X SIZE & MOUNTING AS REQ		630	GLY
1	EA	ASTRAGAL	43SP		SP	ZER
2	EA	SILENCER	SR64		GRY	IVE





HARDWARE SET # 203

Each SGL door(s) to have:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	VANDL STOREROOM LOCK	ND96P6D RHO		626	SCH
1	EA	WALL STOP	WS406/407CCV		630	IVE
3	EA	SILENCER	SR64		GRY	IVE





HARDWARE SET # 203S

Each SGL door(s) to have:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	VANDL STOREROOM LOCK	ND96P6D RHO		626	SCH
1	EA	OH STOP	900S X SIZE & MOUNTING AS REQ		630	GLY
3	EA	SILENCER	SR64		GRY	IVE

HARDWARE SET # 203SW








Each SGL door(s) to have:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1HW 5 X 4.5 NRP		652	IVE
1	EA	VANDL STOREROOM LOCK	ND96P6D RHO		626	SCH
1	EA	OH STOP	900S X SIZE & MOUNTING AS REQ		630	GLY
3	EA	SILENCER	SR64		GRY	IVE

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HARDWARE SET # 341

Each SGL door(s) to have:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	PRIVACY W/INDICATOR	L9040 06A L583-363 L283-722		626	SCH
1	EA	SURFACE CLOSER	1461 RW/PA FC		689	LCN
			X MTG PLT/BRKT/SPCR AS REQ			
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS406/407CCV		630	IVE
1	EA	GASKETING	488S PSA H & J (USE SILENCERS AT NON-RATED DOORS)		BK	ZER
1	EA	COAT AND HAT HOOK	582		B26D	IVE








HARDWARE SET # 343

Each SGL door(s) to have:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	PRIVACY W/INDICATOR	L9040 06A L583-363 L283-722		626	SCH
1	EA	WALL STOP	WS406/407CCV		630	IVE
1	EA	COAT AND HAT HOOK	582		B26D	IVE
3	EA	SILENCER	SR64		GRY	IVE





HARDWARE SET # 347

Each SGL door(s) to have:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	PRIVACY W/INDICATOR	L9040 06A L583-363 L283-722		626	SCH
1	EA	OH STOP	900S		630	GLY
			X SIZE & MOUNTING AS REQ			
1	EA	SURFACE CLOSER	1461 RW/PA FC		689	LCN
			X MTG PLT/BRKT/SPCR AS REQ			
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	COAT AND HAT HOOK	582		B26D	IVE
3	EA	SILENCER	SR64		GRY	IVE

HARDWARE SET # 403





Each SGL door(s) to have:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	PASSAGE SET	ND10S RHO		626	SCH
1	EA	WALL STOP	WS406/407CCV		630	IVE
3	EA	SILENCER	SR64		GRY	IVE

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HARDWARE SET # 403S

Each SGL door(s) to have:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	PASSAGE SET	ND10S RHO		626	SCH
1	EA	OH STOP	900S		630	GLY
			X SIZE & MOUNTING AS REQ			
3	EA	SILENCER	SR64		GRY	IVE







HARDWARE SET # 501

Each SGL door(s) to have:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	VANDL CLASSROOM LOCK	ND94P6D RHO		626	SCH
1	EA	SURFACE CLOSER	1461 RW/PA FC		689	LCN
			X MTG PLT/BRKT/SPCR AS REQ			
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS406/407CCV		630	IVE
1	EA	GASKETING	488S PSA H & J (USE SILENCERS AT NON-RATED DOORS)		BK	ZER

HARDWARE SET # 501E

Each SGL door(s) to have:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	VANDL CLASSROOM LOCK	ND94P6D RHO		626	SCH
1	EA	SURFACE CLOSER	1461 EDA FC		689	LCN
			X MTG PLT/BRKT/SPCR AS REQ			
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS406/407CCV		630	IVE
1	EA	GASKETING	488S PSA H & J (USE SILENCERS AT NON-RATED DOORS)		BK	ZER

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HARDWARE SET # 711C

Each SGL door(s) to have:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP		652	IVE
1	EA	PANIC HARDWARE	99-NL-SNB		626	VON
1	EA	RIM CYLINDER	20-022		626	SCH
1	EA	SURFACE CLOSER	1461 SCUSH FC		689	LCN
			X MTG PLT/BRKT/SPCR AS REQ			
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
3	EA	SILENCER	SR64		GRY	IVE

HARDWARE SET # 711H

Each SGL door(s) to have:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP		652	IVE
1	EA	PANIC HARDWARE	99-NL-SNB		626	VON
1	EA	RIM CYLINDER	20-022		626	SCH
1	EA	SURFACE CLOSER	1461 HEDA FC		689	LCN
			X MTG PLT/BRKT/SPCR AS REQ			
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	FLOOR/WALL STOP	FS436/WS406CCV AS REQ		626	IVE
3	EA	SILENCER	SR64		GRY	IVE

HARDWARE SET # 714AM

Each PR door(s) to have:









QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
2	EA	CONT. HINGE	112XY		628	IVE
1	EA	FIRE RATED REMOVABLE MULLION	KR9954 STAB MT54		689	VON
1	EA	PANIC HARDWARE	99-DT-499F-SNB		626	VON
1	EA	PANIC HARDWARE	99-NL-499F-SNB		626	VON
1	EA	MORTISE CYLINDER	20-001		626	SCH
1	EA	RIM CYLINDER	20-022		626	SCH
2	EA	SURFACE CLOSER	4040XP SCUSH TBSRT		689	LCN
			X MTG PLT/BRKT/SPCR AS REQ			
1	EA	MULLION SEAL	8780NBK PSA		BK	ZER
1	SET	SEAL	PERIMETER SEAL BY FRAME MANUFACTURER			
2	EA	DOOR SWEEP	39A		A	ZER
1	EA	THRESHOLD	65A		A	ZER

DOOR MUST HAVE MIN. 5" STILE TO ACCOMMODATE SPECIFIED HARDWARE.

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HARDWARE SET # 801L

Each SGL door(s) to have:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5		652	IVE
1	EA	CLASSROOM DEADBOLT	B663P6 12-631		626	SCH
1	EA	PUSH PLATE	8200 8" X 16"		630	IVE
1	EA	PULL PLATE	8305 8" 3.5" X 15"		630	IVE
1	EA	SURFACE CLOSER	1461 RW/PA FC X MTG PLT/BRKT/SPCR AS REQ		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS406/407CCV		630	IVE
3	EA	SILENCER	SR64		GRY	IVE

HARDWARE SET # C201

Each SGL door(s) to have:







QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	POWER TRANSFER	EPT10 CON		689	VON
1	EA	VANDL EU STOREROOM	ND96P6DEU RHO RX CON 12V/24V DC		626	SCH
1	EA	SURFACE CLOSER	1461 RW/PA FC X MTG PLT/BRKT/SPCR AS REQ		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS406/407CCV		630	IVE
1	EA	GASKETING	488S PSA H & J (USE SILENCERS AT NON-RATED DOORS)		BK	ZER
1	EA	WIRE HARNESS (IN DOOR)	CON-XXP - LENGTH AS REQ			SCH
1	EA	HARNESS (TO POWER SUPPLY)	CON-6W - CONNECTION LEADS			SCH
1	EA	CREDENTIAL READER	BY SECURITY CONTRACTOR			
1	EA	DOOR CONTACT	BY SECURITY CONTRACTOR			
1	EA	POWER SUPPLY	BY SECURITY CONTRACTOR			

DOOR NORMALLY CLOSED AND LOCKED. ENTRY VIA VALID CREDENTIAL OR KEY OVERRIDE.  
FREE EGRESS AT ALL TIMES. DOOR TO REMAIN LOCKED UPON POWER FAILURE OR FIRE  
ALARM ACTIVATION. FAIL-SECURE.

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HARDWARE SET # C201C

Each SGL door(s) to have:








QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP - 3 EA PER LEAF AT DRS <90"		652	IVE
1	EA	POWER TRANSFER	EPT10 CON		689	VON
1	EA	VANDL EU STOREROOM	ND96P6DEU RHO RX CON 12V/24V DC		626	SCH
1	EA	SURFACE CLOSER	1461 SCUSH FC X MTG PLT/BRKT/SPCR AS REQ		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	GASKETING	488S PSA H & J (USE SILENCERS AT NON-RATED DOORS)		BK	ZER
1	EA	WIRE HARNESS (IN DOOR)	CON-XXP - LENGTH AS REQ			SCH
1	EA	HARNESS (TO POWER SUPPLY)	CON-6W - CONNECTION LEADS			SCH
1	EA	CREDENTIAL READER	BY SECURITY CONTRACTOR			
1	EA	DOOR CONTACT	BY SECURITY CONTRACTOR			
1	EA	POWER SUPPLY	BY SECURITY CONTRACTOR			

DOOR NORMALLY CLOSED AND LOCKED. ENTRY VIA VALID CREDENTIAL OR KEY OVERRIDE.  
 FREE EGRESS AT ALL TIMES. DOOR TO REMAIN LOCKED UPON POWER FAILURE OR FIRE  
 ALARM ACTIVATION. FAIL-SECURE.

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HARDWARE SET # C207

Each SGL door(s) to have:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	POWER TRANSFER	EPT10 CON		689	VON
1	EA	VANDL EU STOREROOM	ND96P6DEU RHO RX CON 12V/24V DC		626	SCH
1	EA	OH STOP	900S X SIZE & MOUNTING AS REQ		630	GLY
1	EA	SURFACE CLOSER	1461 RW/PA FC X MTG PLT/BRKT/SPCR AS REQ		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	GASKETING	488S PSA H & J (USE SILENCERS AT NON-RATED DOORS)		BK	ZER
1	EA	WIRE HARNESS (IN DOOR)	CON-XXP - LENGTH AS REQ			SCH
1	EA	HARNESS (TO POWER SUPPLY)	CON-6W - CONNECTION LEADS			SCH
1	EA	CREDENTIAL READER	BY SECURITY CONTRACTOR			
1	EA	DOOR CONTACT	BY SECURITY CONTRACTOR			
1	EA	POWER SUPPLY	BY SECURITY CONTRACTOR			









DOOR NORMALLY CLOSED AND LOCKED. ENTRY VIA VALID CREDENTIAL OR KEY OVERRIDE.  
FREE EGRESS AT ALL TIMES. DOOR TO REMAIN LOCKED UPON POWER FAILURE OR FIRE  
ALARM ACTIVATION. FAIL-SECURE.



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HARDWARE SET # C281

Each SGL door(s) to have:










QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	POWER TRANSFER	EPT10 CON		689	VON
1	EA	EU MORTISE LOCK	L9492P6EU 06A L583-363 RX DM CON 12/24 VDC		626	SCH
1	EA	OCCUPANCY INDICATOR	L283-414		626	SCH
1	EA	SURFACE CLOSER	1461 RW/PA FC X MTG PLT/BRKT/SPCR AS REQ		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	FLOOR/WALL STOP	FS436/WS406CCV AS REQ		626	IVE
1	EA	GASKETING	488S PSA H & J (USE SILENCERS AT NON-RATED DOORS)		BK	ZER
1	EA	COAT AND HAT HOOK	582		B26D	IVE
1	EA	WIRE HARNESS (IN DOOR)	CON-XXP - LENGTH AS REQ			SCH
1	EA	HARNESS (TO POWER SUPPLY)	CON-6W - CONNECTION LEADS			SCH
1	EA	CREDENTIAL READER	BY SECURITY CONTRACTOR			
1	EA	DOOR CONTACT	BY SECURITY CONTRACTOR			
1	EA	POWER SUPPLY	BY SECURITY CONTRACTOR			

DOOR NORMALLY CLOSED AND LOCKED. ENTRY VIA VALID CREDENTIAL OR KEY OVERRIDE.  
WHEN IN-USE, DM TO DE-ACTIVATE CARD ACCESS FOR PRIVACY. FREE EGRESS AT ALL  
TIMES. DOOR TO REMAIN LOCKED UPON POWER FAILURE OR FIRE ALARM ACTIVATION. FAIL-  
SECURE.

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GMS ARCHITECTS

HARDWARE SET # C710CAM

Each PR door(s) to have:













QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
2	EA	CONT. HINGE	112XY EPT		628	IVE
2	EA	POWER TRANSFER	EPT10 CON		689	VON
1	EA	FIRE RATED REMOVABLE MULLION	KR9954 STAB MT54		689	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-99-DT-499F-CON-SNB 24 VDC		626	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-99-NL-499F-CON-SNB 24 VDC		626	VON
1	EA	MORTISE CYLINDER	20-001		626	SCH
1	EA	RIM CYLINDER	20-022		626	SCH
2	EA	SURFACE CLOSER	1461 SCUSH FC		689	LCN
			X MTG PLT/BRKT/SPCR AS REQ			
1	EA	MULLION SEAL	8780NBK PSA		BK	ZER
1	SET	SEAL	PERIMETER SEAL BY FRAME MANUFACTURER			
2	EA	WIRE HARNESS (IN DOOR)	CON-XXP - LENGTH AS REQ			SCH
2	EA	HARNESS (TO POWER SUPPLY)	CON-6W - CONNECTION LEADS			SCH
1	EA	CREDENTIAL READER	BY SECURITY CONTRACTOR			
2	EA	DOOR CONTACT	BY SECURITY CONTRACTOR			
1	EA	POWER SUPPLY	BY SECURITY CONTRACTOR			

DOOR MUST HAVE MIN. 5" STILE TO ACCOMMODATE SPECIFIED HARDWARE.  
[OPERATIONAL DESCRIPTION] - DOOR NORMALLY CLOSED AND LOCKED. ENTRY VIA VALID  
CREDENTIAL OR KEY OVERRIDE. FREE EGRESS AT ALL TIMES. DOOR TO REMAIN LOCKED  
UPON POWER FAILURE OR FIRE ALARM ACTIVATION. FAIL-SECURE.

UTRGV / EDINBURG CISD COLLEGIATE HIGH SCHOOL  
GMS ARCHITECTS

HARDWARE SET # C710WMR

Each PR door(s) to have:









QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
6	EA	HINGE	5BB1HW 5 X 4.5 NRP		652	IVE
2	EA	POWER TRANSFER	EPT10 CON		689	VON
1	EA	FIRE RATED REMOVABLE MULLION	KR9954 STAB MT54		689	VON
1	EA	ELEC FIRE EXIT HARDWARE	RX-99-EO-F-499F-CON-SNB - LENGTH AS REQ		626	VON
1	EA	ELEC FIRE EXIT HARDWARE	RX-QEL-99-NL-F-499F-CON-SNB 24 VDC - LENGTH AS REQ		626	VON
1	EA	MORTISE CYLINDER	20-001		626	SCH
1	EA	RIM CYLINDER	20-022		626	SCH
2	EA	SURFACE CLOSER	1461 SCUSH FC X MTG PLT/BRKT/SPCR AS REQ		689	LCN
2	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	GASKETING SET	188S PSA H & J		BK	ZER
1	SET	MEETING STILE	328AA (2 PCS - 1 SET)		AA	ZER
1	EA	MULLION SEAL	8780NBK PSA		BK	ZER
2	EA	WIRE HARNESS (IN DOOR)	CON-XXP - LENGTH AS REQ			SCH
2	EA	HARNESS (TO POWER SUPPLY)	CON-6W - CONNECTION LEADS			SCH
1	EA	CREDENTIAL READER	BY SECURITY CONTRACTOR			
2	EA	DOOR CONTACT	BY SECURITY CONTRACTOR			
1	EA	POWER SUPPLY	BY SECURITY CONTRACTOR			

DOOR NORMALLY CLOSED AND LOCKED. ENTRY VIA VALID CREDENTIAL OR KEY OVERRIDE. FREE EGRESS AT ALL TIMES. DOOR TO REMAIN LOCKED UPON POWER FAILURE OR FIRE ALARM ACTIVATION. FAIL-SECURE.

UTRGV / EDINBURG CISD COLLEGIATE HIGH SCHOOL  
GMS ARCHITECTS

HARDWARE SET # C711









Each SGL door(s) to have:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP		652	IVE
1	EA	POWER TRANSFER	EPT10 CON		689	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-99-NL-CON-SNB 24 VDC		626	VON
1	EA	RIM CYLINDER	20-022		626	SCH
1	EA	SURFACE CLOSER	1461 EDA FC		689	LCN
			X MTG PLT/BRKT/SPCR AS REQ			
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	FLOOR/WALL STOP	FS436/WS406CCV AS REQ		626	IVE
3	EA	SILENCER	SR64		GRY	IVE
1	EA	WIRE HARNESS (IN DOOR)	CON-XXP - LENGTH AS REQ			SCH
1	EA	HARNESS (TO POWER SUPPLY)	CON-6W - CONNECTION LEADS			SCH
1	EA	CREDENTIAL READER	BY SECURITY CONTRACTOR			
1	EA	DOOR CONTACT	BY SECURITY CONTRACTOR			
1	EA	POWER SUPPLY	BY SECURITY CONTRACTOR			

DOOR NORMALLY CLOSED AND LOCKED. ENTRY VIA VALID CREDENTIAL OR KEY OVERRIDE. FREE EGRESS AT ALL TIMES. DOOR TO REMAIN LOCKED UPON POWER FAILURE OR FIRE ALARM ACTIVATION. FAIL-SECURE.

HARDWARE SET # C711W

Each SGL door(s) to have:













QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1HW 5 X 4.5 NRP		652	IVE
1	EA	POWER TRANSFER	EPT10 CON		689	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-99-NL-CON-SNB 24 VDC		626	VON
			- LENGTH AS REQ			
1	EA	RIM CYLINDER	20-022		626	SCH
1	EA	SURFACE CLOSER	1461 EDA FC		689	LCN
			X MTG PLT/BRKT/SPCR AS REQ			
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	FLOOR/WALL STOP	FS436/WS406CCV AS REQ		626	IVE
3	EA	SILENCER	SR64		GRY	IVE
1	EA	WIRE HARNESS (IN DOOR)	CON-XXP - LENGTH AS REQ			SCH
1	EA	HARNESS (TO POWER SUPPLY)	CON-6W - CONNECTION LEADS			SCH
1	EA	CREDENTIAL READER	BY SECURITY CONTRACTOR			
1	EA	DOOR CONTACT	BY SECURITY CONTRACTOR			
1	EA	POWER SUPPLY	BY SECURITY CONTRACTOR			

DOOR NORMALLY CLOSED AND LOCKED. ENTRY VIA VALID CREDENTIAL OR KEY OVERRIDE. FREE EGRESS AT ALL TIMES. DOOR TO REMAIN LOCKED UPON POWER FAILURE OR FIRE ALARM ACTIVATION. FAIL-SECURE.

UTRGV / EDINBURG CISD COLLEGIATE HIGH SCHOOL  
GMS ARCHITECTS

HARDWARE SET # C714AM

Each PR door(s) to have:
















QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
2	EA	CONT. HINGE	112XY EPT		628	IVE
2	EA	POWER TRANSFER	EPT10 CON		689	VON
1	EA	FIRE RATED REMOVABLE MULLION	KR9954 STAB MT54		689	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-99-DT-499F-CON-SNB 24 VDC		626	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-99-NL-499F-CON-SNB 24 VDC		626	VON
1	EA	MORTISE CYLINDER	20-001		626	SCH
1	EA	RIM CYLINDER	20-022		626	SCH
2	EA	SURFACE CLOSER	4040XP SCUSH TBSRT X MTG PLT/BRKT/SPCR AS REQ		689	LCN
2	EA	FLOOR STOP	FS18L		BLK	IVE
1	EA	MULLION SEAL	8780NBK PSA		BK	ZER
1	SET	SEAL	PERIMETER SEAL BY FRAME MANUFACTURER			
2	EA	DOOR SWEEP	39A		A	ZER
1	EA	THRESHOLD	65A		A	ZER
2	EA	WIRE HARNESS (IN DOOR)	CON-XXP - LENGTH AS REQ			SCH
2	EA	HARNESS (TO POWER SUPPLY)	CON-6W - CONNECTION LEADS			SCH
1	EA	CREDENTIAL READER	BY SECURITY CONTRACTOR			
2	EA	DOOR CONTACT	BY SECURITY CONTRACTOR			
1	EA	POWER SUPPLY	BY SECURITY CONTRACTOR			

DOOR MUST HAVE MIN. 5" STILE TO ACCOMMODATE SPECIFIED HARDWARE.  
[OPERATIONAL DESCRIPTION] - DOOR NORMALLY CLOSED AND LOCKED. ENTRY VIA VALID  
CREDENTIAL OR KEY OVERRIDE. FREE EGRESS AT ALL TIMES. DOOR TO REMAIN LOCKED  
UPON POWER FAILURE OR FIRE ALARM ACTIVATION. FAIL-SECURE.

UTRGV / EDINBURG CISD COLLEGIATE HIGH SCHOOL  
GMS ARCHITECTS

HARDWARE SET # C714MR

Each PR door(s) to have:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
6	EA	HINGE	5BB1HW 4.5 X 4.5 NRP		630	IVE
2	EA	POWER TRANSFER	EPT10 CON		689	VON
1	EA	FIRE RATED REMOVABLE MULLION	KR9954 STAB MT54		689	VON
1	EA	ELEC FIRE EXIT HARDWARE	RX-99-EO-F-499F-CON-SNB		626	VON
1	EA	ELEC FIRE EXIT HARDWARE	RX-QEL-99-NL-F-499F-CON-SNB 24 VDC		626	VON
1	EA	MORTISE CYLINDER	20-001		626	SCH
1	EA	RIM CYLINDER	20-022		626	SCH
2	EA	SURFACE CLOSER	4040XP SCUSH TBSRT X MTG PLT/BRKT/SPCR AS REQ		689	LCN
2	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	RAIN DRIP	142A DW + 4" (OMIT @ COVERED AREAS)		AA	ZER
1	EA	GASKETING SET	188S PSA H & J		BK	ZER
1	SET	MEETING STILE	328AA (2 PCS - 1 SET)		AA	ZER
1	EA	MULLION SEAL	8780NBK PSA		BK	ZER
2	EA	DOOR SWEEP	39A		A	ZER
1	EA	THRESHOLD	65A		A	ZER
2	EA	WIRE HARNESS (IN DOOR)	CON-XXP - LENGTH AS REQ			SCH
2	EA	HARNESS (TO POWER SUPPLY)	CON-6W - CONNECTION LEADS			SCH
1	EA	CREDENTIAL READER	BY SECURITY CONTRACTOR			
2	EA	DOOR CONTACT	BY SECURITY CONTRACTOR			
1	EA	POWER SUPPLY	BY SECURITY CONTRACTOR			

DOOR NORMALLY CLOSED AND LOCKED. ENTRY VIA VALID CREDENTIAL OR KEY OVERRIDE.  
FREE EGRESS AT ALL TIMES. DOOR TO REMAIN LOCKED UPON POWER FAILURE OR FIRE  
ALARM ACTIVATION. FAIL-SECURE.

UTRGV / EDINBURG CISD COLLEGIATE HIGH SCHOOL  
GMS ARCHITECTS

HARDWARE SET # C714WMR

Each PR door(s) to have:











QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
6	EA	HINGE	5BB1HW 5 X 4.5 NRP		630	IVE
2	EA	POWER TRANSFER	EPT10 CON		689	VON
1	EA	FIRE RATED REMOVABLE MULLION	KR9954 STAB MT54		689	VON
1	EA	ELEC FIRE EXIT HARDWARE	RX-99-EO-F-499F-CON-SNB - LENGTH AS REQ		626	VON
1	EA	ELEC FIRE EXIT HARDWARE	RX-QEL-99-NL-F-499F-CON-SNB 24 VDC - LENGTH AS REQ		626	VON
1	EA	MORTISE CYLINDER	20-001		626	SCH
1	EA	RIM CYLINDER	20-022		626	SCH
2	EA	SURFACE CLOSER	4040XP SCUSH TBSRT X MTG PLT/BRKT/SPCR AS REQ		689	LCN
2	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	RAIN DRIP	142A DW + 4" (OMIT @ COVERED AREAS)		AA	ZER
1	EA	GASKETING SET	188S PSA H & J		BK	ZER
1	SET	MEETING STILE	328AA (2 PCS - 1 SET)		AA	ZER
1	EA	MULLION SEAL	8780NBK PSA		BK	ZER
2	EA	DOOR SWEEP	39A		A	ZER
1	EA	THRESHOLD	65A		A	ZER
2	EA	WIRE HARNESS (IN DOOR)	CON-XXP - LENGTH AS REQ			SCH
2	EA	HARNESS (TO POWER SUPPLY)	CON-6W - CONNECTION LEADS			SCH
1	EA	CREDENTIAL READER	BY SECURITY CONTRACTOR			
2	EA	DOOR CONTACT	BY SECURITY CONTRACTOR			
1	EA	POWER SUPPLY	BY SECURITY CONTRACTOR			

DOOR NORMALLY CLOSED AND LOCKED. ENTRY VIA VALID CREDENTIAL OR KEY OVERRIDE.  
FREE EGRESS AT ALL TIMES. DOOR TO REMAIN LOCKED UPON POWER FAILURE OR FIRE  
ALARM ACTIVATION. FAIL-SECURE.

UTRGV / EDINBURG CISD COLLEGIATE HIGH SCHOOL  
GMS ARCHITECTS

HARDWARE SET # C715

Each SGL door(s) to have:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP		630	IVE
1	EA	POWER TRANSFER	EPT10 CON		689	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-99-NL-CON-SNB 24 VDC		626	VON
1	EA	RIM CYLINDER	20-022		626	SCH
1	EA	SURFACE CLOSER	4040XP SCUSH TBSRT X MTG PLT/BRKT/SPCR AS REQ		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	RAIN DRIP	142A DW + 4" (OMIT @ COVERED AREAS)		AA	ZER
1	EA	GASKETING SET	188S PSA H & J		BK	ZER
1	EA	DOOR SWEEP	39A		A	ZER
1	EA	THRESHOLD	65A		A	ZER
1	EA	WIRE HARNESS (IN DOOR)	CON-XXP - LENGTH AS REQ			SCH
1	EA	HARNESS (TO POWER SUPPLY)	CON-6W - CONNECTION LEADS			SCH
1	EA	CREDENTIAL READER	BY SECURITY CONTRACTOR			
1	EA	DOOR CONTACT	BY SECURITY CONTRACTOR			
1	EA	POWER SUPPLY	BY SECURITY CONTRACTOR			








DOOR NORMALLY CLOSED AND LOCKED. ENTRY VIA VALID CREDENTIAL OR KEY OVERRIDE.  
FREE EGRESS AT ALL TIMES. DOOR TO REMAIN LOCKED UPON POWER FAILURE OR FIRE  
ALARM ACTIVATION. FAIL-SECURE.



UTRGV / EDINBURG CISD COLLEGIATE HIGH SCHOOL  
GMS ARCHITECTS

HARDWARE SET # C715A

Each SGL door(s) to have:












QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	CONT. HINGE	112XY EPT		628	IVE
1	EA	POWER TRANSFER	EPT10 CON		689	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-99-NL-CON-SNB 24 VDC		626	VON
1	EA	RIM CYLINDER	20-022		626	SCH
1	EA	SURFACE CLOSER	4040XP SCUSH TBSRT		689	LCN
1	SET	SEAL	X MTG PLT/BRKT/SPCR AS REQ PERIMETER SEAL BY FRAME MANUFACTURER			
1	EA	DOOR SWEEP	39A		A	ZER
1	EA	THRESHOLD	65A		A	ZER
1	EA	WIRE HARNESS (IN DOOR)	CON-XXP - LENGTH AS REQ			SCH
1	EA	HARNESS (TO POWER SUPPLY)	CON-6W - CONNECTION LEADS			SCH
1	EA	CREDENTIAL READER	BY SECURITY CONTRACTOR			
1	EA	DOOR CONTACT	BY SECURITY CONTRACTOR			
1	EA	POWER SUPPLY	BY SECURITY CONTRACTOR			

DOOR MUST HAVE MIN. 5" STILE TO ACCOMMODATE SPECIFIED HARDWARE.[OPERATIONAL DESCRIPTION] - DOOR NORMALLY CLOSED AND LOCKED. ENTRY VIA VALID CREDENTIAL OR KEY OVERRIDE. FREE EGRESS AT ALL TIMES. DOOR TO REMAIN LOCKED UPON POWER FAILURE OR FIRE ALARM ACTIVATION. FAIL-SECURE.

UTRGV / EDINBURG CISD COLLEGIATE HIGH SCHOOL  
GMS ARCHITECTS

HARDWARE SET # C715WVR

Each SGL door(s) to have:







QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1HW 5 X 4.5 NRP		630	IVE
1	EA	POWER TRANSFER	EPT10 CON		689	VON
1	EA	ELEC FIRE EXIT HARDWARE	RX-QEL-99-NL-F-CON-SNB 24 VDC		626	VON
1	EA	RIM CYLINDER	20-022		626	SCH
1	EA	SURFACE CLOSER	4040XP SCUSH TBSRT X MTG PLT/BRKT/SPCR AS REQ		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	RAIN DRIP	142A DW + 4" (OMIT @ COVERED AREAS)		AA	ZER
1	EA	GASKETING SET	188S PSA H & J		BK	ZER
1	EA	DOOR SWEEP	39A		A	ZER
1	EA	THRESHOLD	65A		A	ZER
1	EA	VIEWER	U698		626	IVE
1	EA	WIRE HARNESS (IN DOOR)	CON-XXP - LENGTH AS REQ			SCH
1	EA	HARNESS (TO POWER SUPPLY)	CON-6W - CONNECTION LEADS			SCH
1	EA	CREDENTIAL READER	BY SECURITY CONTRACTOR			
1	EA	DOOR CONTACT	BY SECURITY CONTRACTOR			
1	EA	POWER SUPPLY	BY SECURITY CONTRACTOR			

DOOR NORMALLY CLOSED AND LOCKED. ENTRY VIA VALID CREDENTIAL OR KEY OVERRIDE.  
FREE EGRESS AT ALL TIMES. DOOR TO REMAIN LOCKED UPON POWER FAILURE OR FIRE  
ALARM ACTIVATION. FAIL-SECURE.

UTRGV / EDINBURG CISD COLLEGIATE HIGH SCHOOL  
GMS ARCHITECTS

HARDWARE SET # CR201A

Each SGL door(s) to have:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	CONT. HINGE	112XY		628	IVE
1	EA	VANDL STOREROOM LOCK	ND96P6D RHO		626	SCH
1	EA	ELECTRIC STRIKE	6211 FSE CON 12/16/24/28 VAC/VDC		630	VON
1	EA	SURFACE CLOSER	1461 RW/PA FC X MTG PLT/BRKT/SPCR AS REQ		689	LCN
1	EA	FLOOR/WALL STOP	FS436/WS406CCV AS REQ		626	IVE
1	SET	SEAL	PERIMETER SEAL BY FRAME MANUFACTURER			
1	EA	HARNESS (TO POWER SUPPLY)	CON-6W - CONNECTION LEADS			SCH
1	EA	CREDENTIAL READER	BY SECURITY CONTRACTOR			
1	EA	REMOTE RELEASE BUTTON	660-PB X BY SECURITY CONTRACTOR		628	SCE
1	EA	DOOR CONTACT	BY SECURITY CONTRACTOR			
1	EA	POWER SUPPLY	BY SECURITY CONTRACTOR			

DOOR MUST HAVE MIN. 5" STILE TO ACCOMMODATE SPECIFIED HARDWARE.  
[OPERATIONAL DESCRIPTION] - DOOR NORMALLY CLOSED AND LOCKED FROM LOBBY. ENTRY  
VIA VALID CREDENTIAL, REMOTE RELEASE BY RECEPTIONIST OR KEY OVERRIDE. DOOR TO  
REMAIN LOCKED UPON POWER FAILURE OR FIRE ALARM ACTIVATION. FAIL-SECURE.

UTRGV / EDINBURG CISD COLLEGIATE HIGH SCHOOL  
GMS ARCHITECTS

HARDWARE SET # CR201AC

Each SGL door(s) to have:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CONT. HINGE	112XY	628	IVE
1	EA	VANDL STOREROOM LOCK	ND96P6D RHO	626	SCH
1	EA	ELECTRIC STRIKE	6211 FSE CON 12/16/24/28 VAC/VDC	630	VON
1	EA	SURFACE CLOSER	1461 SCUSH FC X MTG PLT/BRKT/SPCR AS REQ	689	LCN
1	SET	SEAL	PERIMETER SEAL BY FRAME MANUFACTURER		
1	EA	HARNESS (TO POWER SUPPLY)	CON-6W - CONNECTION LEADS		SCH
1	EA	CREDENTIAL READER	BY SECURITY CONTRACTOR		
1	EA	REMOTE RELEASE BUTTON	660-PB X BY SECURITY CONTRACTOR	628	SCE
1	EA	DOOR CONTACT	BY SECURITY CONTRACTOR		
1	EA	POWER SUPPLY	BY SECURITY CONTRACTOR		

DOOR MUST HAVE MIN. 5" STILE TO ACCOMMODATE SPECIFIED HARDWARE.  
[OPERATIONAL DESCRIPTION] - DOOR NORMALLY CLOSED AND LOCKED. ENTRY VIA VALID  
CREDENTIAL, REMOTE RELEASE BY RECEPTIONIST OR KEY OVERRIDE. FREE EGRESS AT ALL  
TIMES. DOOR TO REMAIN LOCKED UPON POWER FAILURE OR FIRE ALARM ACTIVATION. FAIL-  
SECURE.

END OF SECTION

## SECTION 088000 - GLAZING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Glass products.
  - 2. Laminated glass.
  - 3. Insulating glass.
  - 4. Glazing sealants.
  - 5. Glazing tapes.
  - 6. Miscellaneous glazing materials.

#### 1.2 COORDINATION

- A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

#### 1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Glass Samples: For each type of glass product other than clear monolithic vision glass; 12 inches square.
- C. Delegated-Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by qualified professional engineer responsible for their preparation.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For glass.
- B. Product test reports.
- C. Preconstruction adhesion and compatibility test report.
- D. Sample warranties.

## 1.6 QUALITY ASSURANCE

- A. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C1021 to conduct the testing indicated.
- B. Impact Resistant Glass: Exterior Doors and Windows:  
In addition, all exterior glazed openings will need to be specified as impact rated assemblies meeting ASTM E 1886 and ASTM E 1996 for large missile impact.
- C. The contractor shall submit shop drawings and test reports indicating the proposed window and exterior door assemblies meet the noted project design wind pressure requirements. Laminated glazing shall match window and door tested assemblies for glass thickness, heat treatment, and laminate thickness.

## 1.7 WARRANTY

- A. Manufacturer's Special Warranty for Insulating Glass: 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 obstruction of vision by dust, moisture, or film on interior surfaces of glass.
  - 1. Warranty Period: 10 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Glazing shall withstand the following design loads within limits and under conditions indicated determined in accordance with the IBC and ASTM E1300:
  - 1. Design Wind Pressures: As indicated on Structural Drawings.
  - 2. Differential Shading: Design glass to resist thermal stresses induced by differential shading within individual glass lites.
- B. Windborne-Debris-Impact Resistance: Exterior glazing shall pass ASTM E1886 missile-impact and cyclic-pressure tests in accordance with ASTM E1996 for Wind Zone 4 for basic protection.
  - 1. Large-Missile Test: For glazing located within 30 feet of grade.
- C. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.
- D. 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. U-Factors: Center-of-glazing values, in accordance with NFRC 100 and based on LBL's WINDOW 7 computer program, expressed as Btu/sq. ft. x h x deg F.
2. SHGC and Visible Transmittance: Center-of-glazing values, in accordance with NFRC 200 and based on LBL's WINDOW 7 computer program.
3. Visible Reflectance: Center-of-glazing values, in accordance with NFRC 300.

## 2.2 GLASS PRODUCTS, GENERAL

- A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.
  1. NGA Publications: "Laminated Glazing Reference Manual" and "Glazing Manual."
  2. AAMA Publications: AAMA GDSG-1, "Glass Design for Sloped Glazing," and AAMA TIR A7, "Sloped Glazing Guidelines."
  3. IGMA Publication for Sloped Glazing: IGMA TB-3001, "Guidelines for Sloped Glazing."
  4. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."
- B. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
- C. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of the IGCC.
- D. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass that complies with performance requirements and is not less than thickness indicated.
- E. Strength: Where annealed float glass is indicated, provide annealed float glass, heat-strengthened float glass, or fully tempered float glass. Where heat-strengthened float glass is indicated, provide heat-strengthened float glass or fully tempered float glass. Where fully tempered float glass is indicated, provide fully tempered float glass.

## 2.3 GLASS PRODUCTS

- A. Clear Annealed Float Glass: ASTM C1036, Type I, Class 1 (clear), Quality-Q3.
  1. Provide a manufacturer from the following:
    - a. AGC Glass Company North America, Inc.
    - b. Pilkington North America
    - c. Guardian Glass; SunGuard
- B. Ultraclear Annealed Float Glass: ASTM C1036, Type I, Class I (clear), Quality-Q3; and with visible light transmission of not less than 91 percent and SHGC of not less than 0.87.
  1. Provide a manufacturer from the following:
    - a. AGC Glass Company North America, Inc.

- b. Pilkington North America
  - c. Guardian Glass; SunGuard
- C. Tinted Annealed Float Glass: ASTM C1036, Type I, Class 2 (tinted), Quality-Q3.
  - 1. Provide a manufacturer from the following:
    - a. AGC Glass Company North America, Inc.
    - b. Pilkington North America
    - c. Guardian Glass; SunGuard
- D. Fully Tempered Float Glass: ASTM C1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.
- E. Heat-Strengthened Float Glass: ASTM C1048, Kind HS (heat strengthened), Type I, Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.
- F. Reflective- and Low-E-Coated Vision Glass: ASTM C1376.
  - 1. Provide a manufacturer from the following:
    - a. Vitro Architectural Glass
    - b. Guardian Glass; SunGuard
    - c. Pilkington North America
- G. Ceramic-Coated Vision Glass: ASTM C1048, Condition C, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3; and complying with Specification No. 95-1-31 in NGA's "Engineering Standards Manual."

## 2.4 LAMINATED GLASS

- A. Windborne-Debris-Impact-Resistant Laminated Glass: Comply with requirements specified above for laminated glass except laminate glass with the following to comply with interlayer manufacturer's written instructions:
  - 1. Provide a manufacturer from the following:
    - a. Eastman Chem. Co
    - b. Kuraray Buticite
  - 2. Construction: Laminate glass with polyvinyl butyral interlayer reinforced with polyethylene terephthalate film to comply with interlayer manufacturer's written instructions.
  - 3. Interlayer Thickness: Provide thickness not less than that indicated and as needed to comply with requirements.
  - 4. Interlayer Color: Clear unless otherwise indicated.



## 2.5 INSULATING GLASS

- A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified in accordance with ASTM E2190.
  - 1. Sealing System: Dual seal, with manufacturer's standard primary and secondary sealants.
  - 2. Perimeter Spacer: Manufacturer's standard spacer material and construction
    - a. Provide a manufacturer from the following:
      - 1) Technoform
      - 2) Thermix; a brand of Ensinger USA
  - 3. Desiccant: Molecular sieve or silica gel, or a blend of both.

## 2.6 GLAZING SEALANTS

- A. General:
  - 1. Compatibility: Compatible with one another and with other materials they contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
  - 2. 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.
  - 3. Colors of Exposed Glazing Sealants: As indicated by manufacturer's designations.
- B. Neutral-Curing Silicone Glazing Sealant, Class 50: Complying with ASTM C920, Type S, Grade NS, Use NT.

## 2.7 GLAZING TAPES

- A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as 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.
- B. 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 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.

## 2.8 MISCELLANEOUS GLAZING MATERIALS

- A. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- B. Setting Blocks:
  - 1. Neoprene with Shore A durometer hardness of 85, plus or minus 5.
  - 2. Type recommended in writing by sealant or glass manufacturer.
- C. Spacers:
  - 1. Neoprene blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
  - 2. Type recommended in writing by sealant or glass manufacturer.
- D. Edge Blocks:
  - 1. Neoprene with Shore A durometer hardness per manufacturer's written instructions.
  - 2. Type recommended in writing by sealant or glass manufacturer.
- E. 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.

## PART 3 - EXECUTION

### 3.1 GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. 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.

- 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 in accordance with requirements in referenced glazing publications.

### 3.2 TAPE GLAZING

- A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.
- B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.
- C. 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.
- D. 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.
- E. Apply heel bead of elastomeric sealant.
- F. 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.
- G. Apply cap bead of elastomeric sealant over exposed edge of tape.

### 3.3 GASKET GLAZING (DRY)

- A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
- B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
- C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended in writing by gasket manufacturer.
- D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended in writing by gasket manufacturer.
- E. Install gaskets so they protrude past face of glazing stops.

### 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, despite such protection, contaminating substances do 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.

### 3.5 MONOLITHIC GLASS SCHEDULE

- A. Clear Glass Type: Fully tempered float glass.
  - 1. Minimum Thickness: 6 mm.
  - 2. Safety glazing required.

### 3.6 LAMINATED GLASS SCHEDULE

- 1. Sealed insulating glass units. The sealed insulating glass unit is comprised of a laminated glass unit and a 1/4" fully tempered glass lite separated by a desiccant-filled spacer system. The laminated glass unit is comprised of (2) 1/4" heat strengthened glass lites with a 0.090 SentryGlass Plus interlayer. The glass thickness and type used in the insulating glass unit shall comply with ASTM E 1300-04. Total Thickness= 1-5/16.

#### A. Insulating Glass Unit Make-up (Solarban 70 XL)

- Outboard Lite 1/4"
  - 1. Glass Type: Low-E Coated
  - 2. Glass Tint: Clear
  - 3. Glass Strength: (Heat-Strengthened or Tempered)
  - 4. Coating Orientation: Surface #2
- Spacer
  - 1. Nominal Thickness: 1/2"
  - 2. Gas Fill: Air
- Inboard Lite 1/4"
  - 1. Glass Type: Uncoated
  - 2. Glass Tint: Clear
  - 3. Glass Strength: (Annealed, Heat-Strengthened or Tempered)
  - 4. Coating Orientation: NA

#### B. Performance Characteristics (Center of Glass)

(Note: Verify that the glass type and thickness specified matches the Performance Characteristics listed below.)

- Visible Transmittance: 64%
- Visible Reflectance: 12%
- Winter U-Factor (U-Value): 0.28
- Shading Coefficient (SC): 0.27
- Solar Heat Gain Coefficient (SHGC): 0.32

C. Provide hermetically sealed IG units with dehydrated airspace, dual sealed with a primary seal of polyisobutylene (PIB), or thermo plastic spacer (TPS) and a secondary seal of silicone or an organic sealant depending on the application.

END OF SECTION 088000

## SECTION 092600 - GYPSUM BOARD ASSEMBLIES

### PART 1 - GENERAL

#### RELATED DOCUMENTS

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 General Requirements sections, apply to work of this section.

#### DESCRIPTION OF WORK:

Types of work include:

Gypsum drywall including screw type metal support system

Drywall finishing (joint tape and compound treatment)

Gypsum Sheathing

#### QUALITY ASSURANCE:

Fire Resistance Rating: Where gypsum drywall systems with fire resistance ratings are indicated or are required to comply with governing regulations, provide materials and installations identical with applicable assemblies which have been tested and listed by recognized authorities, including UL and AIA.

Gypsum Board Terminology Standard: GA 505 by Gypsum Association.

Single Source Responsibility: Obtain gypsum board products from a single manufacturer, or from manufacturers recommended by the prime manufacturer of gypsum boards.

#### SUBMITTALS:

Product Data: Submit manufacturer's product specifications and installation instructions for each gypsum drywall component, including other data as may be required to show compliance with these specifications.

#### DELIVERY, STORAGE AND HANDLING:

Deliver materials in original packages, containers or bundles bearing brand name and identification of manufacturer or supplier.

Store materials inside under cover and in manner to keep them dry, protected from weather, direct sunlight, surface contamination, corrosion and damage from construction traffic and other causes. Neatly stack gypsum boards flat to prevent sagging.

Handle gypsum boards to prevent damage to edges, ends or surfaces. Protect metal corner beads and trim from being bent or damaged.

#### PROJECT CONDITIONS:

Environmental Requirements, General: Comply with requirements of referenced gypsum board application standards and recommendations of gypsum board manufacturer, for environmental conditions before, during and after application of gypsum board.

Cold Weather Protection: When ambient outdoor temperatures are below 55 degrees F (13 degree C) maintain continuous, uniform, comfortable building working temperatures of not less than 55 degree F (13 degree C) for a minimum period of 48 hours prior to, during and following application of gypsum board and joint treatment materials or bonding of adhesives.

Ventilation: Ventilate building spaces as required to remove water in excess of that required for drying of joint treatment material immediately after its application. Avoid drafts during dry, hot weather to prevent too rapid drying.

## PART 2 PRODUCTS

### 2.0 ACCEPTABLE MANUFACTURERS

#### Metal Support Materials:

Gold Bond Building Products Div., National Gypsum Co.  
Milcor Division; Inryco Inc.  
United States Gypsum Co.

#### Direct Suspension Systems:

Chicago Metallic Corp.  
Donn Corporation.  
National Rolling Mills Co.  
Roblin Building Products, Inc.  
United States Gypsum Co.

#### Gypsum Board and Related Products:

Gold Bond Building Products Div., National Gypsum Co.  
United States Gypsum Co.

## METAL SUPPORT MATERIALS:

### Ceiling Support Materials and Systems:

General: Size ceiling support components to comply with ASTM C 754 unless indicated otherwise, hot dipped galvanized at exterior walls.

Main Runners: Steel channels with rust inhibitive paint finish, hot or cold rolled.

Hanger Wire: ASTM A 641, soft, Class 1 galvanized.

Hanger Anchorage Devices: Screws, clips, bolts, cast in place concrete inserts or other devices applicable to the indicated method of structural anchorage for ceiling hangers and whose suitability for use intended has been proven through standard construction practices or by certified test data. Size devices for 3x calculated load supported except size direct pull out concrete inserts for 5x calculated loads.

Furring Members: ASTM C 645; 0.0179" min. thickness of base metal, hat shaped.

Where shown as "Resilient", provide manufacturer's special type designed to reduce

sound transmission.

Furring Members: ASTM C 645; 0.0179" min. thickness of base metal, C shaped studs.

Furring Anchorages: 16 gage galvanized wire ties, manufacturer's standard wire type clips, bolts, nails or screws as recommended by furring manufacturer and complying with C 754.

Direct Suspension Systems: Manufacturer's standard zinc coated or painted steel system of furring runners, furring tees, and accessories designed for concealed support of gypsum drywall ceilings; of proper type for use intended.

Wall/Partition Support Materials:

Exterior Studs: Refer to Structural

Interior Studs: Refer to schedule in Section 3.2.

Depth of Section: 6", except as otherwise indicated.

Deflection System: Provide Slotted Deflection Track at all interior partitions.

Suspended Drywall System: Equal to Armstrong Drywall Grid System

Shaft Wall System: Equal to USG Shaftwall System at elevator/mechanical shafts. Provide and install system with C-H profile studs.

Runners: Match studs; type recommended by stud manufacturer for floor and ceiling support of studs, and for vertical abutment of drywall work at other work.

Furring Members: ASTM C 645; 0.0179" min. thickness of base metal, hat shaped. Where shown as "Resilient," provide manufacturer's special type designed to reduce sound transmission.

Z Furring Members: Manufacturer's standard screw type galvanized steel, zee shaped furring members; ASTM A 525, G60, 0.0179" min. thickness of base metal; of depth indicated; designed for mechanical attachment of insulation boards or blankets to monolithic concrete and masonry walls. Hot dipped galvanized at exterior walls.

Fasteners for Furring Members: Type and size recommended by furring manufacturer for substrate and application indicated.

## 2.1 GYPSUM BOARD PRODUCTS

A. Sizes: Maximum lengths and widths available that will minimize short edge-to-short edge butt joints

and to correspond to support system indicated.

B. Typical Paper-Faced Gypsum Board Products:

1. Paper-Faced Type X Gypsum Board:

a. Material Quality Standard: ASTM C 1396 / C 1396M, Type X.

b. Description: Noncombustible fire resistant gypsum core with paper surfacing on face, back, and long edges; tapered long edges; 5/8 in (15 mm) thick.

c. Manufacturers and Products:

1) CertainTeed Corporation; ProRoc Type X Gypsum Board

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- 2) Georgia-Pacific Gypsum LLC; ToughRock Fireguard Gypsum Board.
- 3) National Gypsum Company; Gold Bond Fire-Shield Gypsum board.
- 4) United States Gypsum Company (USG); Sheetrock Firecode Core.
- 5) USG SHEETROCK® BRAND FIRECODE® X PANELS

C. Moisture-Resistant Gypsum Board Products:

1. Moisture-Resistant Paper-Faced Gypsum Board:

- a. Material Quality Standard: ASTM C 1396 / C 1396M, Type X.
- b. Description: Enhanced moisture-resistant, noncombustible gypsum core, with moisture-resistant paper surfacing on face, back and long edges; tapered long edges; score of 10 according to ASTM D 3273; 5/8 in (15 mm) thick.
- c. Manufacturers and Products:
  - 1) CertainTeed Corporation; ProRoc Moisture and Mold Resistant Type X Gypsum Board.
  - 2) National Gypsum Company; Gold Bond XP Gypsum Board.
  - 3) ~~United States Gypsum Company (USG); Sheetrock Mold Tough Firecode Gypsum Board.~~
  - 4) USG Sheetrock® Brand Mold Tough® Panels Firecode® X

2. Moisture-Resistant Paperless Glass-Mat Gypsum Board:

- a. Material Quality Standard: ASTM C 1658 / C 1658M.
- b. Description: Enhanced moisture-resistant, noncombustible gypsum core with inorganic, embedded fiberglass mat on both faces; square edges; score or 10 according to ASTM D 3273; 5/8 in thick.
- c. Manufacturers and Products:
  - 1) Georgia-Pacific Gypsum LLC; DensArmor Plus Fireguard Interior Guard.
  - 2) National Gypsum Company; eXP Interior Extreme Gypsum Panels.
  - 3) USG Durock™ Brand Glass-Mat Tile Backerboard moisture- and mold-resistant gypsum

3. Moisture-Resistant, Abuse-Resistant Gypsum Board Products:

- a. Material Quality Standard: ASTM C 1629, Type X, and as follows:
  - 1) Soft Body Impact Test: ASTM E 695, Classification Level 2.
  - 2) Hard Body Impact Test: Annex A1, Classification Level 1.
  - 3) Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D3274.
- b. Paper-Faced Products: Specially formulated, noncombustible, gypsum core with heavy liner paper on back and smooth, heavy abrasive-resistant face paper on face and long edges; manufactured to produce greater resistance to surface indentation and through-penetration than typical gypsum panels; tapered long edges; 5/8" thick.
  - 1) Manufacturers and Products:
    - a) CertainTeed Corporation; Air Renew Extreme Abuse.
    - b) National Gypsum Company: Gold Bond Hi-Abuse XP Gypsum Board.

- c. Paperless Products: Specially formulated, noncombustible, gypsum core with coated, fiberglass mat on both faces; manufactured to produce greater resistance to surface indentation and through-penetration than

typical gypsum panels; tapered long edges; 5/8 in thick

1) Manufacturers and Products:

- 1) National Gypsum Company; Gold Bond eXP Interior Extreme AR Gypsum Panel.
- 2) USG Corporation; Fiberock Interior Panel, Abuse Resistant.
- 3) USG Sheetrock® Brand Mold Tough® VHI Firecode® X Panels

4. Moisture-Resistant Coated Glass-Mat Gypsum Board Products:

- a. Material Quality Standard: ASTM C 1178 / C 1178M.
- b. Description: Enhanced moisture-resistant, noncombustible, gypsum core with inorganic, embedded fiberglass mat on both sides; outside face coated with heat-cured copolymer water-resistant coating; square edges; score or 10 according to ASTM D 3273; 5/8 in thick.
- c. Manufacturers and Products:

- 1) Georgia-Pacific Gypsum LLC; DensShield Tile

5. Moisture-Resistant type X Gypsum shaftliner panel:

- a. Material Quality Standard: ASTM C1658, C1396, ASTM E136, ASTM E84 .

- b. Description: noncombustible, moisture- and mold-resistant gypsum core that is encased in a moisture- and mold-resistant glass mat. The panels are UL Classified as to fire resistance (Type SLX) and feature double-beveled edges for easy installation.; score or 10 according to ASTM D 3273; 1 in thick.

- c. Manufacturers and Products:

- 1) USG Sheetrock® Brand Glass-Mat Liner Panels Mold Tough®

## 2.2 FASTENERS

A. Limitations: Nails and staples are not permitted.

B. Fasteners for Attaching Metal Framing to Concrete Structure:

1. Anchors: Fabricated from corrosion-resistant materials with holes or loops for attaching hanger wires and capable of sustaining, without failure, a load equal to 5 times that imposed by construction as determined by testing according to ASTM E 488 by a qualified independent testing agency.

- a. Cast-in-place anchor, designed for attachment to concrete.
- b. Post-installed chemical anchor.
- c. Post-installed expansion anchor.

2. Powder-Actuated Fasteners: Suitable for application indicated, ANSI A 10.3; low velocity, powder-actuated fasteners; drive pins and clip angles fabricated from corrosion-resistant materials, with clips or other devices for attaching hangers of type indicated, and capable of sustaining, without failure, an ultimate load capacity not less than 10 times that imposed by construction as determined by testing according to ASTM E 1190 by a qualified independent testing agency.

3. Manufacturers:

- a. Construction Materials, Inc.
- b. Heckman Building Products, Inc.
- c. Hilti Corp.
- d. ITW Ramset/Red Head.
- e. Powers Fasteners.
- f. Simpson Strong Tie Anchor Systems.

C. Metal Framing Screws: Screw fasteners of type, material, size, corrosion resistance, holding power, and other properties required to fasten metal framing and furring members securely to substrates involved; complying with recommendations of gypsum board manufacturers for applications indicated.

D. Gypsum Board Screws:

1. Material Quality Standards:

a. Metal Framing Members less than 0.03 in (0.75 mm) Thick: ASTM C 1002, Type S.

b. Metal Framing Members from 0.033 in to 0.112 in (0.79 mm to 2.9 mm) Thick:  
ASTM C 954, Type S-12.

2. Product Description - Standard Applications: Bugle head, self-drilling, self-tapping, steel screws with Phillips-head recess of size, holding power, and other properties recommended by respective gypsum board manufacturer; minimum 1 in (25 mm) long; with corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B 117.

E. Miscellaneous Fasteners: For conditions not indicated, fasteners shall be type, finish, size, and holding power recommended by respective gypsum board manufacturer and conditions.

## 2.3 JOINT TREATMENT MATERIALS

A. Material Quality Standard: ASTM C 475 / C 475M.

B. Joint Tape:

1. Paper Tape: Nominal 2 in (50 mm) wide cross-fibered paper tape with finish suitable for bonding, creased in center for easy folding, and compatible with joint compound.

2. Mesh Tape: Nominal 2 in (50 mm) wide self-adhering 10-by-10 fiberglass mesh tape.

C. Joint Compound:

1. Setting-Type: Job-mixed powder for mixing with water, chemical-hardening compound; includes taping types.

2. Drying-Type: Ready-mixed or job-mixed powder for mixing with water, air-drying, vinyl based compounds; includes taping, topping, and all-purpose types.

## 2.4 TRIM ACCESSORIES

General: Provide manufacturer's standard trim accessories of types indicated for drywall work, formed of galvanized steel unless otherwise indicated, with either knurled and perforated or expanded flanges for nailing or stapling, and beaded for concealment of flanges in joint compound. Provide corner beads, L type edge trim beads, U type edge trim beads, special L kerf type edge trim beads, and one piece control joint beads.

Corner bead and Edge Trim for Interior Installation: Comply with ASTM C 840 and the following:

Corner bead formed from zinc alloy, with flanges knurled and perforated or of fine mesh expanded metal.

Steel Edge trim formed from galvanized steel, types per Fig. 1 of ASTM C 840 as follows:

"LC" Bead, unless otherwise indicated.

"LK" Bead with square nose for use with kerfed jams.

"L" Bead where indicated.

"U" Bead where indicated.

Plastic Edge Trim: Manufacturers standard rigid or semi rigid PVC moldings shaped to provide resilient contact of gypsum board edges with other construction; friction fit, or pressure sensitive adhesive mounting.

One Piece Control Joint: Formed with perforated face flanges connected by vee shaped slot, 1/4 inch wide by approximately 7/16 inch deep and covered with removable tape, fabricated from the following material:

Roll formed zinc.

Extruded vinyl.

Either roll formed zinc or extruded vinyl.

#### JOINT TREATMENT MATERIALS:

General: ASTM C 475; type recommended by the manufacturer for the application indicated, except as otherwise indicated.

Joint Tape: Paper reinforcing type.

Joint Compound: Vinyl type powder or ready mixed vinyl type for interior use.

Joint Compound: On interior work provide chemical hardening type for bedding and filling, ready mixed vinyl type or vinyl type powder for topping.

#### MISCELLANEOUS MATERIALS:

General: Provide auxiliary materials for gypsum drywall work of the type and grade recommended by the manufacturer of the gypsum board.

Laminating Adhesive: Special adhesive or joint compound specifically recommended for laminating gypsum boards.

Gypsum Board Screws: Comply with ASTM C 646.

Concealed Acoustical Sealant: Nondrying, non-hardening, non-skinning, non-staining, non-bleeding, gunnable sealant for concealed applications per ASTM C 919.

Sound Attenuation Blankets: Refer to Section 07201 for sound attenuation blanket specification.

Corner Guards: Refer to Section 10260 for Clear Corner Guard specification.

#### TEXTURE FINISH MATERIALS:

Primer: Of type recommended by manufacturer of texture finish.

Polystyrene Aggregated Finish: One of the following:

QT Imperial Texture Finish: United States Gypsum Co.

Perfect Spray: Gold Bond Bldg. Products Div.

Regular Texture

Light Monterrey

Medium Monterrey

Orange Peel

## PART 3 EXECUTION

### PREPARATION FOR METAL SUPPORT SYSTEMS

Ceiling Anchorages: Coordinate work with structural ceiling work to ensure that inserts and other structural anchorage provisions have been installed to receive ceiling hangers.

### INSTALLATION OF METAL SUPPORT SYSTEMS:

#### General:

Metal Support Installation Standard: Comply with ASTM C 754.

Do not bridge building expansion joints with support system, frame both sides of joints with furring and other support as indicated.

#### 3.1. CEILING SUPPORT SUSPENSION SYSTEMS

Secure hangers to structural support by connecting directly to structure where possible, otherwise connect to inserts, clips or other anchorage devices or fasteners as indicated.

Space main runners 4' 0" o.c. and space hangers 4' 0" o.c. along runners, except as otherwise shown.

Level main runners to a tolerance of 1/8" in 12' 0", measured both lengthwise on each runner and transversely between parallel runners.

Wire tie or clip furring members to main runners and to other structural supports as indicated.

Space furring member 16" o.c., except as otherwise indicated.

#### Wall/Partition Support Systems:

Install supplementary framing, blocking and bracing at terminations in the work and for support of fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, and similar work to comply with details indicated or if not otherwise indicated, to comply with applicable published recommendations of gypsum board manufacturer, or if not available, of "Gypsum Construction handbook" published by United States Gypsum Co.

Isolate stud system from transfer of structural loading to system, both horizontally and vertically. Provide slip or cushioned type joints to attain lateral support and avoid axial loading.

Install runner tracks at floors, ceilings and structural walls and columns where gypsum drywall stud system abuts other work, except as otherwise indicated.

Extend partition stud system through acoustical ceilings and elsewhere as indicated to the structural support or substrate above the ceiling.

Space studs 16" o.c., unless otherwise indicated.

Frame door openings to comply with detailed indicated or if not otherwise indicated, to comply with applicable published recommendations of gypsum board manufacturer, or if not available, of "Gypsum Construction Handbook" published by United States Gypsum

Com. Attach vertical studs at jambs with screws either directly to frames or to jamb anchor clips on door frames; install runner track section (for jack studs) at head and secure to jamb studs.

Extend vertical jamb studs through suspended ceilings and attach to underside of floor or roof structure above, unless otherwise indicated.

Frame openings other than door openings to comply with details indicated or if not indicated, in same manner as required for door openings; and install framing below sills of openings to match framing required above door heads.

Space wall furring members 16" o.c., unless otherwise indicated.

Erect thermal insulation vertically and hold in place with Z furring members spaced 24" o.c. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails or power drive fasteners spaced 24" o.c. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw attach short flange of furring channel to web of attached channel. Start from this furring member channel with standard width insulation panel and continue in regular manner. At interior corners, space second member no more than 12" from corner and cut insulation to fit. Until gypsum board is installed hold insulation in place with 10" staples fabricated from 18 gage tie wire and inserted through slot in web of member, or by an equally acceptable method.

### 3.2 METAL FRAMING SCHEDULE

#### A. Metal Stud Framing Schedule:

1. Stud Depth: As indicated on Drawings.
2. Spacing: Maximum 16 in (400 mm) on centers, unless otherwise indicated, or as required to comply with respective assembly test report.
3. Minimum Performance Requirements - unless otherwise indicated:
  - a. Typical Partitions: L/240 at 5 lb/sq ft (239 Pa) lateral load
  - b. Elevator Shaft Partitions: L/240 at 7.5 lb/sq ft lateral load.
  - c. Partitions with Tile Facing: L/360 at 7.5 lb/sq ft (359 Pa) lateral load.
4. Minimum Uncoated Base Metal Thickness:
  - a. Typical Gypsum Board Assemblies: As determined by manufacturer's limiting height engineering data unless otherwise indicated.
    - 1) 25 Gage or 25 Gage Equivalent Studs: Typical at partitions without wall-mounted components installed on either side.
    - 3) 20 Gage or 20 Gage Equivalent Studs:
      - a) Partitions supporting ceramic tile.
      - b) Partitions with gypsum board on one side only.
      - c) At door jambs.
      - d) Partitions supporting wall hung cabinets or shelving.

### 3.3 GYPSUM BOARD SCHEDULE

A. Gypsum Board Schedule, General: Install the designated gypsum board product based on exposure classification to water and / or moisture and applied finish system as follows, unless otherwise indicated or scheduled on the Drawings.

B. No Exposure: Surfaces not normally exposed to water and / or moisture sources including but not limited to the following:

1. Typical walls and ceilings.
  - a. Paint and Wall Coverings Only: Typical paper-faced gypsum board.
  - b. Tile and Adhered Sheet/Panel Coverings: Moisture-resistant coated-glass-mat gypsum board.
2. Abuse-resistant walls as indicated in the Drawings:

- a. Paint and Wall Coverings Only: Abuse-resistant paper-faced gypsum board.
- C. Incidental Exposure: Surfaces immediately adjacent to water and / or moisture sources including, but not limited to, the following locations:
  - 1. Top of walls above ceilings adjacent to mechanical equipment in corridors.
  - 2. Walls and ceilings in mechanical equipment rooms and janitor closets.
  - 3. Walls within 24 inches of centerline of drinking fountains, isolated wall-hung lavatories, and countertop sinks and other similar water sources.
  - 4. Interior face of exterior walls.
  - 5. Acceptable gypsum board products for the above listed conditions:
    - a. Paint and Wall Coverings: Moisture-resistant paper-faced or moisture-resistant paperless glass-mat gypsum board.
    - b. Tile and Adhered Sheet/Panel Coverings: Moisture-resistant coated-glass-mat gypsum board.
  - 6. Abuse-resistant walls as indicated in the Drawings:
    - a. Paint and Wall Coverings Only: Moisture Resistant abuse-resistant paper-faced gypsum board.
- D. Direct Exposure: Surfaces normally soaked, saturated, or regularly and frequently exposed to water and / or moisture including, but not limited to, the following locations:
  - 1. Walls and ceilings in toilet rooms and bathrooms including bathtubs and showers:
    - a. Paint and Wall Coverings: Moisture-resistant paper-faced or moisture-resistant paperless glass-mat gypsum board.
    - b. Tile and Adhered Sheet/Panel Coverings: Moisture-resistant coated-glass-mat gypsum board.

### 3.4 GYPSUM BOARD FINISHING SCHEDULE

- A. Gypsum Board Finishing Schedule, General: Finish panels to Levels of Finish indicated below. Apply joint tape over panel joints, except those with trim having flanges not intended for tape. Sand between coats and after last coat to produce a surface free of defects and ready for applied finish system.
- B. Preparation: Apply joint compound at open joints, panel edges, and damaged surface areas.
- C. Level 1: At following locations, embed tape at joints in joint compound unless a higher level of finish is required for fire resistance rated assemblies:
  - 1. Ceiling plenum areas above ceilings.
  - 2. Concealed areas.
- D. Level 2: At following locations, embed tape and apply separate first coat of joint compound to tape, fasteners, and trim flanges:
  - 1. Substrate for tiling.
- E. Level 3: At following locations, embed tape and apply separate first and second coats of joint compound to tape, fasteners, and trim flanges:
  - 1. Mechanical, electrical, data and elevator equipment rooms.
- F. Level 4: At following locations, embed tape and apply separate first, fill, and finish coats of joint compound to tape, fasteners, and trim flanges:
  - 1. Areas to receive paint.
- G. Level 5: At following locations, embed tape and apply separate first, fill, and finish coats of joint compound to tape, fasteners, and trim flanges, and apply skim coat of joint compound or Level 5 Primer and Surfacer over entire surface:
  - 1. Areas indicated on drawings

### 3.5 GENERAL GYPSUM BOARD INSTALLATION REQUIREMENTS

Gypsum Board Application and Finishing Standards: ASTM C 840 and GA 216.

Where handrails are indicated for direct attachment to gypsum board shaft wall system, provide not less than a 0.0341 inch thick by 4 inch wide galvanized steel reinforcement strip, accurately positioned and secured behind not less than one gypsum board face layer of 1/2 inch or 5/8 inch thickness.

Install sound attenuation blankets as indicated, prior to gypsum board unless readily installed after board has been installed.

Locate exposed end butt joints as far from center of walls and ceilings as possible, and stagger not less than 1' 0" in alternate courses of board.

Install ceiling boards in the direction and manner which will minimize the number of end butt joints, and which will avoid end joints in the central area of each ceiling. Stagger end joints at least 1' 0".

Install wall/partition boards vertically to avoid end butt joints wherever possible. At stairwells and similar high walls, install boards horizontally with end joints staggered over studs.

Install exposed gypsum board with face side out. Do not install imperfect, damaged or damp boards. Butt boards together for a light contact at edges and ends with not more than 1/16" open space between boards. Do not force into place.

Located either edge or end joints over supports, except in horizontal applications or where intermediate supports or gypsum board back blocking is provided behind end joints. Position boards so that like edges abut, tapered edges against tapered edges and mill cut or field cut ends against mill cut or field cut ends. Do not place tapered edges against cut edges or ends. Stagger vertical joints over different studs on opposite sides of partitions.

Attach gypsum board to framing and blocking as required for additional support at openings and cutouts.

Form control joints and expansion joints with space between edges of boards, prepared to receive trim accessories.

Cover both faces of steel stud partition framing with gypsum board in concealed spaces (above ceilings, etc.), except in chase walls which are properly braced internally.

Except where concealed application is required for sound, fire, air or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. area, and may be limited to not less than 75% of full coverage.

Isolate perimeter of non load bearing drywall partitions at structural abutments. Provide 1/4" to 1/2" space and trim edge with J type semi finishing edge trim. Seal joints with acoustical sealant. Do not fasten drywall directly to stud system runner tracks.

For double layer partition system, work above acoustical ceilings may be installed with base layer only.

Space fasteners in gypsum boards in accordance with referenced standards and manufacturer's recommendations, except as otherwise indicated.

### 3.6 METHODS OF GYPSUM DRYWALL APPLICATION



Single layer Application: Install gypsum wallboard.

On ceilings apply gypsum board prior to wall/partition board application to the greatest extent possible.

On partitions/walls apply gypsum board vertically (parallel), unless otherwise indicated, and provide sheet lengths which will minimize end joints.

Double Layer Fastening Methods: Apply base layer of gypsum board and face layer to base layer as follows:

Fasten base layers to supports with screws. Stagger joints on face layers.

### 3.7 INSTALLATION OF DRYWALL TRIM ACCESSORIES

General: Where feasible, use the same fasteners to anchor trim accessory flanges as required to fasten gypsum board to the supports. Otherwise, fasten flanges by nailing or stapling in accordance with manufacturer's instructions and recommendations.

Install metal corner beads at external corners of drywall work.

Install metal edge trim whenever edge of gypsum board would otherwise be exposed or semi exposed, and except where plastic trim is indicated. Provide type with face flange to receive joint compound except where semi finishing type is indicated. Install L type trim where work is tightly abutted to other work, and install special kerf type where other work is kerfed to receive long leg of L type trim. Install U type trim where edge is exposed, revealed, gasketed, or sealant filled (including expansion joints).

Install plastic edge trim where indicated on wall panels at juncture with ceilings.

Install metal control joint (beaded type) at all wall openings, at interior structural members and intervals not to exceed 30'-0", and where indicated otherwise.

### 3.8 FINISHING OF DRYWALL

General: Apply treatment at gypsum board joints (both directions), flanges of trim accessories, penetrations, fastener heads, surface defects and elsewhere as required to prepare work for decoration. Pre-fill open joints and rounded or beveled edges, using type of compound recommended by manufacturer.

Apply joint tape at joints between gypsum boards, except where a trim accessory is indicated.

Apply joint compound in 3 coats (not including pre-fill of openings in base), and sand between last 2 coats and after last coat.

Refer to sections on painting, coatings and wall coverings in Division 9 for decorative finishes to be applied to drywall work.

### 3.9 APPLICATION OF TEXTURE FINISH

Surface Preparation and Primer: Prepare and prime drywall and other surfaces in strict accordance with texture finish manufacturer's instructions. Apply primer of proper type to all surfaces to receive texture finish.

Finish Application: Mix and apply finish to drywall and other surfaces indicated to receive finish in strict accordance with manufacturer's instructions to produce a uniform texture without starved spots or other evidence of thin application, and free of application patterns.

Remove any texture droppings or overspray from door frames, windows and other adjoining work.

### 3.10 PROTECTION OF WORK:

Installer shall advise Contractor of required procedures for protecting gypsum drywall work from damage and deterioration during remainder of construction period.

END OF SECTION 09250

## SECTION 093013 - TILE

### PART 1 - GENERAL

#### RELATED DOCUMENTS:

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

#### DESCRIPTION OF WORK:

Definition: Tile includes ceramic surfacing units made from clay or other ceramic materials.

Extent of tile work is indicated on drawings and schedules.

Types of tile work in this section include the following:

- Glazed Ceramic Tile
- Colorbody Porcelain Tile
- Waterproofing Membrane
- Stone Thresholds
- Metal Edge Strips

#### QUALITY ASSURANCE:

Source of Materials: Provide materials obtained from one source for each type and color of tile, grout and setting materials.

#### SUBMITTALS

Product Data: Submit manufacturer's technical information and installation instructions for materials required, except bulk materials.

Samples for Initial Selection Purposes: Submit manufacturer's color charts consisting of actual tiles or sections of tiles showing full range of colors, textures and patterns available for each type of tile specified. Include samples of grout and accessories requiring color selection.

Samples for verification purposes: Submit the following:

Samples for each type of tile and for each color and texture required, not less than 12" square, on plywood or hardboard backing and grouted.

Full size samples for each type of trim, accessory and for each color.

Certification: Furnish Master Grade Certificate for each shipment and type of tile, signed by manufacturer and Installer.

#### PRODUCT HANDLING:

Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Prevent damage or contamination to materials by water, freezing, foreign matter or other causes.

#### PROJECT CONDITIONS:

Maintain environmental conditions and protect work during and after installation to comply with referenced standards and manufacturer's printed recommendations.

Vent temporary heaters to exterior to prevent damage to tile work from carbon dioxide buildup.

Maintain temperatures at not less than 50 deg.F (10 deg.) in tiled areas during installation and for 7 days after completion, unless higher temperatures are required by referenced installation standard or manufacturer's instructions.

## PART 2 PRODUCTS

### ACCEPTABLE MANUFACTURERS:

Available Manufacturers:

Glazed Ceramic Tile and Porcelain:

Basis of Design: Daltile

American Olean Tile Co., Div., National Gypsum Co.

Dry Set Grouts: (Non staining)

Custom Building Products.

Laticrete International Inc.

L & M Surco Mfg., Inc.

Commercial Portland Cement Grout: (Non staining)

Custom Building Products.

L & M Surco Mfg. Co., Inc.

TheUpco Co.

### PRODUCTS, GENERAL:

ANSI Standard for Ceramic Tile: Comply with ANSI A137.1 "American National Standard Specifications for Ceramic Tile" for types and grades of tile indicated.

ANSI Standard for Tile Installation Materials: Comply with ANSI standard referenced with products and materials indicated for setting and grouting.

Colors, Textures and Patterns: For tile, grout and other products requiring selection of colors, surface textures or other appearance characteristics, provide products to match Characteristics indicated or, if not otherwise indicated, as selected by Architect from manufacturer's standards.

Provide tile trim and accessories which match color and finish of adjoining flat tile.

Mounting: Where factory mounted tile is required provide back or edge mounted tile assemblies as standard with manufacturer unless another mounting method is indicated.

### TILE PRODUCTS:

Colorbody Porcelain Tile (Floor): Provide factory mounted flat tile complying with the following requirements:

Type: Porcelain

Series: Portfolio

Nominal Facial Dimensions: 5-3/4" x 23-3/8" (6"x24")

Color: Select from Manufacturers full range.

Glazed Ceramic Tile (Wall): Provide factory mounted flat tile complying with the following requirements:

Type: Glazed Ceramic  
Series: Classic Color Wheel Collection  
Nominal Facial Dimensions: 3" x 6"  
Finish: Semi-Gloss  
Pattern: Manufacturers Standard Angled Pattern  
Color: Select from Manufacturers full range. (Type 1-40%, Type 2-35%, Type 3 25%)

Unglazed Quarry Tile: Provide square cage tile complying with the following requirements:

Type: Quarry Tile  
Series: Quarry  
Nominal Face Dimensions: 6"x6"  
Color: as selected from standard colors

Trim Units: Provide tile trim units to match characteristics of adjoining flat tile and to comply with following requirements:

#### SETTING MATERIALS:

Portland Cement Mortar Installation Materials: Provide materials to comply with ANSI A108.1 as required for installation method designated, unless otherwise indicated.

Thin set Portland Cement Mortar: Where thin set portland cement mortar applications are indicated, use the following unless otherwise required.

Dry Set Portland Cement Mortar: ANSI A108.5, factory sanded; or latex portland cement mortar, ANSI A108.4.

Organic Adhesive: ANSI A136.1; use Type I for showers, tub recesses, or other areas requiring prolonged water resistance, Type II elsewhere, unless indicated. Provide primer sealer where recommended by manufacturer.

#### GROUTING MATERIALS:

Commercial Portland Cement Grout: Proprietary Pre-blended compounded composed of portland cement and additives formulated for the type of tile installed.

Dry Set Grout: Proprietary compound composed of portland cement and additives formulated for type of tile installed.

Grout for Pre-grouted Tile Sheets: Same elastomeric material used in factory pre-grouted sheets.

Colors to be selected by Architect from manufacturer's standard colors.

#### MISCELLANEOUS MATERIALS:

Metal Edge Strips: Zinc alloy or stainless steel, 1/8" wide at top edge with integral provision for anchorage to mortar bed or substrate, unless otherwise indicated.

Tile Cleaner: DuPont StoneTech Professional Stone & Tile Cleaner

Tile Sealer: DuPont StoneTech Professional Heavy-Duty Grout Sealer.

## THRESHOLDS

- A. General: Fabricate to sizes and profiles indicated or required to provide transition between adjacent floor finishes.
  - 1. Bevel edges at 1:2 slope, with lower edge of bevel aligned with or up to 1/16 inch above adjacent floor surface. Finish bevel to match top surface of threshold. Limit height of threshold to 1/2 inch or less above adjacent floor surface.
- B. Marble Thresholds: ASTM C503/C503M, with a minimum abrasion resistance of 10 according to ASTM C1353 or ASTM C241/C241M and with honed finish.
  - 1. Description: Uniform, fine- to medium-grained white stone with gray veining.
- C. Metal Edge Strips: Angle or L-shape, height to match tile and setting-bed thickness, metallic or combination of metal and PVC or neoprene base, designed specifically for flooring applications; nickel silver exposed-edge material.

## WATERPROOFING MEMBRANE

- A. Schuler-KERDI Membrane - Refer to Specification Section 093050.

## PART 3 - EXECUTION

### INSPECTION:

Examine surfaces to receive tile work and conditions under which tile will be installed. Do not proceed with tile work until surfaces and conditions comply with requirements indicated in referenced tile installation standard.

### INSTALLATION, GENERAL:

ANSI Tile Installation Standard: Comply with applicable parts of ANSI 108 series of tile installation standards included under "American National Standard Specifications for the Installation of Ceramic Tile".

TCA Installation Guidelines: TCA "Handbook for Ceramic Tile Installation"; comply with TCA installation methods indicated or, if not otherwise indicated, as applicable to installation conditions shown.

Extend tile work into recesses and under or behind equipment and fixtures, to form a complete covering without interruptions, except as otherwise shown. Terminate work neatly at obstructions, edges and corners without disrupting pattern or joint alignments.

Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish or built in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures and other penetrations so that plates, collars, or covers overlap tile.

Jointing Pattern: Unless otherwise shown, lay tile in grid pattern. Align joints when adjoining tiles on floor, base, walls and trim are same size. Layout tile work and center tile fields in both directions in each space or on each wall area. Adjust to minimize tile

cutting. Provide uniform joint widths, unless otherwise shown. For tile mounted in sheets make joints between tile sheets same width as joints within tile sheets so that extent of each sheet is not apparent in finished work.

Grout tile to comply with referenced installation standards, using grout materials indicated.

#### FLOOR INSTALLATION METHODS:

Ceramic Tile: Install tile to comply with requirements indicated below for setting bed methods, TCA installation methods related to types of sub-floor construction, and grout types:

Portland Cement Mortar: ANSI A108.1.

Bond Coat: Portland cement paste on plastic bed or thin set portland cement on cured bed, ANSI A108.5; at Contractor's option.

Concrete Sub-floors, Interior, Waterproofing Membrane: TCA F121.

Mortar: Sand portland cement

Thin set Portland Cement Mortar: ANSI A108.5

Concrete Sub-floors; Interior: TCA F113.

Grout: Sand portland cement

Conductive Ceramic Mosaic Tile: Install to comply with ANSI A108.7 using conductive dry-set mortar bond coat on damp cured and dried portland cement mortar bed as per TCA F112; grout type as indicated below:

Grout: Sand-portland cement

Paver Tile: Install tile to comply with requirements indicated below for setting bed method, TCA installation method related to types of sub-floor construction, and grout types:

Portland Cement Mortar: ANSI A108.1

Concrete Sub-floor, Interior: TCA F112 (bonded)

Grout: Sand-portland cement.

Metal Edge Strips: Install at locations indicated or where exposed edge of the flooring meets carpet, wood or other flooring which finishes flush with top of tile.

#### WALL TILE INSTALLATION METHODS:

Install types of tile designated for wall application to comply with requirements indicated below for setting bed methods, TCA installation methods related to subsurface wall conditions, and grout types:

Grout: Dry set.; Thin-set Portland Cement Mortar: ANSI A108.5.

Interior; TCA W213

#### CLEANING AND PROTECTION:

Cleaning: Upon completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.

Unglazed tile may be cleaned with acid solution only when permitted by tile and grout manufacturer's printed instructions, but no sooner than 14 days after installation. Protect metal surfaces, cast iron and vitreous plumbing fixtures from effects of acid cleaning. Flush surface with clean water before and after cleaning.

Finished Tile Work: Leave finished installation clean and free of cracked, chipped, broken, un-bonded, or otherwise defective tile work.

Protection: When recommended by tile manufacturer, apply a protective coat of neutral protective cleaner to completed tile walls and floors. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage and wear.

Prohibit foot and wheel traffic from using tiled floors for at least 7 days after grouting is completed.

Before final inspection, remove protective coverings and rinse neutral cleaner from tile surfaces.

Seal grout in all areas receiving ceramic tile finish.

END OF SECTION 09300



## SECTION 093050 - TILE SETTING MATERIALS AND ACCESSORIES

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Waterproofing Membrane.

#### 1.2 RELATED SECTIONS

- A. Section 09 30 00 - Tiling.

#### 1.3 REFERENCES

- A. CSA B79-08: Floor, Area, and Shower Drains, and Cleanouts for Residential Construction.
- B. IAPMO IGC 195: Interim Guide Criteria for Floor Drain with Integrated Bonding Flange.
- C. Tile Council of North America (TCNA) Handbook for Ceramic Tile Installation.
- D. Terrazzo, Tile and Marble Association of Canada (TTMAC) Specification Guide 09300 Tile Installation Manual.
- E. American National Standard Specifications for the installation of ceramic tile A108 / A118 / A136.1.

#### 1.4 SUBMITTALS

- A. Submit under provisions of Section 01 30 00.
- 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.
- C. Verification Samples: For each finish product specified, two samples, minimum size 6 inches (150 mm) long, representing actual product, color, and finish.
- D. Manufacturer's Certificates: Certify products meet or exceed specified requirements.

#### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing the work of this section with minimum five years' experience.
- B. Source Limitations for Setting Materials and Accessories: Obtain product of a uniform quality for each application condition from a single manufacturer.
- C. Preinstallation Conference: Conduct conference at the Project site.
  - 1. Convene one week prior to commencing work of this section.
  - 2. Require attendance of installation material manufacturer, tile supplier, tile installer and installers of related work. Review installation procedures and coordination required with related work.
  - 3. Meeting agenda includes but is not limited to:
    - a. Surface preparation.
    - b. Tile and installation material compatibility.

- c. Edge protection, transition and pre-fabricated movement joint profiles.
- d. Waterproofing techniques.
- e. Crack isolation techniques.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Protect materials from exposure to moisture. Do not deliver until after wet work is complete and dry.
- C. Store materials in a dry, warm, ventilated weathertight location.

## 1.7 PROJECT CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

## 1.8 COORDINATION

- A. Coordinate Work with other operations and installation of floor finish materials to avoid damage to installed materials.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Acceptable Manufacturer: Schluter Systems, L.P., 194 Pleasant Ridge Road, Plattsburgh, NY 12901-5841. ASD. Tel: (800) 472-4588. Fax (800) 477-9783. E-mail: [specassist@schluter.com](mailto:specassist@schluter.com). Web: [www.schluter.com](http://www.schluter.com).
- B. Requests for substitutions will be considered in accordance with provisions of Section 01 60 00.

### 2.2 WATERPROOFING MEMBRANE

- A. Schluter-KERDI
  - 1. Description: 0.008 inch (0.2 mm) thick, orange polyethylene membrane, with polypropylene fleece laminated on both sides, which is listed by cUPC to meet or exceed requirements of the "American national standard specifications for load bearing, bonded, waterproof membranes for thin-set ceramic tile and dimension stone installation A118.10 and is listed by cUPC, and is evaluated by ICC-ES (see Report No. ESR-2467).
  - 2. Corners and seals:
    - a. Provide matching preformed inside corners.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

### 3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

### 3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions.

### 3.4 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

## SECTION 095100 - ACOUSTICAL CEILINGS

### PART 1 - GENERAL

#### RELATED DOCUMENTS:

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

#### DESCRIPTION OF WORK:

Extent of each type of acoustical ceiling is shown and scheduled on drawings.

Types of acoustical ceilings specified in this section include the following:

Acoustical panel ceilings, exposed suspension.

#### QUALITY ASSURANCE:

Installer Qualifications: Firm with not less than three years of successful experience in installation of acoustical ceilings similar to requirements for this project and which is acceptable to manufacturer of acoustical units, as shown by current written statement from manufacturer.

Coordination of Work: Coordinate layout and installation of acoustical ceiling units and suspension system components with other work supported by or penetrating through, ceilings, including light fixtures, HVAC equipment, fire suppression system components (if any), and partition system (if any).

#### SUBMITTALS:

Product Data: Manufacturer's product specifications and installation instructions for each acoustical ceiling material required, and for each suspension system, including certified laboratory test reports and other data as required to show compliance with these specifications.

#### DELIVERY, STORAGE, AND HANDLING:

Deliver acoustical ceiling units to project site in original, unopened packages and store them in a fully enclosed space where they will be protected against damage from moisture, direct sunlight, surface contamination or other causes.

Before installing acoustical ceiling units, permit them to reach room temperature and stabilized moisture content.

Handle acoustical ceiling units carefully to avoid chipping edges or damaging units in any way.

#### PROJECT CONDITIONS:

Space Enclosure: Do not install interior acoustical ceilings until space is enclosed and weatherproof, wet work in space is completed and nominally dry, work above ceilings completed, and ambient conditions of temperature and humidity will be continuously maintained at values near those indicated for final occupancy.

### PART 2 - PRODUCTS

#### ACOUSTICAL CEILING UNITS, GENERAL:

Standard for Acoustical Ceiling Units: Provide manufacturer's standard units of configuration indicated which are prepared for mounting method designated and which comply with FS SS S 118 requirements, including those indicated by reference to type,

form, pattern, grade (NRC or NIC's as applicable), light reflectance coefficient (LR), edge detail, and joint detail (if any).

Sound Attenuation Performance: Provide acoustical ceiling units with ratings for ceiling sound transmission class (STC) of range indicated as determined according to AMA 1 II "Ceiling Sound Transmission Test by Two Room Method" with ceilings continuous at partitions and supported by a metal suspension system of type appropriate for ceiling unit of configuration indicated (concealed for tile, exposed for panels).

Colors, Textures, and Patterns: Provide products to match appearance characteristics indicated or, if not otherwise indicated, as selected by Architect from manufacturer's standard colors, surface textures, and patterns available for acoustical ceiling units and exposed metal suspension system members of quality designated.

#### ACOUSTICAL PANELS:

SAC I Panels Mineral Composition with Standard Washable painted finish:

Nodulated, Cast or Molded Units, Fissured: Form 2, Pattern d, NRC 60, LR 1, STC Square edge, white, 24" x 24" x 5/8". No. 2210 Panels:

USG Radar Acoustical Panels Climaplus Performance

SAC II Panels Mineral Composition with Standard Washable painted finish:

Nodulated, Cast or Molded Units, Fissured: Form 2, Pattern d, NRC 60, LR 1, STC Tegular edge, white, 24" x 24" x 5/8". No. 2230 Panels:

USG Radar Acoustical Panels Climaplus Performance

SAC III Panels - Other (Panel Material as indicated below).

High Density Ceramic Composition Units with Scrubbable Finish: Resistant to heat, moisture, and corrosive fumes; suitable for exterior applications; Pattern/NRC as indicated below; LR1 (0.75); square edge, white, 24" X24" X 5/8" or as indicated.

Provide locking hold down clips at all Restrooms.

56644 USG Radar Ceramic Acoustical Panels

SAC IV Panels Mineral Composition with Standard Washable painted finish:

Vinyl Faced Units, perforated, NRC 55, LR .79, CAC 335, Lay-in, white, 24" x 24" x 5/8". No. 56060 Panels:

USG Clean Room Acoustical Panels

SAC V Panels Mineral Composition with Standard Washable painted finish:

Vinyl Faced Units, Un-perforated, NRC 55, LR .79, CAC 335, Lay-in, white, 24" x 24" x 5/8". No. 56099 Panels:

USG Clean Room Acoustical Panels

Cloud 1 – USG Celebration Torsion Spring System (Provide at Computer Science 130) 2x4 system with custom perforated panels in Silver Satin 002. Donn DX26 15/16" Heavy Duty suspension system. Provide 6" USG Compasso Trim. Refer to Reflected Ceiling Plan for layout.

Cloud 2 – USG True Wood Panels (Provide at Collaboration 170, LGI 229, Entry 142 and Stair 134B); Nominal 6" Panel. USG DWss Black HD Linear Carrier Suspension System. Provide integrated clips at LGI exterior wall location to provide curved transition. Color: Dark Bamboo. Refer to Reflected Ceiling Plans for layout.

Cloud 3 – USG Paraline Baffles Linear Ceiling System (Provide at ILC 167) Un-perforated Blades Color: Matte White 3708 with blade end caps; Attachment clip Black Oxide; USG DWSS Matte Black. Curved Compasso trim. Lengths vary. Refer to Reflected Ceiling Plans for layout

Upon completion of project, the Contractor shall provide the Owner with two boxes of ceiling tile for each style used for future repairs.

METAL SUSPENSION SYSTEMS, GENERAL:

Standard for Metal Suspension Systems: Provide metal suspension systems of type, structural classification and finish indicated which comply with applicable ASTM C 635 requirements.

Finishes and Colors: Provide manufacturer's standard finish for type of system indicated, unless otherwise required. For exposed suspension members and accessories with painted finish, provide black color.

High Humidity Finish: Comply with ASTM C 635 requirements for Coating Classification for "Severe Environment Performance" where high humidity finishes are indicated.

Attachment Devices: Size for 5 times design load indicated in ASTM C 635, Table 1, Direct-Hung.

Hanger Wire: Galvanized carbon steel wire, ASTM A 641, soft temper, pre-stretched, Class 1 coating, sized so that stress at 3 times hanger design load (ASTM C 635, Table 1, Direct Hung), will be less than yield stress of wire, but provide not less than 12 gage.

Edge Moldings and Trim: Metal or extruded plastic of types and profiles indicated or, if not indicated, provide manufacturer's standard molding for edges and penetrations of ceiling which fits with type of edge detail and suspension system indicated.

Available Manufacturers: Manufacturers of Steel Exposed Suspension Systems: (in air-conditioned areas)

Same as acoustical unit manufacturer:

Chicago Metallic Corp.

Donn Corp.

National Rolling Mills, INc.

EXPOSED METAL DIRECT HUNG SUSPENSION SYSTEM:

Fire Rated Double Web Suspension System: 15/16" USG Donn DX/DXL

Finish: Aluminum cap painted white.

Structural Classification: Intermediate Duty System: 15/16" USG Donn DX/DXL

Finish: Aluminum cap painted white.

Structural Classification: Intermediate Duty System: 9/16" USG Donn DXT

Finish: Aluminum cap painted white.

USG Drywall Suspension System Flat Ceilings DGLW26 and DGLW424

## PART 3 - EXECUTION

### PREPARATION:

Coordination: Furnish layouts for inserts, clips, or other supports required to be installed by other trades for support of acoustical ceilings.

Measure each ceiling area and establish layout of acoustical units to balance border widths at opposite edges of each ceiling. Avoid use of less than half width units at borders, and comply with reflected ceiling plans wherever possible.

### INSTALLATION:

General: Install materials in accordance with manufacturer's printed instructions, and to comply with governing regulations, fire resistance rating requirements as indicated, and industry standards applicable to work.

Arrange acoustical units and orient directionally patterned units (if any) in manner shown by reflected ceiling plans.

Install tile with pattern running in alternating one direction.

Install suspension systems to comply with ASTM C 636, with hangers supported only from building structural members. Locate hangers not less than 6" from each end and spaced 4'-0" along each carrying channel or direct hung runner, unless otherwise indicated, leveling to tolerance of 3/32" in 12'-0".

Secure wire hangers by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices which are secure and appropriate for substrate, and which will not deteriorate or fail with age or elevated temperatures.

Install hangers plumb and free from contact with insulation or other objects within ceiling plenum which are not part of supporting structural or ceiling suspension system. Splay hangers only where required to miss obstructions and offset resulting horizontal force by bracing, counter splaying or other equally effective means.

Install edge moldings of type indicated at perimeter of acoustical ceiling area and at locations where necessary to conceal edges of acoustical units.

Screw attached moldings to substrate at intervals not over 16" o.c. and not more than 3" from ends, leveling with ceiling suspension system to tolerance of 1/8" in 12' 0". Miter corners accurately and connect securely.

Install acoustical tile in coordination with suspension system. Place splines or flanges of suspension system into kerfed edges, or insert tile tongues into tile grooves, so that every tile to tile joint is closed by double lap of material.

Fit adjoining tile to form flush, tight joints. Scribe and cut for accurate fit at borders and around penetrating work.

Install acoustical panels in coordination with suspension system, with edges concealed by support of suspension members. Scribe and cut panels to fit accurately at borders and at penetrations.

### ADJUST AND CLEAN:

Clean exposed surfaces of acoustical ceilings, including trim, edge moldings, and

suspension members; comply with manufacturer's instructions for cleaning and touch up of minor finish damage.

Remove and replace work which cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 09510



## SECTION 096500 - RESILIENT FLOORING

### PART 1 - GENERAL

#### RELATED DOCUMENTS:

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

#### DESCRIPTION OF WORK:

Luxury Vinyl Tile Resilient Flooring

#### QUALITY ASSURANCE:

Manufacturer: Provide each type of resilient flooring and accessories as produced by a single manufacturer, including recommended primers, adhesives, sealants, and leveling compounds.

Wherever possible, provide required resilient flooring and accessories produced by a single manufacturer.

#### SUBMITTALS:

Product Data: Submit 2 copies of manufacturer's technical data and installation instructions for each type of resilient flooring and accessory.

Samples: Submit, for verification purposes, samples of each type, color, and pattern of resilient flooring, including accessories, required, indicating full range of color and pattern variation.

Maintenance Instructions: Submit 2 copies of manufacturer's recommended maintenance practices for each type of resilient flooring and accessory required.

Replacement Material: After completion of work, deliver to project site replacement materials from same manufactured lot as materials installed, and as follows:

Tile flooring, not less than one box for each 50 boxes or fraction thereof, for each type, size, and color installed.

#### JOB CONDITIONS:

Maintain minimum temperature of 65 degrees F (18 degrees C) in spaces to receive resilient flooring for at least 40 hours prior to installation, during installation, and for not less than 48 hours after installation. Store resilient flooring materials in spaces where they will be installed for at least 48 hours before beginning installation. Subsequently, maintain minimum temperature of 55 degrees F (13 degrees C) in areas where work is completed.

Install resilient flooring and accessories after other finishing operations, including painting, have been completed. Do not install resilient flooring over concrete slabs until the latter have been cured and are sufficiently dry to achieve bond with adhesive as determined by manufacturer's recommended bond and moisture test.

## PART 2 - PRODUCTS

### ACCEPTABLE MANUFACTURERS:

Available manufacturers must have thru-chip technology or equal manufacturing technology.

#### Luxury Vinyl Tile:

Basis of Design: Interface

Product: Studio Set

Colors: Architect to Select from Manufacturers Full Range. Refer to Drawings for current color selections and anticipated pattern.

Patcraft – Colors/Patterns as submitted for approval consideration

Mannington - Colors/Patterns as submitted for approval consideration

#### Rubber Wall Base:

Wall Base (WL BS): Provide rubber base complying with FS SS W 40, Type I, with matching end stops and preformed corner units, and as follows:

Height: 4".

Thickness: 1/8" gage.

Style: Standard top set cove.

Finish: Matte.

Basis of Design: Roppee Rubber Corp

Selected Color: Architect to Select from Mfg full range of colors

Johnson Rubber Co., Inc., Flooring Accessories Div.

R. C. Musson Rubber Co., Inc.

Flexco Floors

### MATERIALS:

Colors and Patterns: As shown or scheduled, or as selected by Architect from manufacturer's standards.

#### LVT Flooring:

LVT is Class III printed vinyl plank. Wear layer thickness of 22mil. Total thickness is 4.5mm. Commercial grade backing class. Nominal dimensions of plank area 25 cm x 1 m (9.845 in x 39.38 in). 15 year Standard Warranty.

IIC Sound Rating (ASTM E492-09) 57 IIC

Slip Resistance (ASTM D2047) >0.55 wet/dry, ADA Compliant

Static Load Limit (ASTM F970) 1500 psi

Flexibility (ASTM F137) Passes

Resistance to Heat (ASTM F1514) Passes

Resistance to Light (ASTM F1515) Passes

Radiant Flux (ASTM E648) Class I

Smoke Density (ASTM E 662) ≤ 450

Size & Squareness (ASTM F2055) Passes, +/- 0.016 in. per linear foot

Thickness (ASTM F386) Passes

Dimensional Stability (ASTM F2199) Passes

Residual Indentation (ASTM F1914) Passes

Resistance to Chemicals (ASTM F925) Passes

### Raised Rubber Flooring at Elevator Cab:

Basis of Design: Flextones Rubber Flooring – Color: Architect to select from Mfg full range of colors.

Floor tiles to meet ASTM F-1344 standard specification for rubber floor tile designation: IA. ADA slip resistance.

Size: 18-1/8" x 18-1/8"  
Tile Type: Round  
Gage: 3.18 mm  
Color: standard colors available (solids)

### Transition strip:

Provide 1" wide transition strips between all differing floor conditions.  
Provide 1" transition strips at all door openings.

Adhesives (Cements): Waterproof, stabilized type as recommended by flooring manufacturer to suit material and substrate conditions.

Concrete Slab Primer: Non staining type as recommended by flooring manufacturer.

Leveling Compound: Latex type as recommended by flooring manufacturer.

## PART 3 - EXECUTION

### PREPARATION:

Broom clean or vacuum surfaces to be covered, and inspect sub-floor. Start of flooring installation indicates acceptance of sub-floor conditions and full responsibility for completed work.

Use leveling compound as recommended by flooring manufacturer for filling small cracks and depressions in sub-floors.

Perform moisture tests on concrete slabs to determine that concrete surfaces are sufficiently cured and ready to receive flooring.

Apply concrete slab primer, if recommended by flooring manufacturer, prior to application of adhesive. Apply in compliance with manufacturer's directions.

### INSTALLATION:

#### General:

Install flooring using method indicated in strict compliance with manufacturer's recommendations. Extend flooring into toe spaces, door reveals, and into closets and similar openings.

Maintain reference markers, holes, or openings that are in place or plainly marked for future cutting by repeating on finish flooring as marked on sub-floor. Use chalk or other non-permanent marking device.

Install flooring on covers for telephone and electrical ducts, and other such items as occur within finished floor areas.

Maintain overall continuity of color and pattern with pieces of flooring installed on these

covers. Tightly cement edges to perimeter of floor around covers and to covers.

Tightly cement flooring to sub-base without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, or other surface imperfections. Hand roll flooring at perimeter of each covered area to assure adhesion.

#### Tile Floors:

Lay tile from center marks established with principal walls, discounting minor offsets, so that tile at opposite edges of room are of equal width. Adjust as necessary to avoid use of cut widths less than 1/2 tile at room perimeters. Lay tile square to room axis, unless otherwise shown.

Match tiles for color and pattern by using tile from cartons in same sequence as manufactured and packaged. Cut tile neatly around all fixtures. Broken, cracked, chipped, or deformed tiles are not acceptable.

Lay tile in "checkerboard" fashion with grain reversed in adjacent tiles.

Adhere tile flooring to substrates using full spread of adhesive applied in compliance with flooring manufacturer's directions.

#### Accessories:

Apply wall base to walls, columns, pilasters, casework and other permanent fixtures in rooms or areas where base is required. Install base in lengths as long as practicable, with preformed corner units, or fabricated from base materials with metered or coped inside corners. Tightly bond tile to substrate throughout length of each piece to provide continuous contact at horizontal and vertical surfaces.

On masonry surfaces, or other similar irregular surfaces, fill voids along top edge of resilient wall base with manufacturer's recommended adhesive filler material.

Place resilient edge strips tightly butted to flooring and secure with adhesive. Install edging strips at edges of flooring which, when changed to different floor material, would otherwise be exposed.

#### CLEANING AND PROTECTION:

Remove any excess adhesive or other surface blemishes, using neutral type cleaners as recommended by flooring manufacturer. Protect installed flooring with heavy Kraft paper or other covering.

Finishing: After completion of project and just prior to final inspection of work, thoroughly clean floors and accessories.

END OF SECTION 09650

## SECTION 096623 - RESINOUS MATRIX TERRAZZO FLOORING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes thin-set, epoxy-resin terrazzo flooring.

#### 1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Include terrazzo installation requirements. Include plans, sections, component details, and relationship to other work.
- C. Samples: For each exposed product and for each color and texture specified.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Material certificates.
- C. Preinstallation moisture-testing reports.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Maintenance data.

#### 1.6 QUALITY ASSURANCE

- A. Installer Qualifications:
  - 1. Engage an installer who is a contractor member of NTMA.
  - 2. Engage an installer who is certified in writing by terrazzo manufacturer as qualified to install manufacturer's products.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. NTMA Standards: Comply with NTMA's written recommendations for terrazzo type indicated unless more stringent requirements are specified.

### 2.2 EPOXY-RESIN TERRAZZO

- A. Epoxy-Resin Terrazzo: Comply with manufacturer's written instructions for matrix and aggregate proportions and mixing.
- B. Mix Color and Pattern: As selected by Architect from all series of NTMA's "Terrazzo Color Palette". Allow for (2) selections.
- C. Materials:
  - 1. Moisture-Vapor-Emission-Control Membrane: Two-component, high-solids, high-density, low-odor, epoxy-based membrane-forming product produced by epoxy terrazzo manufacturer that reduces moisture emission from concrete substrate to not more than 3 lb of water/1000 sq. ft. in 24 hours.
  - 2. Substrate-Crack-Suppression Membrane: Product of terrazzo-resin manufacturer, having minimum 120 percent elongation potential according to ASTM D412.
    - a. Reinforcement: Fiberglass scrim.
  - 3. Primer: Manufacturer's product recommended for substrate and use indicated.
  - 4. Epoxy-Resin Matrix: Manufacturer's standard recommended for use indicated and in color required for mix indicated.
  - 5. Finishing Grout: Resin based.

### 2.3 STRIP MATERIALS

- A. Thin-Set Divider Strips: L-type angle in depth required for topping thickness indicated.
  - 1. Material: Aluminum.
  - 2. Top Width: 1/8 inch.
- B. Control-Joint Strips: Separate, double L-type angles, positioned back to back, that match material and color of divider strips and in depth required for topping thickness indicated.
- C. Accessory Strips: Match divider-strip width, material, and color unless otherwise indicated. Use the following types of accessory strips as required to provide a complete installation:
  - 1. Base-bead strips for exposed top edge of terrazzo base.
  - 2. Edge-bead strips for exposed edges of terrazzo.

## 2.4 MISCELLANEOUS ACCESSORIES

- A. Strip Adhesive: Epoxy-resin adhesive recommended by adhesive manufacturer for this use.
- B. Anchoring Devices: Provide mechanical anchoring devices or adhesives for strip materials as recommended by manufacturer and as required for secure attachment to substrate.
- C. Patching and Fill Material: Terrazzo manufacturer's resinous product approved and recommended by manufacturer for application indicated.
- D. Joint Compound: Terrazzo manufacturer's resinous product approved and recommended by manufacturer for application indicated.
- E. Resinous Matrix Terrazzo Cleaner: Chemically neutral cleaner with pH factor between 7 and 10 that is biodegradable, phosphate free, and recommended by sealer manufacturer for use on terrazzo type indicated.
- F. Sealer: Slip- and stain-resistant, penetrating-type sealer that is chemically neutral; does not affect terrazzo color or physical properties; and is recommended by sealer manufacturer.
  - 1. Surface Friction: Not less than 0.6 according to ASTM D2047.
  - 2. Acid-Base Properties: With pH factor between 7 and 10.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Clean substrates of substances, including oil, grease, and curing compounds, that might impair terrazzo bond. Provide clean, dry, and neutral substrate for terrazzo application.
- B. Concrete Slabs:
  - 1. Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants incompatible with terrazzo.
    - a. Shot-blast surfaces with an apparatus that abrades the concrete surface, contains the dispensed shot within the apparatus, and recirculates the shot by vacuum pickup.
    - b. Repair damaged and deteriorated concrete according to terrazzo manufacturer's written instructions.
    - c. Use patching and fill material to fill holes and depressions in substrates according to terrazzo manufacturer's written instructions.
- C. Verify that concrete substrates are dry and moisture-vapor emissions are within acceptable levels according to manufacturer's written instructions.
- D. Preinstallation Moisture Testing:
  - 1. Testing Agency: Engage a qualified testing agency to perform tests.

2. Moisture Testing: Perform tests so that each test area does not exceed 200 sq. ft. and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
    - a. Moisture-Vapor-Emission Test: Maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours when tested according to ASTM F1869 using anhydrous calcium chloride.
    - b. Relative Humidity Test: Maximum 75 percent relative humidity measurement when tested according to ASTM F2170 using in-situ probes.
  3. Proceed with terrazzo installation only after concrete substrates pass moisture testing.
- E. Moisture-Vapor-Emission-Control Membrane: Install according to manufacturer's written instructions.
1. Install on concrete substrates that incorporate lightweight aggregates.
  2. Install concrete substrates that fail preinstallation moisture testing.
- F. Substrate-Crack-Suppression Membrane: Install to isolate and suppress substrate cracks according to manufacturer's written instructions.
1. Prepare and prefill substrate cracks with membrane material.
  2. Install membrane at substrate cracks in areas to receive terrazzo.
  3. Reinforce membrane with fiberglass scrim.
- G. Protect other work from water and dust generated by grinding operations. Control water and dust to comply with environmental protection regulations.
1. Erect and maintain temporary enclosures and other suitable methods to limit water damage and dust migration and to ensure adequate ambient temperatures and ventilation conditions during installation.

### 3.2 EPOXY-RESIN TERRAZZO INSTALLATION

- A. Comply with NTMA's written recommendations for terrazzo and accessory installation.
- B. Strip Materials:
1. Divider and Control-Joint Strips:
    - a. Locate divider strips in locations indicated.
    - b. Install control-joint strips back to back and directly above concrete-slab control joints.
    - c. Install control-joint strips with 1/4-inch gap between strips, and install sealant in gap.
    - d. Install strips in adhesive setting bed without voids below strips, or mechanically anchor strips as required to attach strips to substrate, as recommended by strip manufacturer.
- C. Apply primer to terrazzo substrates according to manufacturer's written instructions.



- D. Place, rough grind, grout, cure grout, fine grind, and finish terrazzo according to manufacturer's written instructions.
  - 1. Installed Thickness: 1/4 inch.
  - 2. Terrazzo Finishing: Ensure that matrix components and fluids from grinding operations do not stain terrazzo by reacting with divider and control-joint strips.
    - a. Rough Grinding: Grind with 24-grit or finer stones or with comparable diamond abrasives. Follow initial grind with 60/80-grit stones or with comparable diamond abrasives.
    - b. Grouting: Before grouting, clean terrazzo with water, rinse, and allow to dry. Apply and cure epoxy grout.
    - c. Fine Grinding/Polishing: Delay fine grinding until heavy trade work is complete and construction traffic through area is restricted. Grind with [80] [120]-grit stones or with comparable diamond abrasives until grout is removed from surface.
  - 3. Installation Tolerance: Limit variation in terrazzo surface from level to [1/4 inch in 10 feet noncumulative.
- E. Install and finish poured-in-place terrazzo stairs at the same time the adjacent terrazzo flooring is installed.
- F. Install and finish poured-in-place terrazzo base at the same time the adjacent terrazzo flooring is installed.
- G. Cut out and replace terrazzo areas that evidence lack of bond with substrate. Cut out terrazzo areas in panels defined by strips and replace to match adjacent terrazzo, or repair panels according to NTMA's written recommendations, as approved by Architect.
- H. Cleaning:
  - 1. Remove grinding dust from installation and adjacent areas.
  - 2. Wash surfaces with cleaner according to NTMA's written recommendations and manufacturer's written instructions; rinse surfaces with water and allow them to dry thoroughly.
- I. Sealing:
  - 1. Seal surfaces according to NTMA's written recommendations.
  - 2. Apply sealer according to sealer manufacturer's written instructions.

END OF SECTION 096623

## SECTION 096813 - TILE CARPETING

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Modular carpet tile.

#### 1.2 PREINSTALLATION MEETINGS

- ##### A. Preinstallation Conference: Conduct conference at Project site.

#### 1.3 ACTION SUBMITTALS

- ##### A. Product Data: For each type of product.

- ##### B. Shop Drawings: For carpet tile installation, plans showing the following:

1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet tiles.
2. Carpet tile type, color, and dye lot.
3. Type of subfloor.
4. Type of installation.
5. Pattern of installation.
6. Pattern type, location, and direction.
7. Pile direction.
8. Type, color, and location of insets and borders.
9. Type, color, and location of edge, transition, and other accessory strips.
10. Transition details to other flooring materials.

- ##### C. Samples: For each exposed product and for each color and texture required.

#### 1.4 INFORMATIONAL SUBMITTALS

- ##### A. Product test reports.

- ##### B. Sample warranty.

#### 1.5 CLOSEOUT SUBMITTALS

- ##### A. Maintenance data.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Certified by manufacture to install product.

1.7 WARRANTY

- A. Special Warranty for Carpet Tiles: Manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.

- 1. Warranty Period: Manufacturers Standard Warranty

PART 2 - PRODUCTS

2.1 CARPET TILE

- A. Basis of Design: Interface  
Acceptable Manufacturers:  
Mannington  
Patcraft
- B. Collection: Aerial Flying Colors (Series AE311 and AE317)
- C. Color: As selected by Architect from manufacturer's full range,
- D. Fiber Content: 100 percent recycled content nylon.
- E. Yarn Manufacturer Aquafil
- F. Dye Method 100% Solution Dyed
- G. Soil/Stain Protection Protekt<sup>2</sup>
- H. Preservative Protection Intersept
- I. Imperial Metric
- J. Tufted Yarn Weight 15 oz/yd<sup>2</sup> 509 g/m<sup>2</sup>
- K. Machine Gauge 1/12 in 47.2 ends/10cm
- L. Pile Height 0.18 in 4.6 mm
- M. Pile Thickness 0.097 in 2.5 mm
- N. Stitches 9 /in 35.4 ends/10cm
- O. Pile Density 5,567 oz/yd<sup>3</sup> 206,423.1 g/m<sup>3</sup>
- P. Size 9.845 in x 39.38 in 25cm x 1m

## 2.2. PERFORMANCE SPECIFICATIONS

- A. Flooring Radiant Panel (ASTM E-648) Passes
- B. Smoke Density (ASTM E 662)  $\leq 450$
- C. Flammability Passes Methenamine Pill Test (DOC-FF1-70)
- D. Lightfastness (AATCC 16 - E)  $\geq 4.0 @ 60$  AFU's
- E. Static (AATCC - 134)  $< 3.0$  KV
- F. Dimensional Stability AACHEN Din 54318  $<.10\%$
- G. Traffic Classification Heavy
- H. Fiber Modification Ratio 1.9 to 2.2
- I. Preservative Efficacy (AATCC 174 Parts 2&3) 99% Reduction/No Mold 7 Days
- J. (ASTM E-2471) Complete Inhibition

## 2.2 INSTALLATION ACCESSORIES

- A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.
- B. Adhesives: Water-resistant, mildew-resistant, no staining, pressure-sensitive type to suit products and subfloor conditions indicated, that comply with flammability requirements for installed carpet tile, and are recommended by carpet tile manufacturer for releasable installation.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Concrete Slabs:
  - 1. Moisture Testing: Perform tests so that each test area does not exceed 1000 sq. ft., and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
    - a. Anhydrous Calcium Chloride Test: ASTM F1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. 24 hours.
    - b. Relative Humidity Test: Using in situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
    - c. Perform additional moisture tests recommended in writing by adhesive and carpet tile manufacturers. Proceed with installation only after substrates pass testing.

### 3.2 PREPARATION

- A. General: Comply with the Carpet and Rug Institute's CRI 104 and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile.
- B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8-inch-wide or wider, and protrusions more than 1/32 inch unless more stringent requirements are required by manufacturer's written instructions.
- C. Concrete Substrates: 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 adhesive and carpet tile manufacturers.
- D. Metal Substrates: Clean grease, oil, soil and rust, and prime if recommended in writing by adhesive manufacturer. Rough sand painted metal surfaces and remove loose paint. Sand aluminum surfaces, to remove metal oxides, immediately before applying adhesive.
- E. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

### 3.3 INSTALLATION

- A. General: Comply with the Carpet and Rug Institute's CRI 104, Section 10, "Carpet Tile," and with carpet tile manufacturer's written installation instructions.
- B. Installation Method: As recommended in writing by carpet tile manufacturer.
- C. Maintain dye-lot integrity. Do not mix dye lots in same area.
- D. Maintain pile-direction patterns recommended in writing by carpet tile manufacturer.
- E. Cut and fit carpet tile 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 tile manufacturer.
- F. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
- G. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on carpet tile as marked on subfloor. Use nonpermanent, nonstaining marking device.
- H. Install pattern parallel to walls and borders.
- I. Access Flooring: Stagger joints of carpet tiles so carpet tile grid is offset from access flooring panel grid. Do not fill seams of access flooring panels with carpet adhesive; keep seams free of adhesive.

- J. Protect carpet tile 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 tile manufacturer.

END OF SECTION 096813

## **SECTION 099000 PAINTING**

### **PART 1 GENERAL**

#### **RELATED DOCUMENTS:**

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work in this section.

#### **DESCRIPTION OF WORK:**

Extent of painting work is indicated on drawings and schedules, and as herein specified.

Work includes painting and finishing of interior and exterior exposed items and surfaces throughout Project, except as otherwise indicated.

Surface preparation, priming and coats or paint specified are in addition to shop priming and surface treatment specified under other sections of work.

"Paint" as used herein means all coating systems materials, including primers, emulsions, enamels, stains, sealers and fillers, and other applied materials whether used as prime, intermediate or finish coats.

Paint exposed surfaces whether or not colors are designated in "schedules", except where natural finish of material is specifically noted as a surface not to be painted. Where items or surfaces are not specifically mentioned, paint the same as similar adjacent materials or areas. If color or finish is not designated, Architect will select these from standard colors available for materials systems specified.

Pre Finished Items: Unless otherwise indicated, do not include painting when factory finishing or installer finishing is specified for such items as (but not limited to) metal toilet enclosures, pre-finished partition systems, acoustic materials, architectural woodwork and casework, finished mechanical and electrical equipment, including light fixtures, switchgear and distribution cabinets, elevator entrance frames, doors and equipment.

Concealed Surfaces: Unless otherwise indicated, painting is not required on surfaces such as walls or ceilings in concealed areas and generally inaccessible areas, foundation spaces, furred areas, utility tunnels, pipe spaces, duct shafts and elevator shafts.

Finished Metal Surfaces: Unless otherwise indicated, metal surfaces of anodized aluminum, stainless steel, chromium plate, copper, bronze and similar finished materials will not require finish painting.

Operating Parts: Unless otherwise indicated, moving parts of operating units, mechanical and electrical parts, such as valve and damper operators, linkages, sensing devices, and motor and fan shafts will not require finish painting.

Do not paint over any code required labels, such as Underwriters' Laboratories and Factory Mutual, or any equipment identification, performance rating, name, or nomenclature plates.

#### **SUBMITTALS:**

Product Data: Submit manufacturer's technical information including Paint label analysis and application instructions for each material proposed for use.

Samples: Submit samples for Architect's review of color and texture only. Provide a listing of

material and application for each coat of each finish sample.

On 12" x 12" hardboard, provide two samples of each color and material, with texture to simulate actual conditions. Resubmit samples as requested by Architect until acceptable sheen, color, and texture is achieved.

On actual wood surfaces, provide two 4" x 8" samples of natural and stained wood finish. Label and identify each as to location and application.

On concrete masonry, provide two 4" square samples of masonry for each type of finish and color, defining filler, prime and finish coat.

#### DELIVERY AND STORAGE:

Deliver materials to job site in original, new and unopened packages and containers bearing manufacturer's name and label, and following information:

Name or title of material.

Fed. Spec. number, if applicable.

Manufacturer's stock number and date of manufacture.

Manufacturer's name.

Contents by volume, for major pigment and vehicle constituents.

Thinning instructions.

Application instructions.

Color name and number.

#### JOB CONDITIONS:

Apply water base paints only when temperature of surfaces to be painted and surrounding air temperatures are between 50 degrees F (10 degrees C) and 90 degrees F (32 degrees C), unless otherwise permitted by paint manufacturer's printed instructions.

Apply solvent thinned paints only when temperature of surfaces to be painted and surrounding air temperatures are between 45 degrees F (7 degrees C) and 95 degrees F (35 degrees C), unless otherwise permitted by paint manufacturer's printed instructions.

Do not paint in snow, rain, fog or mist, or when relative humidity exceeds 85%, or to damp or wet surfaces, unless otherwise permitted by paint manufacturer's printed instructions.

Painting may be continued during inclement weather if areas and surfaces to be painted are enclosed and heated within temperature limits specified by paint manufacturer during application and drying periods.

## PART 2 PRODUCTS

### COLORS AND FINISHES:

Paint colors, surface treatments, and finishes, are indicated in "schedules" of the contract documents.

Prior to beginning work, Architect will furnish color chips for surfaces to be painted.

Use representative colors when preparing samples for review.



MANUFACTURERS: for interior paint system only:

Sherwin Williams  
Technical Coatings Inc.  
Jones Blair  
Pittsburgh Paint

Manufacturers for exposed steel and exterior paint systems:  
Tnemec (no substitutes for this product)

Color Pigments: Pure, non-fading, applicable types to suit substrates and service indicated.

Paint Coordination: Provide finish coats which are compatible with prime paints used. Review other sections of these specifications in which prime paints are to be provided to ensure compatibility of total coatings system for various substrates. Upon request from other trades, furnish information on characteristics of finish materials proposed for use, to ensure compatible prime coats are used. Provide barrier coats over incompatible primers or remove and re-prime as required. Notify Architect in writing of any anticipated problems using specified coating systems with substrates primed by others.

MATERIALS:

Material Quality: Provide best quality grade of various types of coatings as regularly manufactured by acceptable paint materials manufacturers. Materials not displaying manufacturer's identification as a standard, best grade product will not be acceptable.

EXTERIOR PAINT SYSTEMS (EPS):

Provide following paint systems for various substrates, as indicated.

General Paint Wood:

EPS-1 1<sup>st</sup> coat - Primer undercoat (T-P-25).  
2<sup>nd</sup> coat - Acrylic emulsion (TT-P-19).  
3<sup>rd</sup> coat - Acrylic emulsion (TT-P-19).

Painted Wood Trim:

EPS-2: 1<sup>st</sup> coat - Primer undercoat (TT-P-25).  
2<sup>nd</sup> coat - Alkyd trim enamel (TT-P-37).  
3<sup>rd</sup> coat - Alkyd trim enamel (TT-P-37).

Painted Plywood:

EPS-3 1<sup>st</sup> coat - Surface sealer (TT-S-176).  
2<sup>nd</sup> coat - Primer undercoat (TT-P-25).  
3<sup>rd</sup> coat - Acrylic emulsion (TT-P-19).  
4<sup>th</sup> coat - Acrylic emulsion (TT-P-19).

EXTERIOR CMU

1st Coat - TNEMEC Series 130 Envirofill 60-85SFPG  
2nd Coat and 3rd Coat - TNEMEC Series 157 Enviro-Crete TX 99-111 SFPG

EXPOSED STRUCTURAL STEEL AND ACCESSORIES

Surface Preparation: Commercial Blast Cleaning as per SSPC-SP6. Note do not use this paint

system if surface has been hot dipped galvanized.

Coating System:

Primer:	Tnemec Series 90-97 Tneme-Zinc	2.5 - 3.5 dry mils
First Coat:	Tnemec Series 27WB Typoxy	4.0 - 6.0 dry mils
Finish Coat:	Tnemec Series 740 UVX	3.0 - 5.0 dry mils

EXPOSED STRUCTURAL STEEL AND ACCESSORIES (Hot Dipped Galvanized)

Surface Preparation: Abrasive blast as per ASTM D 6386 providing a minimum 1.5 mil angular anchor profile.

Coating System:

First Coat:	Tnemec Series 27WB Typoxy	4.0 - 6.0 dry mils
Finish Coat:	Tnemec Series 740 UVX	3.0 - 5.0 dry mils

INTERIOR PAINT SYSTEMS:

Provide following paint systems for various substrates, as indicated.

Concrete Masonry units (Epoxy Coating):

IPS2: 1<sup>st</sup> Coat - Heavy Duty Block Filler  
2<sup>nd</sup> Coat- Waterbased Tile Clad Epoxy  
3<sup>rd</sup> Coat - Waterbased Tile Clad Epoxy

Concrete Masonry units:

IPS2: 1<sup>st</sup> Coat - PROMAR Interior/Exterior Block Filler  
2<sup>nd</sup> Coat- PROMAR 200 Interior Latex Semi-Gloss  
3<sup>rd</sup> Coat - PROMAR 200 Interior Latex Semi-Gloss

Apply filler coat at a rate to ensure complete coverage with pores filled. Not less than 3.5 mils dry film thickness, excluding first coat.

Exposed Metal:

IPS2: 1<sup>st</sup> Coat – PROMAR Interior Latex Primer  
2<sup>nd</sup> Coat – PROMAR 200 Interior Latex Semi-Gloss  
3<sup>rd</sup> Coat – PROMAR 200 Interior Latex Semi-Gloss

Gypsum Drywall Systems – (General Use):

1<sup>st</sup> Coat - Interior Latex Based Primer Coat (FS TT-P-650).  
2<sup>nd</sup> Coat & 3<sup>rd</sup> Coat – Odorless interior semi-gloss latex enamel (TS TT-E-509)  
Not less than 2.5 mils dry film thickness.

Painted Wood Work and Hardboard:

IPS-6: 1<sup>st</sup> Coat - Enamel Undercoat.  
2<sup>nd</sup> Coat- Semi-gloss enamel.  
3<sup>rd</sup> Coat - Semi-gloss enamel

Stained Woodwork:

IPS-5: 1<sup>st</sup> Coat - Exterior oil stain.  
2<sup>nd</sup> Coat - Bleached Shellac.  
3<sup>rd</sup> Coat - Rubbing Varnish.  
4<sup>th</sup> Coat - Rubbing Varnish.

Surface Preparation: Wood must be dry and cleaned of dirt, grease, wax, polish, and marks. Old

finishes in poor condition should be completely removed and the surface treated as a new surface (this shall apply to existing floors only). Sand wood to a smooth surface using 100-120 grit paper. If wood is stained, sand carefully to avoid sanding through the color. Remove sanding dust with a vacuum, no dust cloths shall be permitted. New wood should be stored inside for a minimum of 24 hours prior to staining. Stain or varnish applied to wood that has not been dried can exhibit blotching, discoloration, or cracking.

### PART 3 EXECUTION

#### INSPECTION:

Applicator must examine areas and conditions under which painting work is to be applied and notify Contractor in writing of conditions detrimental to proper and timely completion of work. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to Applicator.

Starting of painting work will be construed as Applicator's acceptance of surfaces and conditions within any particular area.

Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions otherwise detrimental to formation of a durable paint film.

#### SURFACE PREPARATION:

General: Perform preparation and cleaning procedures in accordance with paint manufacturer's instructions and as herein specified, for each particular substrate condition.

Remove hardware, hardware accessories, machined surfaces, plates, lighting fixtures, and similar items in place and not to be finish painted, or provide surface applied protection prior to surface preparation and painting operations. Remove, if necessary, for complete painting of items and adjacent surfaces. Following completion of painting of each space or area, reinstall removed items.

Clean surfaces to be painted before applying paint or surface treatments. Remove oil and grease prior to mechanical cleaning. Program cleaning and painting so that contaminants from cleaning process will not fall onto wet, newly painted surfaces.

Cementitious Materials: Prepare cementitious surfaces of concrete, concrete block to be painted by removing efflorescence, chalk, dust, dirt, grease, oils, and by roughening as required to remove glaze as required. Determine alkalinity and moisture content of surfaces to be painted by performing appropriate tests. If surfaces are found to be sufficiently alkaline to cause blistering and burning of finish paint, correct this condition before application of paint. Do not paint over surfaces where moisture content exceeds that permitted in manufacturer's printed directions.

Clean concrete floor surfaces scheduled to be painted with a commercial solution or muriatic acid, or other etching cleaner. Flush floor with clean water to neutralize acid, and allow to dry before painting.

Wood: Clean wood surfaces to be painted of dirt, oil, or other foreign substances with scrapers, mineral spirits, and sandpaper, as required. Sandpaper smooth those finished surfaces exposed to view, and dust off. Scrape and clean small, dry, seasoned knots and apply a thin coat of white shellac or other recommended knot sealer, before application of priming coat. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood filler. Sandpaper smooth when dried.

Prime, stain, or seal wood required to be job painted immediately upon delivery to job. Prime

edges, ends, faces, undersides, and backsides of such wood, including cabinets, counters, cases, paneling. When transparent finish is required, use spar varnish for back-priming.

Back-prime paneling on interior partitions only where masonry or other wet wall construction occurs on backside.

Seal tops, bottoms, and cut outs of unprimed wood doors with a heavy coat of varnish or equivalent sealer immediately upon delivery to job.

Ferrous Metals: Clean ferrous surfaces, which are not galvanized or shop coated, of oil, grease, dirt, loose mill scale and other foreign substances by solvent or mechanical cleaning.

Touch up shop applied prime coats wherever damaged or bare, where required by other sections of these specifications. Clean and touch up with same type shop primer.

Galvanized Surfaces: Clean free of oil and surface contaminants with non petroleum based solvent.

#### MATERIALS PREPARATION:

Mix and prepare painting materials in accordance with manufacturer's directions.

Maintain containers used in mixing and application of paint in a clean condition, free of foreign materials and residue. Store materials not in actual use in tightly covered containers.

Stir materials before application to produce a mixture of uniform density, and stir as required during application. Do not stir surface film into material. Remove film and, if necessary, strain material before using.

#### APPLICATION:

General: Apply paint in accordance with manufacturer's directions. Use applicators and techniques best suited for substrate and type of material being applied.

Apply additional coats when undercoats, stains or other conditions show through final coat of paint, until paint film is of uniform finish, color and appearance. Give special attention to insure that surfaces, including edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.

Paint surfaces behind permanently fixed equipment or furniture with prime coat only before final installation of equipment.

Paint interior surfaces of ducts, where visible through registers or grilles, with a flat, non-specular black paint. Paint back sides of access panels, and removable or hinged covers to match exposed surfaces.

Finish exterior doors on tops, bottoms and side edges same as exterior faces, unless otherwise indicated. Sand lightly between each succeeding enamel or varnish coat.

Omit first coat (primer) on metal surfaces which have been shop primed and touch up painted, unless otherwise indicated.

Scheduling Painting: Apply first coat material to surfaces that have been cleaned, pretreated or otherwise prepared for painting as soon as practicable after preparation and before subsequent

surface deterioration.

Allow sufficient time between successive coatings to permit proper drying. Do not recoat until paint has dried to where it feels firm, does not deform or feel sticky under moderate thumb pressure, and application of another coat of paint does not cause lifting or loss of adhesion of the undercoat.

Minimum Coating Thickness: Apply materials at not less than manufacturer's recommended spreading rate, to establish a total dry film thickness as indicated or, if not indicated, as recommended by coating manufacturer.

Prime Coats: Apply prime coat of material which is required to be painted or finished, and which has not been prime coated by others.

Recoat primed and sealed surfaces where there is evidence of suction spots or unsealed areas in first coat, to assure a finish coat with no burn through or other defects due to insufficient sealing.

Stipple Enamel Finish: Roll and redistribute paint to an even and fine texture. Leave no evidence of rolling such as laps, irregularity in texture, skid marks, or other surface imperfections.

Pigmented (Opaque) Finishes: Completely cover to provide an opaque, smooth surface of uniform finish, color, appearance and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness or other surface imperfections will not be acceptable.

Transparent (Clear) Finish: 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, unless otherwise indicated.

Completed Work: Match approved samples for color, texture and coverage. Remove, refinish or repaint work not in compliance with specified requirements.

#### FIELD QUALITY CONTROL:

The right is reserved by Owner to invoke the following material testing procedure at any time, and any number of times during period of field painting:

Engage services of an independent testing laboratory to sample paint being used. Samples of materials delivered to project site will be taken, identified and sealed, and certified in presence of Contractor.

Testing laboratory will perform appropriate tests for any or all of following characteristics: Abrasion resistance, apparent reflectivity, flexibility, washability, absorption, accelerated weathering, dry opacity, accelerated yellowness, recoating, skinning, color retention, alkali resistance and quantitative materials analysis.

If test results show that material being used does not comply with specified requirements, Contractor may be directed to stop painting work, and remove non complying paint; pay for testing; repaint surfaces coated with rejected paint; remove rejected paint from previously painted surfaces if, upon repainting with specified paint, the two coatings are non compatible.

#### CLEAN UP AND PROTECTION:

Clean Up: During progress of work, remove from site discarded paint materials, rubbish, cans and rags at end of each work day. Upon completion of painting work, clean window glass and other paint spattered surfaces. Remove spattered paint by proper methods of washing and scraping, using care not to scratch or otherwise damage finished surfaces.

Protection: Protect work of other trades, whether to be painted or not, against damage by painting and finishing work. Correct any damage by cleaning, repairing or replacing, and repainting, as acceptable to Architect.

Provide "Wet Paint" signs as required to protect newly painted finishes. Remove temporary protective wrappings provided by others for protection of their work, after completion of painting operations.

At completion of work of other trades, touch up and restore all damaged or defaced painted surfaces.

END OF SECTION 099000

## SECTION 101000 VISUAL DISPLAY SURFACES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes: Visual display surfaces and accessories necessary for installation, and as follows:
  - 1. Markerboards.
  - 2. Tackboards.

#### 1.2 DEFINITIONS

- A. Tackboard: Framed or unframed, tackable, visual display board assembly.
- B. Visual Display Board Assembly: Visual display surface that is factory fabricated into composite panel form, either with or without a perimeter frame; includes chalkboards, markerboards, and tackboards.

#### 1.3 SUBMITTALS

- A. Product Data: Manufacturer's technical literature for each product and system indicated.
  - 1. Include manufacturer's specifications for materials, finishes, construction details, installation instructions, and recommendations for maintenance.
- B. Shop Drawings: Show details of fabrication and installation, including plans, elevations, sections, details of components and attachments to other work. Distinguish between shop and field-assembled work.
  - 1. Show locations of panel joints.
  - 2. Show locations of special-purpose graphics for visual display surfaces.
  - 3. Include sections of typical trim members.
- C. Samples for Initial Selection: For each type of visual display surface indicated, for units with factory-applied color finishes, and as follows:
  - 1. Actual sections of porcelain-enamel face sheet tackboard assembly visual display wall covering.
  - 2. Include accessory Samples to verify color selected.
- D. Samples for Verification: For each type of visual display surface indicated.
  - 1. Visual Display Surface: Not less than 8-1/2 in by 11 in (212 mm by 275 mm), mounted on substrate indicated for final Work. Include one panel for each type, color, and texture required.
  - 2. Trim: 6 in (150 mm) long sections of each trim profile.
  - 3. Display Rail: 6 in (150 mm) long sections.
  - 4. Accessories: Full-size Sample of each type of accessory.

- E. Product Schedule: For visual display surfaces. Use same designations indicated on Drawings.
- F. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for surface-burning characteristics of fabrics.
- G. Qualification Data: For installer.
  - 1. For firms and persons specified in "Quality Assurance" to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of Architects and Owners, and other information specified.
- H. Maintenance Data: To include in maintenance manuals.
- I. Warranty: Sample of warranty.
  - 1. Provide manufacturer's written warranty covering materials and installation (labor) stating obligations, remedies, limitations and exclusions.

#### 1.4 QUALITY ASSURANCE

- A. Installer Qualifications:
  - 1. Experience: Installer with not less than 5 years experience in performing specified Work similar to scope of this Project, with a record of successful in-service performance and completion of projects for a period of not less than 5 years, and with sufficient production capability, facilities, and personnel to produce required Work.
  - 2. Supervision: Installer shall maintain a competent supervisor who is at Project during times specified Work is in progress, and, who is experienced in installing systems similar to type and scope required for Project.
  - 3. Manufacturer Acceptance: Installer shall be certified, approved, licensed, or acceptable to manufacturer to install products.
- B. Source Limitations: Obtain visual display surfaces from single source from single manufacturer.
- C. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Flame-Spread Index: 25 or less.
  - 2. Smoke-Developed Index: 450 or less.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver factory-built visual display surfaces, including factory-applied trim where indicated, completely assembled in one piece without joints, where possible. If dimensions exceed maximum manufactured panel size, provide two or more pieces of equal length as acceptable to Architect. When overall dimensions require delivery in separate units, prefit components at the factory, disassemble for delivery, and make final joints at the site.
- B. Store visual display surfaces vertically with packing materials between each unit.



## 1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install visual display surfaces until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above ceilings is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

## 1.7 WARRANTY

- A. Special Warranty for Porcelain-Enamel Face Sheets: Manufacturer's standard form in which manufacturer agrees to repair or replace porcelain-enamel face sheets that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Surfaces lose original writing and erasing qualities.
    - b. Surfaces exhibit crazing, cracking, or flaking.
  - 2. Warranty Period: Life of the building.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS AND PRODUCTS

- A. Available Manufacturers and Products: Subject to compliance with requirements of Contract Documents as judged by the Architect, manufacturers offering products that may be incorporated into the Work include, but are not limited to, those listed.

### 2.2 MATERIALS, GENERAL

- A. Porcelain-Enamel Face Sheet: Manufacturer's standard steel sheet with porcelain-enamel coating fused to steel; uncoated thickness indicated.
  - 1. Manufacturers:
    - a. Claridge Products and Equipment, Inc.
    - b. PolyVision Corporation; a Steelcase company.
  - 2. Gloss Finish: Gloss as indicated; dry-erase markers wipe clean with dry cloth or standard eraser.
- B. Plastic-Impregnated Cork Sheet: Seamless, homogeneous, self-sealing sheet consisting of granulated cork, linseed oil, resin binders, and dry pigments that are mixed and calendared onto fabric backing; with washable vinyl finish and integral color throughout with surface-burning characteristics indicated.
- C. Particleboard: ANSI A208.1, Grade M-1, made with binder containing no added urea formaldehyde.
- D. Extruded Aluminum: ASTM B 221 / B 221M, Alloy 6063.

## 2.3 MARKERBOARD ASSEMBLIES

- A. Magnetic Porcelain-Enamel Markerboards: Balanced, high-pressure, factory-laminated markerboard assembly of three-ply construction consisting of backing sheet, core material, and porcelain-enamel magnetic steel face sheet, with low-gloss finish.
1. Manufacturers:
    - a. ADP Lemco, Inc.
    - b. Best-Rite Manufacturing.
    - c. Claridge Products and Equipment, Inc.
    - d. Ghent Manufacturing, Inc.
    - e. Marsh Industries, Inc.; Visual Products Group.
    - f. PolyVision Corporation; a Steelcase company.
  2. Particleboard Core: 3/8 in (10 mm) thick; with 0.015 in (0.38 mm) thick, aluminum sheet backing.
  3. Laminating Adhesive: Manufacturer's standard, moisture-resistant thermoplastic type.
  4. Color: As selected by Architect from manufacturer's standard colors.

## 2.4 TACKBOARD ASSEMBLIES

- A. Manufacturers:
1. ADP Lemco, Inc.
  2. Best-Rite Manufacturing.
  3. Claridge Products and Equipment, Inc.
  4. Ghent Manufacturing, Inc.
  5. Marsh Industries, Inc.; Visual Products Group.
  6. PolyVision Corporation; a Steelcase company.
- B. Plastic-Impregnated-Cork Tackboard: 1/4 in (6 mm) thick, plastic-impregnated cork sheet factory laminated to 1/4 in (6 mm) thick particleboard backing.
1. Color: As selected by Architect from manufacturer's standard colors.

## 2.5 ACCESSORIES

- A. Aluminum Frames and Trim: Fabricated from not less than 0.062 in (1.57 mm) thick, extruded aluminum; slim size and standard shape.
1. Factory-Applied Trim: Manufacturer's standard with no visible screws or exposed joints.
- B. Chalktray: Manufacturer's standard, continuous.
1. Solid Type: Extruded aluminum with ribbed section and smoothly curved exposed ends.
- C. Map Rail: Provide the following accessories:
1. Display Rail: Continuous and integral with map rail; fabricated from cork approximately 1 to 2 in (25 to 50 mm) wide.
  2. End Stops: Located at each end of map rail.
  3. Flag holders; where indicated, or one per room.

## 2.6 FABRICATION

- A. Porcelain-Enamel Visual Display Assemblies: Laminate porcelain-enamel face sheet and backing sheet to core material under heat and pressure with manufacturer's standard flexible, waterproof adhesive.
- B. Visual Display Boards: Factory assemble visual display boards unless field assembled units are required.
  - 1. Where factory-applied trim is indicated, trim shall be assembled and attached to visual display boards at manufacturer's factory before shipment.
- C. Aluminum Frames and Trim: Fabricate units straight and of single lengths, keeping joints to a minimum. Miter corners to a neat, hairline closure.
  - 1. Where factory-applied trim is indicated, trim shall be assembled and attached to visual display units at manufacturer's factory before shipment.

## 2.7 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

## 2.8 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Acceptance of Surfaces and Conditions: Examine substrates to receive products and systems and associated work for compliance with requirements and other conditions affecting performance. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents. Starting work within a particular area will be construed as acceptance of surface conditions.

### 3.2 INSTALLATION, GENERAL

- A. Installation Quality Standards: In addition to standards listed elsewhere, perform Work according to following, unless otherwise specified:
  - 1. Respective manufacturer's written installation instructions.
  - 2. Accepted submittals.
  - 3. Contract Documents.

- B. Install visual display surfaces in locations and at mounting heights indicated. Keep perimeter lines straight, level, and plumb. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for complete installation.

### 3.3 PREPARATION

- A. General: Comply with manufacturer's instructions, recommendations, and specifications for cleaning and surface preparation. Surfaces shall have no defects, contaminants, or errors which would result in poor or potentially defective installation or would cause latent defects in Work.

### 3.4 INSTALLATION OF FACTORY-FABRICATED VISUAL DISPLAY BOARDS AND ASSEMBLIES

- A. Visual Display Boards: Attach concealed clips, hangers, and grounds to wall surfaces and to visual display boards with fasteners at not more than 16 in o.c. Secure both top and bottom of boards to walls.

### 3.5 CLEANING AND PROTECTION

- A. Clean visual display surfaces according to manufacturer's written instructions. Attach one cleaning label to visual display surface in each room.
- B. Touch up factory-applied finishes to restore damaged or soiled areas.
- C. Cover and protect visual display surfaces after installation and cleaning.

END OF SECTION

## SECTION 102100 – TOILET COMPARTMENTS

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Solid plastic toilet compartments including the following: (Hiny Hiders)
  - 1. Floor mounted overhead-braced toilet compartments.
  - 2. Privacy screens.

#### 1.2 RELATED SECTIONS

- A. Section 05 50 00 - Metal Fabrications.
- B. Section 06 10 00 - Rough Carpentry.

#### 1.3 REFERENCES

- A. ASTM A 666 - Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
- B. ASTM B 221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
- C. National Fire Protection Association (NFPA) 286 - Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth.
- D. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

#### 1.4 SUBMITTALS

- A. Submit under provisions of Section 01 30 00 - Administrative Requirements.
- 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.
- C. Shop Drawings: Provide layout drawings and installation details with location and type of hardware required.
- D. Verification Samples: For each finish product specified, two samples representing actual product, color, and patterns.
- E. Sustainable Design Submittals:
  - 1. Recycled Content: Certify percentages of post-consumer and pre-consumer recycled content.
  - 2. Regional Materials: Certify distance between manufacturer and Project and between manufacturer.

#### 1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A company regularly engaged in manufacture of products specified in this section, and whose products have been in satisfactory use under similar service conditions for not less than 5 years.

- B. Installer Qualifications: A company regularly engaged in installation of products specified in this Section, with a minimum of 5 years experience.
- C. Materials: Doors, panels and pilasters, constructed from high density polyethylene (HDPE) resins. Partitions to be fabricated from polymer resins compounded under high pressure, forming a single component which is waterproof, nonabsorbent and has a self-lubricating surface that resists marks from pens, pencils, markers and other writing instruments. Cover all plastic components with a protective plastic masking.
- D. Performance Requirements:
  - 1. Fire Resistance: Partition materials shall comply with the following requirements, when tested in accordance with ASTM E 84:
    - a. Class A flame spread/smoke developed rating.
    - b. Class B flame spread/smoke developed rating.
  - 2. Material Fire Ratings:
    - a. National Fire Protection Association (NFPA) 286: Pass.
    - b. International Code Council (ICC): Class B.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.

#### 1.7 PROJECT CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

#### 1.8 WARRANTY

- A. Manufacturer guarantees its plastic against breakage, corrosion, and delamination under normal conditions for 25 years from the date of receipt by the customer. If materials are found to be defective during that period for reasons listed above, the materials will be replaced free of charge. Labor not included in warranty.

### PART 2 PRODUCTS

#### 2.1 MANUFACTURERS

- A. Acceptable Manufacturer: Scranton Products, which is located at: 801 E. Corey St.; Scranton, PA 18505; Toll Free Tel: 800-445-5148; Fax: 855-376-6161; Email:[request info \(info@scrantonproducts.com\)](mailto:request_info@scrantonproducts.com); Web:[www.scrantonproducts.com](http://www.scrantonproducts.com)
  - 1. Fabricator: Santana Toilet Partitions.
  - 2. Fabricator: Comtec Toilet Partitions.
  - 3. Fabricator: Capitol Toilet Partitions.
- B. Requests for substitutions will be considered in accordance with provisions of Section 01 60 00 - Product Requirements.

#### 2.2 MATERIAL

- A. Plastic Panels: High density polyethylene (HDPE) suitable for exposed applications, waterproof, non-absorbent, and graffiti-resistant textured surface.
  - 1. Recycled Content; Post Industrial: 25 percent.
  - 2. Recycled Content; Post Industrial: 100 percent.
  - 3. Recycled Content; Post Consumer: 100 percent.
- B. Zinc Aluminum Magnesium and Copper Alloy (Zamac): ASTM B 86.

- C. Stainless Steel Castings: ASTM A167, Type 304.
- D. Aluminum: ASTM 6463-T5 alloy.

### 2.3 SOLID PLASTIC TOILET COMPARTMENTS

- A. Basis of Design: Hiny Hiders Toilet Partitions as manufactured by and supplied by Scranton Products.
  - 1. Style: Floor mounted overhead-braced toilet compartments.
- B. Doors, Panels, and Pilasters: 1 inch (25 mm) thick with all edges rounded to a radius. Mount doors and dividing panels based on height of specified system.
  - 1. Door and Panel Height: 66 inches (1676 mm).
  - 2. Aluminum heat sink fastened to bottom edges.
  - 3. Panel Edge: Shiplap.
  - 4. Pilasters: 82 inches (2083 mm) high and fastened to floor.
- C. Panel Color: Architect to select from manufactures full line (All Series).
- D. Pilaster Shoes: 3 inches (76 mm) high type 304, 20 gauge stainless steel. Secured to pilasters with a stainless steel tamper resistant Torx head sex bolt.
- E. Headrail: Heavy-duty extruded 6463-T5 alloy aluminum with anti-grip design. Finish to be clear anodized. Fastened to headrail brackets with stainless steel tamper resistant Torx head sex bolt, and fastened at the top of the pilaster with stainless steel tamper resistant Torx head screws.
  - 1. Headrail Brackets: 20 gauge stainless steel with satin finish. Secured to the wall with stainless steel tamper resistant Torx head screws.
- F. Wall Brackets:
  - 1. Stainless Steel Brackets: Stainless steel type 304.
  - 2. Brackets are fastened to pilasters with stainless steel tamper resistant Torx head screws and fastened to the panels with stainless steel tamper resistant Torx head sex bolts.
  - 3. Bracket Type: Stirrup stainless steel double ear.
- G. Door Hardware:
  - 1. Continuous Stainless Steel Helix Hinge:
    - a. Length: 54 inches (1372 mm).
  - 2. Stainless Steel Slide Bolt Latch and Housing: Heavy-duty stainless steel type 304. The latch and housing to have a bright finish. The slide bolt and button to have a black anodized finish.
  - 3. Doors supplied with one coat hook/bumper and door pull made of chrome plated Zamak.
  - 4. Equip outswing handicapped doors with second door pull and door stop.

### 2.4 SOLID PLASTIC PRIVACY SCREENS

- A. Provide plastic privacy screens in urinal and entry toilet room applications as indicated or scheduled.
- B. Panels, and pilasters, if required, 1 inch (25 mm) thick with edges rounded to a radius. Screens to be mounted at 14 inches (356 mm) above the finished floor. Color as selected by Architect from manufacturer's full line of current colors.
  - 1. Aluminum heat sink fastened to bottom edges.
- C. Screen Type: Wall mounted.
  - 1. Urinal Screens: Headrail braced. 24 inches (610 mm) wide by 42 inches (1067 mm)

high.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

### 3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Examine areas to receive toilet partitions, screens, and shower compartments for correct height and spacing of anchorage/blocking and plumbing fixtures that affect installation of partitions. Report discrepancies to the architect.

### 3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install partitions rigid, straight, plumb, and level manor, with plastic laid out as shown on shop drawings.
- C. Clearance at vertical edges of doors shall be uniform top to bottom and shall not exceed 3/8 inch (9.5 mm).
- D. No evidence of cutting, drilling, and/or patching shall be visible on the finished work.
- E. Finished surfaces shall be cleaned after installation and be left free of imperfections.

### 3.4 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION



## SECTION 103500 - FLAGPOLES

### PART 1 - GENERAL

#### RELATED DOCUMENTS:

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

#### DESCRIPTION OF WORK:

Provide (2) 30' aluminum flagpoles.  
Provide (1) United States Flag – 5'-0" x 8'-0"  
Provide (1) Texas Flag – 5'-0" x 8'-0"

Extent and location of each type of flagpole shown on drawings.

#### QUALITY ASSURANCE:

Manufacturing Standards: Provide each flagpole as a complete unit produced by a single manufacturer, including fittings accessories, bases and anchorage devices.

Design Criteria: Provide flagpoles and installations constructed to withstand a 90 mph wind velocity when flying flag of appropriate size. Use heavy pipe sizes if required for flagpole type and height shown.

Pole Construction: Construct pole and ship to site in one piece if possible. If more than one piece is necessary, provide snug-fitting, precision joints with self-aligning, internal splicing sleeve arrangement for weather-tight, hairline field joints.

#### SUBMITTALS:

Product Data: Submit manufacturer's technical data and installation instructions for each type of flagpole required.

Shop Drawings: Submit shop drawings of flagpoles and bases, showing general layout, jointing and complete anchoring and supporting systems.

#### DELIVERY, STORAGE AND HANDLING:

Spiral wrap flagpoles with heavy Kraft paper or other protective wrapping and prepare for shipment in hard fiber tube or other protective container.

Deliver flagpole and accessories completely identified for installation procedure. Handle and store flagpoles to prevent damage or soiling.

### PART 2 - PRODUCTS

#### ACCEPTABLE MANUFACTURERS:

Manufacturer: Subject to compliance with requirements, provide products of one of the following:

Acme Flagpole Div., Lingo Inc.

American Flagpole, Div. of Kearney-National, Inc.  
Concord Industries, Inc.  
Eagle Mountain Flag & Flagpole Co.  
Eder Flag Mfg. Co.  
Morgan and Co.

FLAGPOLE TYPE:

Aluminum Flagpoles: Fabricate aluminum flagpoles from seamless extruded tubing, complying with ASTM B 241, alloy 6063-T6, having a minimum wall thickness of 3/16" (0.1875").

Provide continuous tapered aluminum flagpoles.

FLAGPOLE MOUNTING:

Provide manufacturer's standard base system for the type of flagpole installation required.

Base Plate: For anchor-bolt mounting, furnish manufacturer's standard cast metal shoe base of same material as flagpole. Furnish and install anchor bolts and lightning ground spike as required.

Foundation Tube: For ground-set flagpoles, provide 16-gage minimum galvanized corrugated steel tube, or 12 gage rolled steel tube, sized to suit flagpole and installation. Furnish complete with welded steel bottom base and support plate, lightning ground spike, and steel centering wedges, all welded construction. Provide loose hardwood wedges at top for plumbing pole after erection. Galvanize steel parts after assembly, including foundation tube.

Provide steel ground protector extending 12" above ground and 6" below ground for steel flagpoles where base or flash collars are not provided.

SHAFT FINISH:

Aluminum: Fine directional, mechanical satin polish (NAAMM-32), finished as follows:

Anodized Aluminum

FITTINGS:

Aluminum Ball: Manufacturer's standard flush seam ball, 6" as indicated, or if not indicated, to match pole butt diameter.

14 ga. spun aluminum, finished to match pole shaft.

Truck: Ball-bearing non-fouling, revolving, double-track assembly of cast metal, finished to match pole shaft.

Cleats: Two 9" cast metal cleats with fasteners, finished to match pole shaft.

Halyards: Provide 2 continuous halyards for each flagpole, as follows:  
Polypropylene, white, braided.

Size: 3/8" (No. 12)

Halyard Flag Snaps: Provide 2 swivel snaps per halyard.

FLAGS:

Made of extra tough poly – woven of two-ply polyester yarn.

Provide (1) United States Flag – 5'-0" x 8'-0"

Provide (1) Texas Flag – 5'-0" x 8'-0"

PART 3 - EXECUTION

INSTALLATION:

Excavation: Excavate for foundation concrete to neat clean lines in undisturbed soil.. Provide forms where require due to unstable soil conditions. Remove wood, loose soil, rubbish and other foreign matter from excavation, and moisten the earth before placing concrete.

Concrete: Provide concrete composed of portland cement, coarse aggregate, fine aggregate and water, mixed in proportions to attain 28-day compressive strength of not less than 3000 psi. Use not less than 5 sacks of portland cement, complying with ASTM C 150, per cubic yard of wet concrete.

Plase concrete immediately after mixing. Perform chuting to avoid segregation of mix. Compact concrete in place by use of vibrators to consolidate. Moist-cure exposed concrete for not less than 7 days, or use a non-staining curing compound in freezing weather.

Finish trowel exposed concrete surfaces to smooth, dense surface.  
Provide positive slope for water runoff to base perimeter

Flagpole Installation: Install flagpoles as shown and in compliance with final shop drawings and manufacturer's instructions.

Provide positive lightning ground for each flagpole installation.

END OF SECTION 10350

## SECTION 104400 SPECIALTY SIGNS

### PART 1 GENERAL

#### RELATED DOCUMENTS:

Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work specified in this section.

#### DESCRIPTION OF WORK:

Extent of specialty signs is shown on drawings.

Forms of specialty signs required include the following:

- Interior Panel signs
- Cast metal plaques
- Exterior Metal signs
- Address Numbers
- Project Job Sign

#### QUALITY ASSURANCE:

Uniformity of Manufacturer: For each sign form and graphic image process indicated, furnish products of a single manufacturer.

#### SUBMITTALS:

Product Data: Submit manufacturer's technical data and installation instructions for each type of sign required.

Samples: Submit samples of each sign form and material showing finishes, colors, surface textures and qualities of manufacture and design of each sign component, including graphics.

Shop Drawings: Submit shop drawings for fabrication and erection of specialty signs. Include plans, elevations, and large-scale details of sign wording and lettering layout. Show anchorages and accessory items. Furnish location template drawings for items supported or anchored to permanent construction.

### PART 2 PRODUCTS

#### ACCEPTABLE MANUFACTURERS:

##### Panel Signage

Manufacturers of Rooms Signs and Address Numbers:

Basis of Design: Corpus Christi Stamp Works  
Bayuk Graphic Systems, Inc.  
MULTI-graphics, Inc.

Manufacturers of Plaques

Basis of Design: A.R.K. Ramos  
The Southwell Company.

#### MATERIALS:

Plastic Laminate: Provide high pressure plastic laminate engraving stock with face and core plies in contrasting colors, in finishes and color combinations indicated or, if not indicated, as selected from the manufacturer's standard.

### FABRICATION OF PANEL SIGNS::

Fabricate panels signs to comply with the requirements indicated for materials, thicknesses, finishes, colors, designs, shapes, sizes and details of construction. Provide and install, one per door.

Produce smooth, even, level sign panel surfaces, constructed to remain flat under installed condition within a tolerance of plus or minus 1/16" measured diagonally from corner to corner.

Panel Signs: Fabricate unframed panel signs with edges mechanically and smoothly finished to conform to following requirements:

A. Character Proportion. Letters and numbers on signs should have a width to height ratio between 3:5 and 1:1 and a stroke width to height ratio between 1:5 to 1:10 utilizing an uppercase "X" for measurement.

B. Color Contrast. Characters and symbols shall contrast with their background.

C. Tactile Characters and Symbols. Characters, symbols, or pictographs on signs required to be tactile, shall be raised 1/32 inch minimum. Letters and numbers refer to plans for text height at specific locations. Font: Helvetica 721.

D. Interior Signs:

A. Provide a sign at each door to each room of the building.

B. Include braille message as required by ADA.

C. Size: 6"x6"

E. Exterior Signs:

A. Provide weather rated exterior sign at each of the following doors on the exterior of the building:

1. Mechanical Rooms

2. Kitchen Doors

3. Engineering Lab

4. Administration Areas

B. Include braille message as required by ADA.

C. Size: 6"x6"

E. Restroom Signs:

A. Provide a sign at each restroom door.

B. Include braille message as required by ADA.

C. Size: 6" x 8" (Pictogram should be 6"x6". Restroom type should be in 2"x8" space)

E. Stair Sign:

A. Provide a sign at Stair 136.

B. Include braille message as required by ADA.

C. Size: 6" x 8" (Pictogram should be 6"x6". "Stair" should be in 2"x8" space)

### BUILDING ADDRESS NUMBERS:

General: Provide precision cut injected molded numbers.

12" Tall – 12345 (Address will be provided at a later date. Allow for 5 numbers)

Refer to drawings for location and spacing.

### CAST METAL PLAQUES:

Fabricate cast plaques to comply with requirements indicated below for metal, border style, background texture and finish, and on drawings for thickness, size, shape and copy. Produce castings free from pits, scale, and sand holes or other defects. Hand tool and buff borders and raised copy to produce manufacturer's standard satin polished finish. Refer to "Finish" article of other finish requirements.

Quantity: One (1)

Size: 30"W x 20"H x 3/4" D (Will include Edinburg CISD Logo and UTRGV Logo)

Metal: Bronze.

Texture: Letherette

Finish: BR-400 Dark Oxidized background with Satin Bronze raised areas

Mounting: Concealed (Verify location for anchoring type)

(Design and Verbiage for plaque will be provided at a later date issued to contractor)

### PROJECT JOB SIGN:

Provide for (3) – 4'x8' Plywood Sheets with Owner directed signage to be used on Project Job Sign. Provide for possible project renderings and school logos and images. Mount on 4"x4" post or as required to stand for duration of project. Location on site to be provided by Owner.

### METAL SIGNS:

General: Provide and install handicap metal signs, stop signs and directions signs as indicated in drawings.

Materials: Aluminum.

Mounting Pole shall be aluminum .125 wall thickness and five feet in height above finished sidewalk elevation.

### FINISHES:

Colors and Surface Textures: For exposed sign materials which require selection of materials with integral or applied colors, surface textures or other characteristics related to appearance, provide color matches indicated, or if not otherwise indicated, as selected by the Architect from the manufacturer's standards.

Metal Finishes: Comply with NAAMM "Metal Finishes Manual" for finish designations and application recommendations.

#### Aluminum Finishes:

Baked Enamel Finish: Provide finish AA M4xC12C42R1x (manufacturer's standard non directional mechanical finish including sanding and filing; cleaning with inhibited chemicals; conversion coated with an acid chromate fluoride phosphate treatment; and painted with organic coating specified below).

#### Bronze Finishes:

Natural Satin Finish: NAAMM-M31-06x (fine satin directional textured mechanical finish with clear organic coating specified below).

Clear Organic Coating: Manufacturer's standard clear coating.

### PART 3 EXECUTION:

#### INSTALLATION:

General: Locate sign units and accessories where shown or scheduled, using mounting methods of type described and in compliance with the manufacturer's instructions, unless otherwise indicated.

Install sign units level, plumb and at the height indicated, with sign surfaces free from distortion or other defects of appearance.

#### Panel Signs:

Wall Mounted Units: Attach panel signs to wall surfaces using the methods indicated below:

Interior:

Vinyl Tape Mounting (VTM): Use double sided foam tape, or thickness indicated, to mount signs to smooth non porous surfaces. Do not use for vinyl covered or rough surfaces.

Where mounted on glass provide additional blank sign on inside of glass to conceal mounting tape.

Exterior:

Mechanically fasten securely to substrate. Fastener should be appropriate for substrate.

#### Metal Letters and Numbers:

Mount letters and numbers as follows: use standard fastening methods recommended by manufacturer for letter form, type of mounting, wall construction, and condition of exposure indicated. Provide heavy weight paper template to establish letter spacing and to locate holes for fasteners.

Flush Mounting (FM): Mount letters either backs in contact with wall surface.

Cast Metal Plaques: Mount cast plaques using the manufacturer's standard fastening methods recommended by manufacturer for type of wall surface indicated.

Concealed Mounting: Mount the plaques by inserting threaded studs into tapped lugs on the back of the plaque. Set in predrilled holes filled with quick setting cement.

#### CLEANING AND PROTECTION:

At completion of the installation, clean soiled sign surface in accordance with the manufacturer's instructions. Protect units from damage until acceptance by the Owner.

END OF SECTION 10440

## SECTION 105000 - LOCKER STORAGE UNITS

### PART 1 GENERAL

#### RELATED DOCUMENTS

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

#### SUMMARY

This Section includes metal lockers and related equipment as indicated on drawings.

Types of products in this section include the following:

Double Stack Lockers with Slope Top.

Concrete base for lockers is specific in Division 3.

#### QUALITY ASSURANCE

Uniformity: Provide metal lockers that are standard products of single manufacturer, with interchangeable like parts. Include necessary mounting accessories, fittings, and fastenings.

#### SUBMITTALS

Submit the following in accordance with Conditions of Contract and Division Specification sections.

Product data and installation instructions for metal locker units.

Color Samples on squares of same metal to be used for fabrication of lockers.

Shop Drawings that show metal lockers in dimensioned relation to adjacent surfaces. Show lockers in detail, method of installation, fillers, trim, base, and accessories. Include locker numbering sequence information.

Combination Listing for combination locks and their respective locker numbers. Coordinate with shop drawings submittal, if required.

#### JOB CONDITIONS

Do not deliver metal lockers until building is enclosed and ready for locker installation. Protect from damage during delivery, handling, storage, and installation.

### PART 2 PRODUCTS

#### MANUFACTURERS

Subject to compliance with requirements, manufacturers offering products that may be incorporated in the work include the following:

Lyon  
Republic Steel Corp., Industrial Products Div.  
Tufftec Lockers – Scranton Products



## MATERIALS

Sheet Steel: Mild cold rolled and leveled furniture steel, free from buckle, scale, and surface imperfections.

Fasteners: Cadmium, zinc, or nickel-plated steel; exposed bolt heads, slot-less type; self locking nuts or lock washers for nuts on moving parts.

Equipment: Hooks and hang rods of cadmium plated or zinc plated steel.

## FABRICATION, GENERAL

Construction: Fabricate lockers square, rigid, and without warp, with metal faces flat and free of dents or distortion. Make exposed metal edges safe to touch. Weld frame members together to form rigid, one piece structure. Weld, bolt, or rivet other joints and connections. Grind exposed welds flush. Do not expose bolts or rivet heads on fronts of locker doors or frames.

Frames: Fabricate of 16 gage channels or 12 gage angles, minimum, with continuous stop/strike formed on vertical members.

Finishing: Chemically pre-treat metal with degreasing and phosphatizing process. Apply baked enamel finish to all surfaces, exposed and concealed, except plates and nonferrous metal.

Color: Provide locker units in color(s) selected by Architect from manufacturer's full line. Unless otherwise indicated, concealed parts may be manufacturer's standard neutral color.

## LOCKERS

Equal to Republic Standard Lockers at Kitchen.

Body: Fabricate back and sides of minimum 24 gage steel, with double flanged connections extending full height. Form top and bottom of not less than 24 gage steel, with flanged edges.

Kitchen Locker Unit Size 12" X 12" X 36 – Double Tiered.

Provide slope top at all lockers

Door: One piece, minimum 16 gage sheet steel, flanged at all edges, constructed to prevent springing when opening or closing. Fabricate to swing 180 degrees.

Reinforcing: Provide extra bracing or reinforcing on inside of doors over 15 inches wide.

Ventilation: Provide stamped, louvered vents in door face, as follows:

Hinges: Heavy duty, not less than 0.050" thick steel, full loop, 5 knuckle, tight pin, 2" high. Weld to inside of frame and secure to door with not fewer than 2 factory installed fasteners that are completely concealed and tamperproof when door is closed.

Provide at least 3 hinges for each door over 42 inches high; at least 2 hinges for each door 42 inches.

Locking Device: Shall be a positive automatic type locking device of the pre-locking type, on all single tier and double tier lockers, whereby locker may be locked while door is open, then closed without unlocking and without damaging locking mechanism. The silencers on the frame hooks shall be securely attached. Lock bar shall be of double channel formation and tamperproof. All handle parts, including fixed case and lifting trigger to be attached to the door with two hex washer heads, thread rolling screws and shock absorbing stud. The case fully shields the lifting trigger from below. the lifting trigger to have two right angle lugs that insert into the lock bar without the use of a fastening device. The lifting trigger is to be equipped with rubber silencers at top and bottom to prevent metal to metal contact. Padlock attachment with 3/8" diameter hole positioned so that the fixed handle case provides a padlock strike. The handle design must be free to openings or surfaces that permit leverage to be applied that forces the handle upward when in a locked position. There shall be three locking points on single tier lockers, and two locking points on double tier lockers. Triple tier and box lockers shall not have pre locking device, lockbar and handle.

Latching Standard: Shall be a one piece, self contained spring steel latch, so designed as to be easily removable from the lock bar for replacement, but completely contained with the lock bar without the use of additional fasteners and is under tension to provide rattle free operation. The lock bar shall be of double channel construction providing maximum strength, as to hold the latch within the door channel at proper operating location. The lock bar shall be held laterally in the door channel by means of non removable self formed retainers, pierced from the door and held in place vertically by the lock bar handle lugs. Rubber silencers and provided at the securely attached to each frame hook on the door jamb.

#### LOCKER ACCESSORIES

Built In Combination Lock: Key controlled, 3 number dialing combination lock, with combination change made automatically by use of control key.

Multi Tier Lockers: Provide #1654 Master Spring Bolt Lock.

Equipment: Furnish each locker with the following items, unless otherwise shown:

Double Tier Units: One double-prong hook ceiling hook and not less than 2 single-prong wall hooks.

Number Plates: Manufacturer's standard etched, embossed, or stamped, nonferrous metal number plates with numerals not less than 3/8 inches high. Number lockers in sequence as directed by Architect. Attach plates to each locker door, near top, centered, with at least 2 fasteners of same finish as number plate.

Separators: Provide horizontal dividers of not less than 16 gage sheet steel between doors of multiple tier lockers to ensure rigidity.

Filler Panels: Provide filler panels where indicated, of not less than 16 gage steel sheet, factory fabricated and finished to match locker units.

## PART 3 EXECUTION

### PREPARATION:

Field Measurements: Take field measurements prior to preparation of shop drawings and fabrication of special components, when possible, to ensure proper fitting of work. However, allow for adjustment and fitting of trim and filler panels wherever taking of field measurements before fabrication might delay work.

### INSTALLATION

Install metal lockers at locations shown in accordance with manufacturer's instructions for plumb, level, rigid, and flush installation.

Space fastenings about 48 inches o.c., unless otherwise recommended by manufacturer, and apply through backup reinforcing plates where necessary to avoid metal distortion, using concealed fasteners.

Install trim, and metal filler panels where indicated, using concealed fasteners. Provide flush, hairline joints against adjacent surfaces.

### ADJUST AND CLEAN

Adjust doors and latches to operate easily without binding. Verify that integral locking devices are operating properly.

Touch up marred finishes, but replace units that cannot be restored to factory finished appearance. Use only materials and procedures recommended or furnished by locker manufacturer.

END OF SECTION 10500

## SECTION 105200 - FIRE PROTECTION SPECIALTIES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes: Fire protection specialties (fire extinguishers, cabinets, and accessories) and supplementary items necessary for installation.

#### 1.2 SUBMITTALS

- A. Product Data: Manufacturer's technical literature for each type of product indicated. Include manufacturer's specifications for materials, finishes, construction details, installation instructions, and recommendations for maintenance.
  - 1. Fire Extinguishers: Include rating and classification.
  - 2. Cabinets: Include rough-in dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type, trim style, fire-rating as applicable, and panel style.
- B. Shop Drawings: Show details of fabrication and installation, including plans, elevations, sections, details of components, and attachments to other work.
- C. Samples for Initial Selection: For each type of cabinet indicated.
- D. Samples for Verification Purposes: For each type of exposed cabinet finish required, prepared on 6 inch square samples of same thickness and material indicated for the Work. If finishes involve normal color and texture variations, include sample sets showing the full range of variations expected.
- E. Product Test Reports: Written reports based on evaluation of comprehensive tests performed by qualified testing agency indicating that each product complies with requirements.
- F. Manufacturer's Project Acceptance Document: Certification by the manufacturer that its product(s) are approved, acceptable, suitable for use in specific locations, for specific details, and for applications indicated, specified, or required, and that a warranty will be issued.
- G. Maintenance Data: To include in maintenance manuals.

#### 1.3 QUALITY ASSURANCE

- A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers".
- B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

#### 1.4 COORDINATION

- A. Coordinate installation of products and systems with interfacing and adjoining construction to provide a successful installation without failure.
- B. Coordinate size of cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated. Coordinate sizes and locations of cabinets with wall depths.

#### 1.5 SEQUENCING

- A. Apply decals on field-painted cabinets after painting is complete.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS AND PRODUCTS

- A. Acceptable Manufacturers and Products: Subject to compliance with requirements of Contract Documents as judged by the Architect, provide product by one of manufacturers listed. If not listed, submit as substitution according to the Conditions of the Contract and Division 01 Section "Substitution Procedures".
  - 1. J.L. Industries, Inc.
  - 2. Larsen's Manufacturing Company
  - 3. Potter Roemer Fire Protection Equipment
- B. Basis of Design (Product Standard): Contract Documents are based on products and systems specified to establish a standard of quality. Other available manufacturers/fabricators offering products having equivalent characteristics may be considered, provided deviations are minor and comply with requirements of Contract Documents as judged by the Architect.

#### 2.2 MATERIALS, GENERAL

- A. Single Source Responsibility: Furnish each type of product from single manufacturer. Provide secondary materials only as recommended by manufacturer of primary materials.

#### 2.3 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B.
- B. Aluminum: Alloy and temper recommended by aluminum producer and manufacturer for type of use and finish indicated, and as follows:
  - 1. Sheet: ASTM B 209.
  - 2. Extruded Shapes: ASTM B 221.
- C. Tempered Break Glass: ASTM C 1048, Kind FT, Condition A, Type I, Quality q3, 1.5 mm thick.

#### 2.4 PORTABLE FIRE EXTINGUISHERS

- A. Fire Extinguishers: Type, size, and capacity for each cabinet or mounting bracket indicated.

- B. Multipurpose Dry-Chemical Type - Typical (unless otherwise indicated): UL-rated 2-A:10-B:C, 5-lb nominal capacity, with monoammonium phosphate-based dry chemical in enameled-steel container.
- C. Wet-Chemical Type for Use at Kitchens: UL-rated 2-A:1-B:C:K, 1.6-gal. nominal capacity, with potassium acetate, citrate, or carbonate or in combination-based chemical in stainless-steel container; with pressure-indicating gage.

## 2.5 FIRE EXTINGUISHER CABINETS

- A. General Cabinet Construction: Provide manufacturer's standard box (tub), with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated of suitable size for each type of fire extinguisher required. Weld joints and grind smooth. Miter and weld perimeter door frames.
- B. Semi-Recessed Cabinet - Typical: Cabinet box partially recessed in walls of sufficient depth to suit style of trim indicated; with one-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend).
  - 1. Rolled-Edge Trim: 2-1/2 in backbend depth.
  - 2. Basis of Design: Larsen 2409-R3 cabinet.
- C. Cabinet Trim Material: Same material and finish as door. One-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend).
- D. Door Material and Construction: Fabricate doors according to manufacturer's standards of steel sheet coordinated with cabinet types and trim styles selected. Provide minimum 1/2-inch thick door frames, fabricated with tubular stiles and rails, and hollow-metal design.
- E. Door Style: Vertical duo panel with frame.
- F. Door Glazing: Tempered break glass.
- G. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.
  - 1. Provide recessed door pull and friction latch.
  - 2. Provide continuous hinge, of same material and finish as trim, permitting door to open 180 degrees.
  - 3. Prepare doors and frames to receive locks.
- H. Cabinet Accessories:
  - 1. Break-Glass Strike: Manufacturer's standard metal strike, complete with chain and mounting clip, secured to cabinet.
  - 2. Door Lock: Cylinder lock, keyed alike to other cabinets.

## 2.6 ACCESSORY ITEMS

- A. Mounting Brackets: Manufacturer's standard galvanized steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish, color as selected by Architect.

- B. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as directed by Architect.
  - 1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to wall surface.
  - 2. Identify fire extinguisher in cabinet with the words "FIRE EXTINGUISHER" in black vinyl letters applied to cabinet door.
    - a. Location: Applied to cabinet door.
    - b. Application Process: Decal or vinyl letters.
    - c. Lettering Color: As indicated above.
    - d. Orientation: Vertical.

## 2.7 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces of fire protection cabinets from damage by applying a strippable, temporary protective covering before shipping.
- C. Finish fire protection cabinets after assembly.
- D. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

## 2.8 STEEL FINISHES

- A. Surface Preparation: Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning" or SSPC-SP 8, "Pickling". After cleaning, apply a conversion coating suited to the organic coating to be applied over it.
- B. Baked-Enamel or Powder-Coat Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 2 mils.
  - 1. Color and Gloss: As selected by Architect from manufacturer's full range.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Acceptance of Surfaces and Conditions: Examine substrates to receive products and systems and associated work for compliance with requirements and other conditions affecting performance. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents. Starting work within a particular area will be construed as acceptance of surface conditions.
- B. Examine fire extinguishers for proper charging and tagging. Remove and replace damaged, defective, or undercharged fire extinguishers.

- C. Examine walls and partitions for suitable framing depth and blocking where cabinets and mounting brackets will be installed.

### 3.2 INSTALLATION, GENERAL

- A. Installation Quality Standards: In addition to standards listed elsewhere, perform Work according to following, unless otherwise specified:
  - 1. Respective manufacturer's written installation instructions.
  - 2. Accepted submittals.
  - 3. Contract Documents.

### 3.3 PREPARATION

- A. General: Comply with manufacturer's instructions, recommendations, and specifications for cleaning and surface preparation. Surfaces shall have no defects, contaminants, or errors which would result in poor or potentially defective installation or would cause latent defects in Work.
- B. Prepare recesses for cabinets as required by type and size of cabinet and trim style.

### 3.4 INSTALLATION OF FIRE PROTECTION SPECIALTIES

- A. General: Install fire extinguishers, cabinets, and mounting brackets in locations and at mounting heights indicated and in compliance with requirements of authorities having jurisdiction.
- B. Fasten mounting brackets and cabinets to structural surfaces, square and plumb.
- C. Identification: Apply decals at locations indicated.

### 3.5 ADJUSTING AND CLEANING

- A. Remove temporary protective coverings and strippable films, if any, as cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.
- B. Adjust cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.
- C. On completion of cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.
- D. Touch up marred finishes, or replace cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by cabinet and mounting bracket manufacturers.
- E. Replace cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION



## SECTION 107300 – ALUMINUM WINDOW CANOPIES AND SUN SHADE FINNS

### 1.0 PART 1 – GENERAL

#### 1.1 DESCRIPTION OF WORK

- 1.1.A Furnish and install custom aluminum Sun Screen Fins and Window Canopies as shown on drawings and specifications.
- 1.1.B The architectural drawings show the general dimensions and profile of the Protective Covers.

#### 1.2 SUBMITTALS

- 1.2.A Submit product specifications and installation instructions from the manufacturer of the Canopies.
- 1.2.B Submit shop drawings for approval by architect prior to fabrication of Canopies.
- 1.2.C The shop drawings shall include plans, elevations, sections, and details showing profiles, angles, and spacing of the blades, the sun cutoff angle, and spacing of the frame supports. Indicate anchorage details and locations.
- 1.2.D Submit two finished samples of each of the materials to be used in each Canopy.
- 1.2.E Provide written warranty to the owner that all Canopies will be free of defective materials and workmanship for a period of one year from the date of installation.

#### 1.3 QUALITY ASSURANCE

- 1.3.A Single subcontract responsibility: Subcontract the work to a single firm that has had no less than five (5) years of experience in the design and manufacturing of the work specified.
- 1.3.B Performance requirements: Design Canopies according to local building code and requirements for snow and wind loading. Provide signed and sealed engineering drawings by a Professional Engineer registered in the state where the project is located.
- 1.3.C Window Canopies shall be installed by manufacturer. Outsourcing installation to a third party subcontractor is not acceptable.
- 1.3.D Canopy systems, including material and workmanship, shall be warranted from defects for a period of one year from substantial completion of installation.

## 1.4 PROJECT CONDITIONS

- 1.4.A Ensure fit by performing field measurements before fabrication. Shop drawings will record the actual measurements.
- 1.4.B Coordinate fabrication schedule with general contractor to avoid construction delays.

## 2.0 PART 2 – PRODUCT

### 2.1 Manufacturer:

Bowman Distributing Company  
2100 J B Drive  
San Benito, TX 78586  
Ph. 956-361-5200  
Fax. 956-361-5204

### 2.2 MATERIALS

- 2.2.A Columns, decking, fascia and beams fabricated from extruded aluminum ASTM B221, Alloy 6063, 6061 or 6005 – T6 temper.
- 2.2.B Roll-formed deck is not acceptable.
- 2.2.C Fasteners shall be aluminum or 300 series stainless steel.
- 2.2.D Anchors and inserts shall be of non-ferrous metal or hot dip galvanized steel as required for corrosion resistance. Use stainless steel or lead expansion bolt devices for drill-in place anchors.
- 2.2.E Decking shall be 0.080” extruded aluminum interlocking bottom and top
- 2.2.F Fascia shall be a minimum of .080 in. wall thickness

### 2.3 FABRICATION

- 2.3.A Preassemble Canopy assemblies in factory to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations.
- 2.3.B Include supports, anchorage, fasteners, and accessories required for complete assembly.
- 2.3.C Provide an all welded extruded aluminum system, complete with concealed drainage. Non-welded systems are unacceptable.

### 2.4 FINISH

- 2.4.A Comply with NAAMM “Metal Finishes Manual” for finish designations and application recommendations, except as otherwise indicated.
- 2.4.B Protect finish on exposed surfaces prior to shipping.

- 2.4.C Anodize finish:  
Clear: AA-M12C22A31, 215-R1, Architectural Class I  
Color: AA-M12C22A31, Clear Anodized Aluminum,  
Architectural Class I.  
Clear: AA-M12C22A41, 204-R1, Architectural ClassII  
Color: AA-M12C22A41, Clear Anodized Aluminum,  
Architectural Class II.

## 2.5 INSTALLATION

- 2.5.A Install according to manufacturers instructions and recommendations.  
2.5.B Verify dimension of supporting structure at the  
2.5.C Anchor Canopies and Sun Screen Fins to building as indicated in  
Architectural drawings and shop drawings.  
2.5.D Install units plumb and level.  
2.5.E Use concealed anchors where possible.  
2.5.F Form closely fitted joints with exposed connections accurately located  
and secured.

## 2.6 CLEANING AND PROTECTING

- 2.6.A Clean exposed surfaces of Canopies to remove soil and fingerprints  
resulting from installation process.  
2.6.B Clean with water and a mild dishwashing soap not harmful to finishes.  
Rinse thoroughly and dry.  
2.6.C Clean and touch up minor abrasions in finish with air-dried coating that  
matches color and gloss of the factory applied finish coating.

## SECTION 108000 TOILET ACCESSORIES

### PART 1 GENERAL

#### RELATED DOCUMENTS:

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

#### DESCRIPTION OF WORK:

Extent of each type of toilet accessory is indicated on drawings and schedules.

Types of toilet accessories required include the following:

- Sanitary napkin disposal units
- Grab bars.
- Mirrors
- Mop and Broom Holders
- Paper Towel Dispensers

#### QUALITY ASSURANCE:

Inserts and Anchorages: Furnish inserts and anchoring devices which must be set in concrete or built into masonry; coordinate delivery with other work to avoid delay.

Accessory Locations: Coordinate accessory locations with other work to avoid interference and to assure proper operation and servicing of accessory units.

Products: Provide products of same manufacturer for each type of accessory unit and for units exposed in same areas, unless otherwise acceptable to Architect.

#### SUBMITTALS:

Product Data: Submit manufacturer's technical data and installation instructions for each toilet accessory.

Setting Drawings: Provide setting drawings, templates, instructions, and directions for installation of anchorage devices in other work.

### PART 2 PRODUCTS:

#### ACCEPTABLE MANUFACTURERS:

- Bobrick Washroom Equipment, Inc.
- Bradley Corporation
- Georgia Pacific

#### MATERIALS, GENERAL:

Stainless Steel: AISI Type 302/304, with polished No. 4 finish, 22 gage minimum, unless otherwise indicated.

Mirror Glass: FS DD G 451, Type I, Class 1, Quality q2, 1/4" thick, with silver coating, copper protective coating, and non metallic paint coating complying with FS DD M 411.

Galvanized Steel Mounting Devices: ASTM A 386, hot dip galvanized after fabrication.

Fasteners: Screws, bolts, and other devices of same material as accessory unit or of galvanized steel where concealed.

#### FABRICATION:

General: Stamped names or labels on exposed faces of toilet accessory units are not permitted, except where otherwise indicated; unobtrusive labels on surfaces not exposed to view are acceptable. Where locks are required for a particular type of toilet accessory, provide same keying throughout project. Furnish two keys for each lock.

Surface Mounted Toilet Accessories, General: Except where otherwise indicated, fabricate units with tight seams and joints, exposed edges rolled. Hang doors or access panels with continuous stainless-steel piano hinge. Provide concealed anchorage wherever possible.

- **Handicap Mirror:** Equal to Bobrick model no. B-165 - 2436, Framed Mirror. Provide one unit at each handicap lavatory. See plans for locations.
- **Hand Dryer:** Hot Air Dryer (see MEP).
- **Grab Bar:** Equal to Bobrick model no. B-6806 series x 42" long, provide at each handicap water closet location.
- **Grab Bar;** Equal to Bobrick model no. B-6806 series x 36" long, provide at each handicap water closet location.
- **Mop & Broom Holder:** Equal to Bobrick model no. B-223X36, provide one unit at each janitorial room.
- **Double Toilet Tissue Dispenser:** (By Owner, Installed by Contractor)
- **Liquid Soap Dispenser:** (Owner provided and Owner Installed)
- **Partition Mounted Napkin Dispenser:** Equal to Bobrick model no. B-354
- **Wall Mounted Napkin Dispenser:** Equal to Bobrick model no. B-35303
- **Paper Towel Dispenser:** Equal to Bobrick model no. B-262
- **Paper Towel Dispenser (Above Counter):**Equal to Bobrick model no. B-262212

#### PART 3 - EXECUTION

##### INSTALLATION:

Install toilet accessory units in accordance with manufacturers' instructions, using fasteners which are appropriate to substrate and recommended by manufacturer of unit. Install units plumb and level, firmly anchored in locations and at heights indicated. General Contractor to provide for solid 2x wood blocking at toilet accessories mounted at gypsum drywall partitons.

##### ADJUSTING AND CLEANING:

Adjust toilet accessories for proper operation and verify that mechanisms function smoothly.

Clean and polish all exposed surfaces after removing protective coatings.

END OF SECTION 108000

## SECTION 111310 - PROJECTION SCREENS

### PART 1 - GENERAL

#### RELATED DOCUMENTS

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

#### DESCRIPTION OF WORK:

Projection Screens required for this work are scheduled on the Plans.  
All other screens are to be included in the Contractors base bid.

#### QUALITY ASSURANCE:

For installation use only personnel who are skilled in the work required.

#### SUBMITTALS:

Installation Methods: Submit two copies of manufacturer's recommended installation method showing all requirements for blocking and backing.

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.

Shop Drawings: Shop drawings showing layout and types of projection screens. Show the following:

1. Location of screen centerline.
2. Seams in viewing surfaces.
3. Detailed drawings for concealed mounting.
4. Connections to suspension systems.
5. Anchorage details.
6. Accessories.
7. Frame details.

Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.

#### PRODUCT HANDLING:

Protection:

Project Projection Screens before, during and after installation.

Protect installed work of other trades.

Replacement: In event of damage, make necessary replacements.

## PROJECTION SCREENS:

### Model: Da-Lite 65x104 Advantage Series Projector Screen, 16:10 Format

Type: Electrically operated, retractable, large size projection screen with rigid metal roller housing motor;

Provide at the following Rooms:

Aspiring Teacher 122. Qty (2)

Computer Science 130. Qty (4)

Collabitat 201. Qty (1)

### Model: Da-Lite Advantage (Over 16"W) (Large-Group Instruction - LGI-229). Required:

TWO (2)

Screen Operation: Electrically operated, UL listed, retractable, heavy duty, with rigid metal roller and motor housed within the roller. Tab guide cable tensioning system to maintain even, lateral tension and hold viewing surface flat. Bottom end of fabric to be inserted into a custom aluminum slat bar with added weight to provide vertical tension on the screen surface.

Motor: 1 UL Certified 120 V, 60 Hz, 3-wire permanently lubricated reversal-type, attached to header.

Amperage: 2.4 amps.

Include automatic thermal overload protection, integral gears, capacitor and electric brake to prevent coasting.

Preset, adjustable limit switches to automatically stop viewing surface in UP or DOWN position.

Screen Mounting: Ceiling recessed.

Screen Case: Wood with double top member for rigidity. Case is designed to receive mounting hardware and is sized to suit projection screen.

Case Finish: Prime painted black.

Screen Size:

Viewing Area: H 108 inches x W 144 inches.

Overall Dimensions: L 167 1/4 inches.

Acceptable Material: Da-Lite Screen Company, Inc., Tensioned Professional Electrol projection screen system.

Screen Viewing Surface: Front projection, flame retardant, mildew-resistant seamless vinyl, black backed, with standard black borders, easily cleaned with mild soap and water solution.

Gain: To SMPTE RP 94-2000, 1.0.

Viewing angle: 60.

Format: Wide Format: 1.00 to 1.6.

Acceptable Materials: Da-Lite Screen Company, Inc.:

Da-Mat viewing surface with GREENGUARD Certification #90068-9.

Optional Accessories:

Screen Drop:

Extra drop of 2-feet in black fabric at the top of the viewing area.

Extra drop of 1-foot in black fabric at the bottom of the viewing area.

Single Motor Low Voltage Control: External.

Remote Control: Infrared 3-button handheld remote control for UP, DOWN and STOP functions with single motor, low voltage control unit.

Key Locking Cover Plate: Hinged cover plate with brushed stainless-steel finish provides keyed access to low voltage control wall switch.

Video Projector Interface Control: DC controls and white rocker switch with cover plate for wall switch operation.

Above to be coordinated with Owner during submittal process; requires Owner coordination.

Model: Professional Electrol (Collaboration 170). Required: TWO (2)

Screen Operation: Electrically operated, UL listed, retractable, heavy duty, with rigid metal roller and motor housed within the roller. Tab guide cable tensioning system to maintain even, lateral tension and hold viewing surface flat. Bottom end of fabric to be inserted into a custom aluminum slat bar with added weight to provide vertical tension on the screen surface.

Motor: 1 UL Certified 120 V, 60 Hz, 3-wire permanently lubricated reversal-type, attached to header.

Amperage: 2.4 amps.

Include automatic thermal overload protection, integral gears, capacitor and electric brake to prevent coasting. Preset, adjustable limit switches to automatically stop viewing surface in UP or DOWN position.

Screen Mounting: Ceiling recessed.

Screen Case: Wood with double top member for rigidity. Case is designed to receive mounting hardware and is sized to suit projection screen.

Case Finish: Prime painted black.

Screen Size:

Viewing Area: H 132-1/2 inches x W 212 inches. (16:10 Format)

Overall Dimensions: L 267 1/4 inches.

Acceptable Material: Da-Lite Screen Company, Inc.

Screen Viewing Surface: Front projection, flame retardant, mildew-resistant seamless vinyl, black backed, with standard black borders, easily cleaned with mild soap and water solution.

Gain: To SMPTE RP 94-2000, 1.0.

Viewing angle: 60.

Format: Wide Format: 1.00 to 1.6.

Acceptable Materials: Da-Lite Screen Company, Inc.:

Da-Mat viewing surface with GREENGUARD Certification #90068-9.

Optional Accessories:

Screen Drop:

Extra drop of 6-feet in black fabric at the top of the viewing area.

Extra drop of 1-foot in black fabric at the bottom of the viewing area.

Single Motor Low Voltage Control: External.

Remote Control: Infrared 3-button handheld remote control for UP, DOWN and STOP functions with single motor, low voltage control unit.

Key Locking Cover Plate: Hinged cover plate with brushed stainless steel finish provides keyed access to low voltage control wall switch.

Video Projector Interface Control: DC controls and white rocker switch with cover plate for wall switch operation.

Above to be coordinated with Owner during submittal process; requires Owner coordination.

Model: Model B by Da-Lite

Type: Manually operated, surface mounted, front projection screens.

Size: 57-1/2" x 92" (16:10 Wide Format) to be located in all Typical Classroom and Conference Rooms. Refer to Plans.



### PART 3 - EXECUTION

#### Surface Conditions:

##### Inspection:

Inspect installed work of other trades and verify that such work is complete to point where this work may commence.

Verify that installation may be made in accordance with approved manufacturer's instructions.

#### Discrepancies:

In event of discrepancy, notify Architect.

Do not proceed with installation until discrepancies have been resolved.

#### Installation:

Install in accordance with manufacturer's instructions.

Install front projection screens with screen cases in position and relationship to adjoining construction as indicated, securely anchored to supporting substrate, and in manner that produces a smoothly operating screen with plumb and straight vertical edges and plumb and flat viewing surfaces when screen is lowered.

Test manually operated units to verify that screen operating components are in optimum functioning condition

END OF SECTION 111310

## SECTION 114000 – FOODSERVICE EQUIPMENT

### PART 1 - GENERAL

1.1 CONDITIONS OF CONTRACT and DIVISION 1, as indexed, apply to this section.

1.2 SCOPE: All Foodservice Equipment as shown on the drawing and as specified herein.

#### 1.3 RELATED WORK SPECIFIED ELSEWHERE

- |    |  |             |
|----|--|-------------|
| A. | Heating, Ventilation, and Air Conditioning | Division 23 |
| B. | Plumbing                                   | Division 22 |
| C. | Electrical                                 | Division 26 |
| D. | Technology                                 | Division 27 |

#### 1.4 RELATED WORK BY OTHERS

- A. The rough-in service and the actual connection between kitchen equipment shall be furnished under Electrical, Plumbing and Mechanical Contractors unless specifically called for in the Item Specifications. The actual hardware connections and required labor to connect equipment to rough ins shall be the entire responsibility of the prospective Contractor.
- B. The Plumbing Contractor shall furnish and install all tailpieces, “P” traps, line strainers, grease traps, indirect copper drain lines, check valves, backflow preventers, fittings and stops for a complete system. All connections shall be made in accordance with local codes, except where plans and specifications exceed code requirements. Exhaust fans, ducts, gas flues and/or vents shall be furnished by the Mechanical Contractor. Final connection to kitchen equipment shall be by Plumbing Contractor. All faucet and pre-rinse assemblies for foodservice equipment are to be furnished by Kitchen Equipment Contractor and installed by Plumbing Contractor unless noted otherwise in item specifications. All certified testing of backflow prevention devices included with foodservice equipment is to be provided by the Plumbing Contractor. All copper drain lines are to be supported by copper compliant supports. Isolation tape is not an acceptable alternative to copper compliant supports. All natural-gas piping is to be coated with a rust-preventative paint in the color of “*Safety Yellow.*”
- C. All exhaust ducts and fans shall be furnished and installed by the Mechanical Contractor. Exhaust ducts to have water and grease tight connections and be constructed of rust resistant metal with continuous welded joints.
- D. The Electrical Contractor shall furnish and install disconnect switches, safety shut-offs, control panels, fuse boxes, fan starters and other electrical controls to complete the project. Starting switches for the kitchen equipment are to be furnished by the Kitchen Contractor. Electrical Contractor responsible for enclosing all electrical outlets by means of cover, sealant (food-grade

silicone, or others as deemed necessary to prevent the intrusion of insects and rodents. Labor for connections shall be by the Electrical Contractor.

- E. Sleeves and P.V.C. tubing for syrup lines and refrigeration lines shall be furnished and installed by Plumbing Contractor.
- F. The Kitchen Equipment Contractor shall be responsible to furnish and install all related refrigeration work. Final plumbing and electrical connections shall be made by other related Contractors. Pipe supports, insulation, spacing and routing of refrigerant lines are to comply with requirements listed in Sections 22 and 26 specifications.
- G. All concrete/masonry bases, depressions, and built up recessed walk-in floors shall be the responsibility of the General Contractor. The General Contractor shall be responsible for providing all wall blocking for over-shelves, pot racks, rack shelves, etc. as mentioned herein. Kitchen Equipment Contractor shall detail and indicate all special provisions required for food service equipment submitted.

#### 1.5 APPROVED KITCHEN EQUIPMENT CONTRACTORS

- A. Subcontractors providing the foodservice equipment, foodservice equipment fabrication and foodservice equipment installation for this project shall meet the following criteria:
  - 1. Subcontractor shall have successfully completed three (3) projects of similar size and scope to this project within a three-year period prior to bidding this project.
  - 2. Subcontractor shall be an authorized dealer for all equipment, as specified, in this section.
  - 3. Stainless-steel fabrication contractor shall be an N.S.F. certified fabricator with U.L. recognition.
- B. Kitchen and foodservice equipment shall be furnished, installed, and guaranteed by one (1) of the following kitchen equipment suppliers:
  - 1. Mission Restaurant Supply (Brian Mosher)  
1126 s. Saint Mary's Street  
San Antonio, TX 78210  
Phone: 210-354-0690 Fax: 210-354-0746
  - 2. Edward Don & Company (Scott Jost)  
36 W. Beauregard Ave, Suite 504  
San Angelo, TX 76903  
Phone: 325-658-5878 Fax: 325-658-7920
  - 3. Texas Metal Equipment Company (Andrew Harmon)  
6707 Mayard Road, Suite 2696  
Houston, TX 77041  
Phone: 713-466-8722 Fax: 713-466-0166
  - 4. Supreme Fixtures Company (Tim Hampel)  
11470 Hillguard Road  
Dallas, TX 75243  
Phone: 214-343-0700 Fax: 214-343-0707
  - 5. Jean's Restaurant Supply (Bobak Mostaghasi)  
426 S. Staples Street

Corpus Christi, TX 78401  
Phone: 361-884-9800 Fax: 361-888-7602

6. Oswalt Restaurant Supply (Samantha Thompson)  
4532 Enterprise Drive  
Oklahoma City, OK 73128  
Phone: 405-843-9000 Fax: 405-840-4044

- C. General Contractor may elect to accept bid(s) from any kitchen equipment vendor whether or not they are included on the approved list as noted in this Specification Section.

## 1.6 QUALITY ASSURANCE

- A. Workmanship and Employees: Workmanship shall be of the highest grade throughout and in accordance with best standards as practiced for heavy-duty kitchen equipment. The Contractor shall enforce at all times strict discipline and good order among his employees and shall not employ any unfit person.

## 1.7 STANDARDS

- A. All foodservice equipment shall be fabricated in accordance with the National Sanitation Foundation (N.S.F.) and post the seal of approval. Where Contract Documents exceed NSF requirements, the Contract Documents govern. If the Architect is not satisfied with the sanitary construction casework details, the Contractor shall call in the area N.S.F. representative for an onsite inspection and evaluation at no cost to the Owner.
- B. All plumbing pipes and fixtures listed herein shall conform to the Safe Drinking Water Act (SDWA) and its LEAD-FREE standards. If for any reason the fixtures do not pass the standards as set forth by the SDWA, it is the Contractors responsibility to replace those fixtures with an approved equal, which does comply.
- C. All equipment, related components, refrigerants, and performance ratings must be in accordance with the current governing International Energy Conservation Code (IECC) requirements.
- D. All foodservice equipment, where applicable, shall comply LEED v4, WEp, and WEc indoor water use reduction requirements.

## 1.8 MECHANICAL

- A. All gas burners, valves, fittings, etc. shall be installed in accordance with local codes and the American Gas Association. All buy-out gas equipment shall bear the seal of A.G.A. All hot and cold-water service stops at point of equipment to be furnished by others.

## 1.9 ELECTRICAL

- A. All fabricated equipment electrical work shall be installed in accordance with local codes Uniform Building and National Electrical Codes, except where plans exceed codes and

specifications. All buy-out equipment to be listed and/or recognized by Under-Writers Laboratories, Inc. All vertical service mounted controls to be recessed.

- B. Electrical fittings and components furnished under this Section area as follows; Components provided loose under this Section for field installation and connection under Division 26 are indicated asterisk \* or as indicated on detail. Coordinate foodservice equipment voltage and phase with building system.
1. \*Walk-in Cooler/Freezer ceiling lights to be pre-wired with pigtails and mounting hardware consisting of F.S. junction box with cover and CPVC plastic nipple to fasten to walk-in box ceiling panels. Division 26 Contractor is to provide and install all loop wire between light fixtures to electrical rough in junction box above walk-in boxes door panel and seal all holes in panels. All wiring to be above ceiling panels in code acceptance conduits.
  2. Division 26 to provide and connect supply power for walk-in box evaporators from the house panel and provide disconnect switch on evaporator, all wiring, and rigid metal conduit to code requirements. Kitchen Equipment Contractor to supply outdoor-type NEMA-4 power disconnect, factory-mounted on unit. Division 26 to connect power lines from rough-in points to disconnect switch.

#### 1.10 SUBMITTALS

- A. The contractor shall submit one (1) electronic copy, or six (6) hard copy sets for the Consultant's approval such as assembly drawings, electrical and mechanical rough-in connection plans, details for plumbing, electrical, air conditioning and ventilation services for all kitchens equipment and brochures, catalog cut-sheets, specifications, and operating characteristics for buy-out equipment. This submittal set shall be submitted within 35 days of notification of bid award. Once documents have been received by the Foodservice Consultant, a mandatory ten (10) business day review period is required by the Architect/General Contractor. Submittals shall be submitted in the following format:
1. Hard copy submittal shall be presented with front and rear hard protective covers with labeled project name.
  2. Front sheet indicating the following: **Name and address of project, Architect, Foodservice Consultant, and Kitchen Equipment Contractor.**
  3. A separate divider sheet for each component and/or item of equipment indicating the following: **Item Number, Name of Item, Quantity of Item, Manufacturer Name, all specified optional equipment, modifications, and necessary utility requirements.**
  4. Clearly indicate any deviations from Contract Documents, such as arrangement of piping, connections, wiring method of fabrication, manner of structural conditions, standard shop practices, or other reasons, as noted in letter of transmittal accompanying submittal documents.
  5. Fabricated equipment drawings shall be no less than 3/4" equal to one (1') foot scale. Scale as noted on rough-in drawings shall be no less than 1/4" equal to one (1') foot scale.
  6. Each category of submittal shall be provided to Foodservice Consultant under a separate submittal number. Failure to provide these documents broken out will result in disapproval and a resubmission requirement by the Architect/General Contractor. Submittal Numbers shall be noted as follows:

- a. 11 40 00-01 Product Data
  - b. 11 40 00-02 Kitchen Rough-in Drawings
  - c. 11 40 00-03 Walk-in Cooler/Freezer Package (Refrigeration Rack shall be included)
  - d. 11 40 00-04 Custom Fabrication Package
  - e. 11 40 00-05 Serving Counter Package
  - f. 11 40 00-06 Closeout Documents Package
7. Under no circumstances shall any work be undertaken, nor material shipped prior to written approval of the Foodservice Consultant. Approval of such plans and cutsheets/brochures by the Foodservice Consultant shall not relieve the Kitchen Equipment Contractor of any obligations to furnish all materials and labor required for the completion of the project. The Foodservice Consultant's approval shall not relieve the Kitchen Equipment Contractor of any responsibility with regard to the final successful operation of the equipment. No approval provided by the Foodservice Consultant shall absolve the Kitchen Equipment Contractor from fulfilling any/all guarantees in the subcontractor's agreement with the General Contractor.
  8. The Kitchen Equipment Contractor shall, after all revisions are complete, furnish (for the Foodservice Consultant) one (1) electronic copy or three (3) sets of drawings and specifications.
  9. All submittals, as related to compliance qualifications with LEED v4, WEp, and WEc indoor water use reduction requirements, as provided herein.

#### 1.11 FIELD MEASUREMENTS

- A. All field measurements required to facilitate the installation and connection of all kitchen equipment shall be the sole responsibility of the Kitchen Equipment Contractor. Foodservice Document dimensions are approximate locations for all plumbing, electrical, and ventilation connections. Any conflicting dimensions and/or obstacles performed by others that prevent the installation of specified equipment shall be reported to the Foodservice Consultant prior to proceeding with installation.

### PART 2 - EQUIPMENT SUBSTITUTIONS

#### 2.1 SUBSTITUTIONS

- A. Wherever an explicit equipment item is specified, it is not the intention of the Owner or Foodservice Consultant to discriminate against another manufacturer. It is the intention to set a definite standard as to the class of material itself. Under no circumstances, however, shall any substitution be made without the written approval of the Foodservice Consultant. In presenting their proposals, each prospective Kitchen Equipment Contractor is expected to include in their proposed sum, the cost of the materials, as specified herein.
- B. No substitutions will be approved prior to bid award. Substitutions may then be considered as provided by other sections of these specifications. If the proposed substitution is not found to be acceptable by the Owner, Consultant, and/or Architect, the specified item must be provided.
- C. In all instances, such request shall be accompanied by complete descriptive literature and complete operation and performance data. The Consultant will investigate such request for

substitutions, consult the Owner when necessary and render final decision as promptly as possible.

- D. If a substitution, previously granted, proves unsatisfactory for the service for which it was intended within the guarantee period, the Contractor shall make the project conform to the specifications at their own expense.
- E. If substituted equipment requires additional and/or different electrical, plumbing, or mechanical connections, the Kitchen Equipment Contractor is responsible for any and all additional charges to respective Contractor. Kitchen Equipment Contractor will also be held responsible for additional charges related to Inspections, Testing & Balancing.
- F. If an item is discontinued by the manufacturer, request for replacement of like unit may be submitted by the Kitchen Equipment Contractor. Unit must match similar size, shape, and overall construction. If proposed unit does not match originally specified unit, Foodservice Consultant reserves the right to request an alternate manufacturer and model to replace unit to perform the function as desired.

## 2.2 CONDEMNATION

- A. Final approval of equipment and installation shall be made by the Consultant and/or Owner's Agent. A review of the installed equipment shall be made with the Contractor at which time the Contractor shall demonstrate the operation procedures of each item. Three (3) hard bound sets of operation procedures and repair part lists shall be presented to the Owner at the time of inspection.
- B. Should any equipment item be rejected by the Consultant and/or Architect as not meeting Contract Document requirements, the Contractor shall remove the equipment within a twenty-four (24) hour period.
- C. All testing of individual equipment components and steel-gauge shall be conducted without cost to the Owner.

## PART 3 - EQUIPMENT

### 3.1 KITCHEN EQUIPMENT

- A. **Fabricated Equipment:** All fabricated equipment such as food servicing units, tables, sinks, etc. described in the item specifications, other than by name and catalog number shall be manufactured in the successful bidder's manufacturing plant having personnel with expertise and facilities to manufacture high quality kitchen equipment. If the bidder does not maintain and operate a fabrication plant, they shall submit the name and address of the factory that is fabricating the proposed equipment, references of prior similar equipment installations, and other documentation deemed necessary at the request of the Consultant.
- B. **Buy-Out Equipment:** The successful bidder shall be an authorized distributor of the buy-out equipment specified in the Item Specifications. They shall be responsible to furnish any replacement part promptly when required.

- C. Guarantee: The Kitchen Equipment Contractor shall guarantee all equipment, materials, and workmanship incorporated in the Project for a period of one (1) year after the date of the final acceptance of the Project. Faults discovered by the Owner within the guarantee period shall be corrected by the Kitchen Contractor.
- D. Any equipment that requires removal to repair shall be replaced with an equal to or better piece of equipment on a loan basis.

### 3.2 MATERIALS

- A. General: All material installed as a permanent part of the fabricated equipment shall be new and unused and of the quality specified. The material on the job shall be maintained in an undamaged condition. All items of buy-out equipment shall be of the latest model at the time of bidding.
- B. Stainless-steel used in the construction of the fabricated kitchen equipment to be Type 304, having a standard analysis type of 188-8. Exposed stainless-steel shall be polished to a No. 4 finish. Sheet colors throughout with a uniform finish and appearance.
- C. Galvanized metal shall be copper bearing galvanized steel sheets or ingot galvanized iron steel sheets equal to Armco or Toncon, re-rolled for smoothness and used in the largest possible size to facilitate as few welded joints, as necessary.
- D. Structural Shapes: Galvanized 1-1/2" x 1-1/2" x 1/8" steel angle as required for structural support of the fabricated equipment.
- E. Bolts, Screws, and Rivets: All working surfaces shall be free of bolts, screws, and rivet heads. When fasteners are required on working and/or exposed surfaces they shall be approved concealed type. All fasteners shall be of the same composition as metal to be fastened.
- F. Tubing shall be seamless: 1-5/8" outside diameter (O.D.). 16-gauge stainless-steel.
- G. Sealant shall be CLEAR silicone by General Electric Co. or equal and approved by USDA for incidental food contact.

### 3.3 FABRICATION

- A. Welding: All welds of stainless-steel shall be Heliarc welded. Welds to be free of pits and flaws and ground smooth and uniform to the grain and finish of the original sheet. Where grinding and polishing have destroyed the grain, restore, and blend the joints such that all traces of the weld are removed. All welds are to be backgrounded. Acetylene welding or silver solder shall not be used. All galvanized welding shall be arc welded. Welds shall be free of pits and flaws and peened to remove flux and other impurities, and ground smooth.
- B. Finishing: All exposed edges shall be deburred such that a rounded smooth edge is produced. All stainless-steel shall have a No. 4 finish except for leading edges that will be highlighted to a No. 7 finish.



- C. Painting: All tables, cabinets and sinks under carriages, except for stainless steel, shall be painted with black semi-gloss acrylic enamel. A baked enamel finish, according to paint manufacturer's recommendations, is required for all exposed surfaces.
- D. Laminated Plastic: Wherever laminated plastic is specified for cabinet work it shall be Formica, Wilson Art or equal. Plastic to be bonded with a Urea based cement, waterproof and heatproof. All edges to be mitered. Plastic shall be applied directly over 1/2" thick close grain plywood.
- E. Sound Deadening: A plastic mastic sound deadening material shall be applied to underside of all counter tops, sinks and worktables to a minimum of 1/8" thickness. Excess mastic on visible part shall be cleaned. An N.S.F. approved material shall be used. A tar base material is not acceptable.
- F. Field Joints: Field joints shall be limited only to facilitate installation and transportation. All field joints to be continuously welded, grounded, and finished smooth without buckling.
- G. Equipment Refrigeration: All refrigeration equipment for a complete system shall be furnished by the Kitchen Contractor. All refrigeration systems rated over 1/3 HP shall have a sight glass, thermal expansion valve, high and low-pressure controls and defrost cycle. All refrigeration lines to have Armaflex covering except for conduit runs.
  - 1. All compressors to have a five (5) year warranty. Completed systems to have a one (1) year warranty from date of substantial completion or acceptance.
  - 2. All thermostatic capillary tubes to be adequately protected from user damage.
  - 3. All refrigeration systems less than one (1) HP, that use a capillary expansion line, shall be properly charged such that ice balling does not occur at the frost line.
- H. Plumbing Trim: Contractor shall furnish all trim, as specified, within or in the Item Specifications.
  - 1. Faucets: Splash mount with adequate nozzle length as manufactured by T&S Brass.
  - 2. Faucets: Deck mount with adequate nozzle length as manufactured by T&S Brass.
  - 3. Faucets: Pantry-type as manufactured by T&S Brass.
  - 4. Faucets: Pre-rinse type as manufactured by T&S Brass.
  - 5. Hose reel as manufactured by T&S Brass.
  - 6. Kettle filler as manufactured by T&S Brass.
  - 7. Drain – Component Hardware “Encore” Series Model No. DSS-8015 with twist handle and overflow assembly.
  - 8. All foodservice related faucet assemblies, pot fillers, piping, fittings, etc. shall comply with the Federal Safe Drinking Water Act requirements.
- I. Hardware: Fabricated Equipment
  - 1. Casters: Klein 222-58-SR adjustable stainless-steel bullet feet
  - 2. Counter Legs: Klein 222-60-S
  - 3. Leg Sockets: Klein 481-58 stainless-steel
  - 4. Door Hinge: Klein 499A continuous stainless-steel piano hinge
  - 5. Pull: Klein 12270 bevel edge recessed pull
  - 6. Hinged Door Catch: Klein 242 or 9475
  - 7. Refrigerator Door Handle and Lock: Klein 13000-C with walnut vinyl insert and keyed alike.

8. Sliding Door Track Assembly: Klein 550 track, NT-551 and NT-552 sheave, and Klein 1096 stainless-steel guide pins.
9. Drawer Slide: Klein SSA-9100-HD

J. Metal Table and Countertops

1. Working tops, unless otherwise specified, shall be 14-gauge stainless-steel. All seams, corners, and end splashes shall be welded closed and finished. All edges not adjacent to walls shall be turned down 1-1/2" at 90 degrees and tight hemmed. Where tops are adjacent to other fixtures, they shall be flanged straight down two (2") inches or turned up two (2") inches. Tabletops shall overhang cabinet base section on working side not less than two (2") inches.
2. Countertop adjacent to walls shall overhang the base by one (1") inch, such that the cabinet can be adjusted to an irregular wall line. Return all body ends to wall. Top to be affixed to cabinet body by concealed welded studs. All backsplashes to be curved on 3/4" radius.

K. Cabinet Bodies and Enclosed Bases

1. All cabinet bodies and enclosed bases shall be wrapped with 18-gauge stainless-steel, galvanized iron or bonderized furniture steel as specified by each specific item. All exterior vertical corners adjacent to walls and kitchen equipment shall be at 90-degree angles.
2. Cabinets are to be supported by a 1-1/2" x 1-1/2" x 1/8" galvanized angle iron frame. All corners to be mitered and welded continuously. Gussets and added framework bracing shall be fabricated into the framework such that buckling does not occur. Weld-in sinks and drop-in equipment shall be spanned on each side by support members. All framework shall be designed and fabricated in such a manner that cabinet tops lay flush without warpage. Cross-bracing shall not be less than twenty-four (24") inches on centers.
3. All enclosed cabinet bases are mounted on six (6") inch high counter style stainless-steel legs or masonry bases as specified in the Item Specifications.

L. Undershelves

1. Interior shelves of enclosed bases and overhead cabinets shall be made on 18-gauge stainless-steel unless otherwise noted.
2. All shelving shall be rigidly enforced with angle and 1" x 4" x 1" channel framework to prevent sagging under shelf loads.
3. Removable shelving, where called out in Item Specifications, shall not exceed 24" sections. Front and side edges to be turned down one (1") inch and corners welded. Rear edge to be turned up two (2") inches and tight hemmed. This removable shelving shall be set in a 1-1/2" x 1-1/2" x 1/8" steel angle frame. All exposed framing to be wrapped with 24-gauge stainless-steel.

M. Open Base Tables

1. All open base kitchen equipment construction shall be comprised of 16-gauge stainless-steel measuring 1-5/8" O.D. All joints between legs and crossmembers shall be welded and ground to match the circumference of the tubing. Where legs meet tabletop, a sanitary-type stainless-steel cylinder gusset, no less than 2-1/2" in diameter at top, shall be welded to a four (4") inch wide, 14-gauge galvanized steel channel. Leg will be

inserted into gussets and held there with a set screw. Each leg shall be fitted with a sanitary-type stainless-steel adjustable bullet foot.

N. Hinged Doors

1. All hinged doors shall be double-pane construction with 18-gauge stainless-steel panels. All exposed corners to be welded and ground smooth. Door hinges to be continuous stainless-steel piano hinge running the entire length of the door. Doors shall be fitted with stainless-steel die-stamped recessed pulls with magnetic door catches.

O. Drawers

1. All drawer bodies to be 18-gauge stainless-steel die-stamped such that all corners are on 3/4" radius corners. Drawer bodies are to be 20" x 20" x 5" with 1/2", flanges unless otherwise specified. The drawer bodies shall be removable.
2. Drawer faces shall be double pan construction with 18-gauge stainless-steel fronts and 20-gauge stainless-steel rear panels. All corner to be welded and ground smooth. A sanitary stainless-steel, die-stamped, recessed pull shall be used. Drawer faces shall be welded to a three (3") inch channel, 18-gauge, galvanized iron frame to hold drawer body. Drawer slides to be mounted on channel frame and fitted with ball-bearing nylon rollers. All drawers to be full opening.

P. Elevated Shelves

1. The elevated shelves shall be constructed of 14-gauge stainless-steel. Front edge to be turned down one (1") inch at 90 degrees. Real edges and ends adjacent to walls and other fixtures shall be turned up two (2") inches on a 3/4" radius. Vertical edge of end turn ups to be on a two (2") inch radius.
2. All wall mounted shelves to be mounted on sanitary, 14-gauge, stainless-steel brackets not greater than 4'-0" on centers. Wall mounted shelves are to be sealed to wall using food-grade silicone. Mounting of shelf to bracket shall be done with weld-on studs. All fasteners are to be comprised of stainless-steel.
3. Shelves mounted over free-standing worktables shall be mounted on 1-5/8" (O.D.) stainless-steel tubing welded continuous to the tabletop. Adequate framework to be fabricated in tabletops to support freestanding overhead shelves.

Q. Sinks

1. All sinks to be constructed of 14-gauge stainless-steel to the specified, with a continuous sheet forming the back, front and bottom. All horizontal and vertical corners including ends and partitions shall be a 3/4" radius. Sink partitions to be double thickness with a 1-1/2" diameter top edge. All welds to be 'ground smooth with no pits.' Solder is not acceptable. The front and side, including drainboards, shall have a 1-1/2" diameter, 180-degree rolldown. Faucet holes to be punched on eight (8") inch centers over center line of single compartment sinks and over partitions of multiple sinks. Sink assembly to be mounted at a three (3") inch distance from rear of backsplash to wall. All vats to be pitched toward a center drain. Drain to be a 3-1/2" Component Hardware "Encore" Series Model No. DSS-8015 twist handle drain with overflow heads, or as specified in the Item Specifications. Lever to have a sanitary support bracket.

R. Sink Inserts

1. Where sinks are to be welded into tabletops, unit shall be fully coved, deep-drawn, 16-gauge stainless-steel. All welding to be continuous with a ground and smooth finish. See item specifications for center drain requirements.

S. Drainboards and Dishboards

1. Drainboards are to be constructed of 14-gauge, stainless-steel, welded continuously to the sink body. All drainboards shall have a 2-1/2" high rim with integral 180-degree rolled edges to match sink body. All corners to be 3/4" radius. Drainboards to be pitched a minimum of 1/8" per foot to sink or dishmachine.

T. Exhaust Hoods – (By Division 23)

1. Exhaust Hoods shall be 18-gauge, all welded, 304 series, stainless-steel closure with stainless-steel angle frame, as required, for support. Exhaust Hood shall be suspended using all thread rod. All welded brackets required for hanging of the hood shall be included. Unless specified, hood shall be supplied with 20" x 20" baffle-type filters.
2. All Type I Exhaust Hoods, or portions thereof, penetrating a ceiling, wall, or furred space shall be enclosed in a fire rated enclosure, as per local and jurisdictional code requirements. Enclosure and/or approved fire blanketing to be provided and installed by General Contractor.
3. Trim: Stainless-steel trim shall be fabricated and installed in any location where an opening of greater than 3/8" or greater exists between fabricated equipment and wall or adjacent equipment.

U. Fire Suppression System – (By Division 23)

1. The fire suppression system shall be plenum fire protection system, U.L. listed, Wet chemical, fire suppression system to be Ansul R-102. Equipment and installation shall be according to NFPA standards 17, 17A and 96; UL 300 and all applicable local code requirements. System to be complete including remote fire pull station, mechanical gas shut-off valve, shunt trip and duct and hood protection devices.
2. Wet Chemical Agents: The fire extinguisher agent shall be potassium carbonate, potassium acetate base formulation designed for fire knockdown and securement of grease related fires. The agent shall be available in plastic container labeled with handling instructions.
3. Agent Tank: The agent tank shall be installed in the exhaust hood or remote stainless-steel enclosure. The tank shall be constructed of stainless-steel. The tank size shall be determined by the Contractor to meet the requirements of the specific application. Tanks shall have 100-PSI working pressure, 300-PSI tank pressure and 600-PSI minimum burst pressure.
4. Tank Adapter: Tank adapter assembly shall be chrome plate steel with a 1/4" NPT female inlet and a 3/8" NPT male outlet.
5. Regulated Release Mechanism: Spring-loaded, mechanical/pneumatic type capable of providing expellant gas supply to all agent tanks. It shall contain a factory installed regulator deadset at 100-PSI.
6. Regulated Actuator Assembly: Provide expellant gas for additional tanks in systems requiring three (3) or more tanks. It shall contain a factory-installed deadset at 100-PSI.
7. Discharge Nozzles: Tested and listed for the specific application and stamped with the flow designation. Each nozzle shall be equipped with a protective cap to keep the nozzle tip orifice free of cooking grease build-up.

8. Equipment and Materials

- a. Distribution Piping: Schedule 40 black steel pipe and fittings sized as per manufacture's recommendations. All piping shall be sealed with pipe tape.
- b. Actuation and Expellant Piping: Schedule 40 black iron pipe and fittings sized per Manufacture's recommendations. All piping shall be sealed with pipe tape.
- c. All exposed distribution pipe and discharge nozzles are to individually penetrate the exhaust hood and be anchored with seal tight fasteners. All exposed pipes and discharge nozzles are to be sleeved with chrome plated sleeves with no exposed threads. Avoid the use of hangers and support brackets in exposed area but, if required, they must be chrome plated.
- d. Fire Suppression Contractor is to coordinate with ALL RESPECTIVE CONTRACTORS for all requirements and final location.
- e. Pipe supports, spacing, and routing of conduits and fire suppression piping are to comply with requirements listed in Section 22 and 26 Specifications.

V. ITEM SPECIFICATIONS

1. General: The following basic category minimum features are listed followed by the specific item specifications. The quantity of all items is to match plans and specifications. If there are any discrepancies or differences in the quantities shown on plans and specifications, the Contractor is to assume the larger quantity in their bid and contract.
2. Refrigeration cabinets shall have the following minimum features, unless otherwise noted by specific model number or wording:
  - a. Full depth cabinets
  - b. Stainless-steel exterior and interior
  - c. Foam-in-place urethane insulation
  - d. Six (6) chrome wire shelves, per section
  - e. Exterior thermometers and audible alarms
  - f. Stainless-steel adjustable legs
  - g. Field changeable door
  - h. Expansion valve refrigeration controls
  - i. Condensate evaporators
  - j. Door swings are to be as shown on plans
  - k. Keyed alike locks on all doors
3. Refrigerated buffet units and refrigerated food preparation units:
  - a. Units shall conform to ANSI/NSF-7, Section 6.3
  - b. Units shall be capable of maintaining product in the open display area (rail) at temperatures not greater than 41° F and not less 33° F. They shall also be capable of maintaining air temperatures in enclosed refrigerated compartments (if provided) between 33° F and 40° F.
4. Shelving shall have the following minimum features:
  - a. InterMetro Industries – MetroMax shelving or approved equal
  - b. Adjustable Shelving
  - c. Four (4) or five (5) tiers on all floor mounted sections
  - d. Standards are 75-1/2" or 87-1/2" high
  - e. Order only after field dimensions have been completed

5. Workstation shall have the minimum features as noted in General Specification, Sections 1-3, and as follows:
  - a. Provide all stainless-steel trim pieces where stations adjoin walls and/or other equipment
  - b. Four (4") inches wide x Eighteen (18") inches x one (1") inch (length as scaled on plans) deep splashes in front of all beverage dispensing equipment.
6. Cooking equipment shall have the following minimum features, unless otherwise noted.
  - a. Gas and water pressure regulators, as required.
  - b. Stainless-steel adjustable legs
  - c. Stainless-steel fronts
  - d. Cords and caps for all electrical equipment
  - e. All mobile cooking equipment to have Dormont Quick Disconnects (of 36" minimum length) complete with swivel elbows and connectors, as required.
7. Ventilation equipment shall have the following minimum features:
  - a. Underwriter's Laboratory approval
  - b. Stainless-steel grease extractors
  - c. Vaporproof bullet-type fixtures at 4'-0" on center. Pre-wire to junction box.
  - d. Cooking line vent hood shall have Ansul R.102 Ansulex liquid fire suppressant system or equal; complete with hand extinguish, manual operation mode, and gas solenoid valve for incoming gas line to equipment under the hood.
8. Warewashing and disposal equipment have the following minimum features:
  - a. Stainless-steel legs
  - b. Plated vacuum breaker
  - c. Pressure regulator
  - d. Water temperature gauges
  - e. Manual off-on (reverse) starter controls
  - f. High water alarms
  - g. Water hammer arrestor
  - h. Pre-rinse unit
  - i. Stainless-steel exhaust ducts from conveyor dishmachine to ceiling, plus three (3") inches, to be coordinated with Mechanical Contractor.
9. Preparation equipment shall have the following minimum features:
  - a. Cord and cap set, as required.
  - b. Leg kits
10. Food holding equipment shall have the following minimum features:
  - a. Cord and cap set for mobile equipment
  - b. Locking casters for mobile equipment
  - c. Manifold drain(s) for steam tables with individual extension handles, drain valves pre-piped.
  - d. Infinite controls
  - e. Cords to run inside standards of over-food warmers by Kitchen Equipment Contractor.

### 3.4 DELIVERY AND INSTALLATION

- A. Kitchen Equipment Contractor is not to install any kitchen equipment until all floors, ceilings, and walls have been completed and cleaned, as required. Damage to the equipment due to premature installation shall be the responsibility of the General Contractor. All damaged equipment must be replaced with new, unused equipment.
1. General Contractors and all subcontractors are prohibited from utilization of any and all foodservice equipment for the purpose of tool, material, and all other storage as determined by the Foodservice Consultant. Failure to abide by said prohibition above will result in replacement or repair of misused and/or damaged equipment at no additional expense to the Owner by the responsible party in question.
- B. Supervision: Provide a competent foreman or supervisor who shall remain on the job during the entire installation.
- C. Delivery: Foodservice equipment (excluding exhaust hoods, trench liners, and walk-in cooler/freezer assemblies) are not to be delivered and/or set-in-place until the following construction has been completed: kitchen floors are to be prepped and cleaned, walls painted, ceiling installed, and wiring pulled to junction boxes. (Note 1: Acid floor washes are not to be used on or near stainless-steel nor aluminum. Any damage caused by the use of acid floor washes shall be remedied at the sole expense of the General Contractor.) (Note 2: Walk-in Cooler/Freezer door assemblies are to remain open during the entire concrete curing process.)
1. Assemble, square, level, and make ready items for final utility connections.
  2. Scribing: cut neatly around obstructions to provide sanitary conditions. Where gaps occur between equipment measuring 1/4" or less, apply CLEAR General Electric silicone construction sealant Series SE-1200 mastic or, where gaps measure 3/8" or larger, stainless-steel trim molding of proper shape with concealed attachment. Use epoxy cement and/or "zee" clips wherever possible to secure trim.
  3. General Contractor responsible for all trade coordination of the installation of CLEAR General Electric silicone where conditions occur that could promote the intrusion of insects, rodents, and/or create a health code issue as determined by the Kitchen Consultant.
  4. All kitchen equipment must be stored on jobsite by Kitchen Equipment Contractor to secure monetary compensation. Failure to provide proof of jobsite storage to Foodservice Consultant will result in dismissal of request for payment, unless otherwise noted (in writing) by Owner.
- D. Protect, Clean, and Adjust
1. All equipment is to be properly covered and protected to prevent any damage, while construction is in progress in the given space, by the General Contractor.
  2. Clean up and remove from job site all debris resulting from the work as installation progresses.
  3. Thoroughly clean and polish all foodservice equipment, in and out, ready for the Owner's use prior to demonstration and final inspection.
  4. Lubricate and adjust drawer slides, hinges, and casters.
  5. Clean, flush, and replace all faucet aerators and water strainers to ensure no obstructions are present.

6. General Contractor to touch-up damage to painted finishes prior to the Owner taking possession of the Kitchen and/or work area.
7. Kitchen Equipment Contractor responsible for start-up and inspection of all refrigeration systems a minimum of seventy-two (72) hours prior to acceptance.

E. Equipment Start-up and Demonstration

1. Prior to final inspection, Kitchen Equipment Contractor to provide an authorized service agent to carefully test, adjust, and regulate all equipment in accordance with manufacturer's instructions and certify **IN WRITING** to Owner/Foodservice Consultant that the installation, adjustments, and performance are in full compliance with manufacturer recommendations.
2. Kitchen Equipment Contractor to provide Owner with ***Kitchen Equipment Inventory List*** which shall include Manufacturer, model number, serial number(s), and cost of each equipment item in a table-style format on no more than three (3) sheets. List shall also include sales and service representatives to allow the Owner to schedule demonstrations and service on equipment upon expiration of warranty period.
3. Kitchen Equipment Contractor is responsible for coordination, schedule, and be present at one (1) equipment operation demonstration and personnel training with Kitchen Manager and staff upon completion of project. Additional demonstrations are the responsibility of the Kitchen Manager and Foodservice Equipment Representative at a time of their choosing.
4. Kitchen Equipment Contractor shall be responsible include one (1) year on all Kitchen Equipment Contractor supplied equipment. Warranty to begin the date of approved substantial completion.
5. Kitchen Equipment Contractor to issue all equipment keys with a transmittal to the Owner at the time of kitchen equipment demonstrations.

F. Final Inspection

1. Final inspection will be made when the Kitchen Equipment Contractor will certify that they have completed their work, made thorough review of the installation/operation of each item in the contract and found it to be in compliance with the Construction Documents.
2. The Foodservice Consultant's repetitive final inspection, and all cost associated thereto, incurred due to the Contractor's failure to comply with the requirements of this Article, will be invoiced to this Contractor.

## PART 4 - EQUIPMENT ITEMS

### 4.1 Kitchen Equipment Items

Contractor to include an **ITEMIZED** bid for each item as listed below with their submitted bid.

#### ITEM K1: CANTILEVER SHELVING UNIT

Provide and install one (1) LOT of New Age Industrial free-standing cantilever shelving the size and shape as shown on Foodservice plans. Units are to be comprised of tubular aluminum construction and NSF® approved. Units are to be made in the USA. Each section to contain a minimum of four (4) T-



Bar shelving units with rear supports and uprights, as required. Division 11 responsible for final verification of field measurements prior to ordering equipment. Channel Manufacturing may be submitted as an approved alternate manufacturer.

#### ITEM K2: DUNNAGE RACK

Provide and install one (1) LOT of New Age Industrial stationary aluminum dunnage racks. Units are to be the size and shape as shown on plans (Kitchen Equipment Contractor to field measure prior to ordering) and 12" high. Units are to be constructed of high dense extruded aluminum tube, 1-1/2" x 1-3/4" x .070 wall thickness uniform throughout. Primary aluminum, Type 6063-T5 alloy. All Heli-arc welded construction and all seams are to be welded and to include feet capped and welded. Units to have the following minimum features:

- Weight capacity: 2000 lbs. minimum capacity (per unit)
- Lifetime warranty against rust and corrosion
- Division 11 to field verify all measurements prior to ordering units.
- Channel Manufacturing and Advance Tabco may be submitted as an approved alternate manufacturer.

#### ITEM K3: THREE TIER UTILITY CART

Provide and install two (2) Lakeside model 244 all stainless-steel medium duty tubular carts. Cart capacity to be 400 lbs. total. Units to be equipped with three (3) all stainless-steel shelves. Units to include round corner bumpers. Overall dimensions not to exceed 22" wide x 36" long x 40-5/8" high. Units to be NSF Listed. Steril-Sil may be submitted as an approved alternate manufacturer.

#### ITEM K4: MOBILE CAN RACK

Provide and install one (1) New Age Industrial model no. 97294CK FIFO Can Rack measuring 27-1/8" wide x 42" deep x 81-1/8" high. Unit to be loaded from the front and hold 156 #10 cans. Unit to be comprised of aluminum and mounted on top of (a total of) four (4) six-inch platform-type casters (two swivel with brake and two rigid). Unit to be made in the USA. Unit to contain a lifetime guarantee against rust and corrosion with a five-year guarantee against workmanship and material defects. Channel Manufacturing may be submitted as an approved alternate manufacturer.

#### ITEM K5/K6: WALK-IN COOLER/FREEZER

Provide and install the following:

General Specifications: Walk-in cooler/freezer specified under this portion of specifications shall be prefabricated modular construction or equal. It shall be designed and constructed to allow fast and easy assembly, disassembly, relocation, and enlargement of unit by the addition of like modular panels. Overall size shall be 17'- 10" long x 22'- 4" wide x 8'- 6" interior ceiling height after finished floor is installed as detailed in construction documents and specified below (Field verify all dimensions). Walk-in to be manufactured by Thermalrite. Actual size required. No nominal sizes accepted. Thermo-Kool and Imperial Brown may be submitted as an approved alternate manufacturer.

Walk-in assembly, all components and refrigerant shall comply and have a performance rating in accordance with the current governing International Energy Conservation Codes (IECC).

Panel Construction: All panels shall be constructed of prefabricated sections joined together to form a room of exact dimensions as shown on the contract drawings. To assure perfect alignment and maximum strength, corner panels shall be 90-degree angles. The ceiling and floor panels shall cam lock to the wall panels. Panels shall consist of interior and exterior metal pans precisely formed, framed with tongue and groove High-Density Hard-Nosed Foam Rail with not less than 2 lbs. per square foot density and thoroughly checked for uniformity and accuracy. The metal pans or "skins" shall be placed into steel molds and liquid urethane injected into the assembly. Urethane shall be UL approved foamed-in-place and, when completely cured, binds tenaciously to the metal skins to form a rigid 4" thick insulated panel. To ensure tight joints, panel edges must be tongue and groove with a flexible vinyl gasket on the interior and exterior edges. Gaskets shall be resistant to oil, fats, water, detergents, and sunlight and must be NSF approved. The assembly must adhere to the following code and design requirements: 2009 US Energy Bill H.R. 6 Energy Independence Act, International Energy Conservation Code 2015 C403.2.15 and C403.2.16, DOE Energy Security and Independence Act of 2007 Section 312, ASHRAE 90.1-2013 Section 6.4.5, Factory Mutual 4880, California Code of Regulations Title 20 Sections 11601 – 1608, NSF/ANSI – Standard No. 7 and Labeled Accordingly, International Building Codes, 2012 and 2015 - Chapter 26, Plastic, Section 2603.

Warranty: Panels shall be covered by a ten (10) year factory warranty.

General Contractor is to provide 8" slab depression the size and shape as detailed on plans. Before the installation of the walk-in assembly the General Contractor is to provide and install a one (1") inch setting bed of clean dry sand for leveling unit. Once walk-in assembly is installed the General Contractor is to provide and install approximately a three (3") inch thick wearing floor and specified finished floor material to match finished floor level in the kitchen area. Wearing slab is to include WWF 4.0 x 4.0 – 2.9 x 2.9 flat sheets (Provided by General Contractor), located in the middle of the slab; lap two (2) squares where required. No ramps or special threshold should be required. Finished flooring material is to include 4"-6" base around entire exposed interior and exterior perimeters and all colors to match the rest of kitchen area. If epoxy flooring is to be used, installation of stainless-steel base plate of 4"-6" shall be performed by the Kitchen Equipment Contractor with material provided by Walk-in Manufacturer.

Insulation: Wall and ceiling panel insulation for the Cooler/Freezer shall be 4" thick foamed-in-place urethane foam with a thermal conductivity K factor of 0.12. Panel insulation shall have a 97% closed-cell structure, compression strength at yield point of 30 lbs. per square inch. The insulation shall be rated self-extinguishing and fire-retardant as specified under UL Class 1 and Factory Mutual 4880. Floor to be the same as described above except heavy-duty reinforced to supply 5,000 lb./sf uniform load.

Metal Finishes: All metal finished for panel skins shall be as follows:

Exterior Open into Kitchen (including Doors & Frames)	Stainless-Steel .022
Exterior Unexposed	Stucco Galvanized .026
Interior Wall Finish	White Stucco Embossed Aluminum .040
Interior Ceiling Finish	White Stucco Embossed Aluminum .040

All wall, ceiling and floor panels shall be assembled with cam-action panel fasteners employing an acentric mechanism and clutch principal to align panels perfectly and compress gaskets fully, including ceiling and floor panels. Each locking device shall consist of a cam-action, hooked locking arm placed in the “tongue” rail and a steel rod precisely positioned in the adjoining “groove” rail. By rotating the locking arm, the hook engages over the rod and with cam-action, draws the panels tightly together. Locking mechanisms shall be operated from the interior utilizing a standard hex type Allen wrench, all lock holes will then be sealed with a matching vinyl plug. The required locking wrench shall be supplied as part of the walk-in. All wall, floor and ceiling panels shall have a minimum of 3 cam-locking devices never to exceed a 46” on center spacing.

Entrance Door and Frame: The two (2) door sections shall each provide a full 4” of foam-in-place polyurethane insulation, flush in-fitting type 34” wide x 78” high. Door(s) and door assemblies finish to match materials as noted above. Completed door sections shall be pre-wired and be an UL approved electrical assembly equipped with the following:

- The door gaskets shall be magnetic and of a dart and retainer design that will allow for easy replacement by the end-user without the need for any tools.
- Sure-close hydraulic door closer with concealed mounting
- Kickplates – 36” high stainless-steel on exterior with interior kickplate to be comprised of aluminum treadplate. Door jamb guards are to match materials listed above for kickplates.
- 14” x 24” Triple-pane viewport per door (Heated in freezer walk-in door)
- Two (2) hinges shall be Kason model no. 1346 Performer™ Lift-Off Adjustable Hinge(s).
- The latch shall be heavy-duty commercial type with inside emergency release to prevent entrapment. Latch is of dead-bolt design with both cylinder lock and padlock provision.
- The door shall be constructed to incorporate a heavy-duty fiberglass molded pultrusion 1/8” minimum thickness, which is permanently foamed-in-place. The bottom of the door shall seal with a double blade sweep gasket. The door jamb shall be constructed of a fully welded, anodized aluminum rigid frame. The perimeter shall not be less than two (2”) inches wide thus providing an integral backing to accommodate all required hardware.
- Flush mounted multi-monitor temperature alarm, door ajar alarm, automatic light control, AC failure system & panic alarm (Model: 75LC) All systems are pre-wired, and factory tested per UL.

- The digital temperature control conduit to be stubbed out through the ceiling panel with no exposed electrical conduit.
- Interior panel trim strips covering panel seams for a neat and clean appearance are to be provided by Walk-in Manufacturer and installed by Division 11.

HEATING PRESSURE RELIEF VENT: The freezer shall be equipped with one (1) each two-way heated pressure relief vent to equalize between exterior and interior caused by defrost cycles and opening of doors. Electric shall be 120v/60hz/1ph.

Special Accessories:

- Two (2) stainless-steel foot treadles
- Provide four (4) LED vapor-proof light fixtures with -40° F to 110° F operating temperature range mounted at locations shown on drawings. Switches to be on interior and exterior of unit.
- Stainless-steel ceiling enclosure panel to ceiling, as required.
- Trim Strips to close vaults to wall and fully encase opening in building wall at exposed front of walk-in assembly.
- **Assembly of walk-in units and refrigeration systems to be performed by a Factory Certified Installer. Provide written approval from manufacturer prior to installation.**
- Kitchen Equipment Contractor is responsible for condensate piping, and insulation, inside walk-ins.
- Pad lock hardware at each door assembly
- Laminated plastic identification door signs at each door identifying “Cooler” and “Freezer”
- Metal insert with vinyl bumpers guards on all exterior exposed wall panels to be mounted and centered at the same height as the door handles on walk-in cooler/freezer doors (approximately 42” A.F.F.)
- Kitchen Equipment Contractor may use butyl at seams of walk-in panels for a better seal. If butyl is to be used, it must be clear in color.
- SJ Cord to be mounted on exterior side of door frame.
- Concealed mounting provisions for Item K13 Air Curtain assemblies as per plans.

NSF Construction: Walk-ins and refrigeration systems shall be constructed in accordance with National Sanitation Foundation, Inc. - Standard No. 7. The NSF approved seal shall be affixed to the serial plate of the walk-in.

Installation, Operation and Maintenance Instructions: Each walk-in shall be supplied with a complete set of installation, operation, and maintenance instructions to cover erection of walk-in, installation of refrigeration systems, operating procedures, and routine maintenance schedule.

General Contractor to coordinate and provide the installation of the final electrical and plumbing connections by licensed trades. Once final connections are accomplished the Kitchen Contractor is to start-up the refrigeration and make necessary adjustments. The start-up will include holding the freezer vault at 40° F for five (5) days prior to allowing the unit to reach freezing temperatures. Installation of walk-in after delivery shall not exceed five (5) working days.

Successful Kitchen Equipment Contractor shall be responsible for taking delivery of walk-in from freight company to check for any damage in shipment.

Refrigeration Systems: Item K19

Provide one (1) Refrigeration Design Technologies Model No. ZS1-02Z-CT4-AST UL Listed air-cooled refrigerated rack system housed in a weather protected compact galvanized steel frame. The equipment to be protected by a set of stainless-steel one-piece louver assemblies. Unit to be factory pre-piped and pre-wired aluminum fin copper tube condenser.

Each unit to be equipped with a ball bearing fan motor, fan cycling switches, crankcase heaters, suction filter, sight glass, drier and high-pressure superhose connection. The liquid line valve is to be all welded.

Refrigeration system, all components and refrigerant utilized shall comply and have a performance rating in accordance with the current governing International Energy Conservation Codes (IECC).

Evaporator coil units to mount flush with ceiling of walk-in panels.

All compressor units shall be scroll-type and factory assembled to operate with the refrigerant specified.

All refrigerant lines to be extended to one side of the package in a neat and orderly manner. All tubing shall be supported and anchored with a non-corrosive coated clamp. All joints to be welded, not soldered. All piping and controls shall be factory tested with nitrogen at 300-PSI.

The package shall have a factory-mounted and pre-wired control panel complete with main fuse disconnect, circuit breakers, and contactors wired for single point power connection.

**The roof curb is to be provided and installed by the Roofing Contractor. Reference Architectural Construction Documents for details and specifications.** All roof penetrations are to be provided and properly sealed by the Roofing Contractor.

Electrical Connection: 480v/60hz/3ph – 13.3A

<u>Equipment</u>	<u>Cooler</u>	<u>Freezer</u>
Compressor	ZS13KAE	ZF18K4E
Amperage	480v/60hz/3ph – 4.3A	480v/60hz/3ph – 9A
Refrigerant	R448A	R448A
Evaporator Model	BEL0115	BEL0155
Fan Motors	120v/60hz/1ph – 1.8A	208v/60hz/1ph – 1.5A
Defrost Heater	N/A	208v/60hz/1ph – 13.7A
Evaporator Weight	52 lbs.	78 lbs.
Rack Weight		450 lbs.

Total Weight

580 lbs.

Accessories to include:

- Evaporator coils shall be a direct expansion type, will be "Underwriters Laboratory Listed" and supplied from factory with an expansion valve, solenoid valve and Eco-Smart demand defrost controller, pre-wired and pre-piped under nitrogen pressure and designed for use with the refrigerant specified.
- One (1) year manufacturer parts and labor warranty and five-year compressor warranty provided solely by Refrigeration Design Technologies of Texas on the specified rack systems listed.
- All exposed refrigerant piping on exterior of building is to be encased in aluminum jacketing to comply with requirements listed in Division 23.

#### INSTALLATION OF FOODSERVICE EQUIPMENT REFRIGERATION SYSTEMS

- Install complete with refrigerant, oil dials dehydrators, gauges, controls (as required) for proper operation of the system.
- Self-contained system of factory-installed compressors: Check and adjust to proper operating temperature.
- Guarantee: Provide five (5) year compressor warranty and ten (10) year panel warranty.
- General Contractor shall furnish, install, and provide final electrical and plumbing connections by licensed trades on refrigeration system.
- **Refrigeration Installer to verify expansion valve settings match OEM Specifications.**

Drain Lines: All evaporator coils shall be provided with proper sized insulated drain lines and p-traps, supplied and field installed by contractor. Drains shall be trapped outside of walk-in. Drain shall be heated and insulated to prevent freezing. All plumbing to be in accordance with applicable codes.

Responsibilities of the Kitchen Equipment Contractor shall include the following:

- **PROVIDE PENETRATION IN ALL WALK-IN PANEL ASSEMBLIES** for electrical, plumbing, and fire system devices. Kitchen Equipment Contractor shall be responsible for sealing of said penetrations and inside conduits for moisture prevention and leakage.
- All door-sweep adjustments on bottom of doors to prevent air leakage.
- Check all handle latches, hinges, and hardware for proper fit, attachment, and adjustment.
- Provide properly sized drain line(s), P-trap(s), and heat tape, where applicable.

- Check all panels all panels for alignment, seal, and levelness prior to start-up of refrigeration system.
- Clean and inspect all surfaces for aesthetic appearance.

Once final connections are accomplished, the Kitchen Equipment Contractor shall provide start-up services for the refrigeration equipment and perform all adjustments required to bring unit into OEM requirements. The service shall include holding the temperature of the freezer vault at 40°F for a minimum of five (5) days. Once freezer vault holding temperature is satisfactory, Kitchen Equipment Contractor may allow freezer to reach appropriate temperatures for the Freezer vault. Installation of the walk-in assembly shall not exceed five (5) working days after delivery to job site.

#### ITEM K7: PAN RACK

Provide and install six (6) New Age model 1331 end loading all aluminum mobile bun pan racks. Units to be constructed of heavy duty, high tensile, extruded aluminum, Type 6063-T5 alloy. Tray slides are all to be fully welded with 3" runner spacing. Each unit to include four platform type 5" diameter, full swivel design casters with sealed ball bearings. Unit to contain a lifetime warranty against rust and corrosion and a five (5) year guarantee against material defects and workmanship. Channel Manufacturing may be submitted as an approved alternate manufacturer.

#### ITEM K8: MILK DOLLY

Provide and install one (1) Lakeside model no. 454 all stainless-steel single handle platform truck measuring 20" (W) x 30" (D) x 8-1/4" (H). Unit to be mounted on fixed eight (8") inch casters in the front and swivel casters in the rear. Unit to be fitted with corner bumper protectors.

#### ITEM K9: LOCKERS

General Contractor to reference Architectural Construction Documents for item specifications and requirements.

#### ITEM K10: STAINLESS-STEEL CORNER GUARD

Provide and install one (1) LOT of custom fabricated 14-gauge, 304 series, stainless-steel corner protectors at all wall corners throughout kitchen area as shown on plans. Kitchen Equipment Contractor to verify corners of wall edges prior to fabrication of units (if wall is not bull nosed, corner guard is not to be constructed with a radius corner). Units are to be 2" x 2" x 48" high and the angle as presented at each wall location. Units are to be secured to wall with heavy duty adhesive and where wall fasteners are required, they shall be stainless-steel and spaced equally in line on each angle of the unit. Kitchen Equipment Contractor to silicone caulk around each unit where abutting wall and flooring surface. Kitchen Equipment Contractor to verify quantity of required units prior to fabrication.

#### ITEM K11: DESK

Kitchen Equipment Contractor to install one (1) owner supplied desk. All requirements and accessories to be verified by Kitchen Equipment Contractor.

#### ITEM K12: FILING CABINET

Kitchen Equipment Contractor to install one (1) owner supplied filing cabinet. All requirements and accessories to be verified by Kitchen Equipment Contractor.

#### ITEM K13: AIR CURTAIN

Provide two (2) Berner Air Curtain Model No. CHD10-1042A-SS. Unit dimensions are to be 45" (W) x 14.5" (D) x 14" (H). Mars may be submitted as an approved alternate manufacturer. Each unit is to be equipped with the following features:

- One (1) 1/2 HP, three speed motor(s), for door height up to 10-feet high
- One (1) five-year warranty (unheated units)
- One (1) model each A – 120v/60hz/1ph – 6.5A (UL Listed)
- One (1) model each 91STR120-BA-M-24 Basic Control Package – 24V (including magnetic reed door switch with transformer, for 120-240V, white.
- Electrical utility connections are to be completed by Division 26 (Electrical Contractor)
- One (1) stainless-steel housing
- Installation by Division 11 (Kitchen Equipment Contractor)

#### ITEM K14: MOP/BROOM RACK

Provide and install two (2) Rubbermaid Commercial Products model no. 1993 Closet Organizer/Tool Holder Kit(s) measuring 34" wide x 3.2" deep x 4.2" high. General contractor to provide concealed wall blocking, as required, for mounting unit(s).

#### ITEM K15: SERVICE FAUCET

Provide one (1) T&S Model B-0665-BSTP Service Faucet complete with 8" centers, 9-1/8" from wall to center of outlet, polished chrome finish, vacuum breaker nozzle with 3/4" garden hose male outlet



and 1/2" NPT female eccentric flanged inlets. Contractor is to provide T&S Model B-0618-01 black rubber hose. Unit to be installed by Division 22 (Plumbing Contractor) 36" above finished floor.

#### ITEM K16: TRENCH DRAIN/MOP SINK

Provide one (1) IMC/Teddy FT-2448 stainless steel trench drain. Unit dimensions to be 48" wide x 24" deep. Unit to be equipped with the following minimum features:

- Floor trough constructed of 14-gauge, 18.8, type 304 stainless-steel with fully welded corners ground and polished smooth.
- Trough shall have a built-in pitch toward center of unit where drain is located and anchor straps for securing unit to the floor, Trough shall have a stainless-steel waste cup with a removable stainless-steel basket for up to a 3" waste pipe.
- Unit to be equipped with New Age Industrial ADA compliant aluminum subway trough grating, with non-slip surface, sized accordingly.
- Unit to be installed flush with finished floor. Verify finished floor material and modify units accordingly.
- Unit to be installed by Division 22 (Plumbing Contractor).
- Advance Tabco and Eagle Manufacturing may be submitted as an approved alternate manufacturer.

#### ITEM K17: AIR CURTAIN

Provide one (1) Berner Air Curtain Model No. CHD10-2060A-SS. Unit dimensions are to be 63" (W) x 14.5" (D) x 14" (H). Unit is to be equipped with the following features:

- Two (2) 1/2 HP, three speed motor(s), for door height up to 10-feet high
- One (1) five-year warranty (unheated units)
- One (1) Model A – 120v/60hz/1ph – 13A (UL Listed)
- One (1) Model 9503SD020-P Automatic Door Switch – plunger type; unit activates air door when door opens, single phase only & max. amp draw of 20 amps
- One (1) stainless-steel housing
- Installation by Division 26 (Electrical Contractor)
- Mars Air Curtains may be submitted as an approved alternate manufacturer.

#### ITEM K18: HAND SINK

Provide and install four (4) Advance Tabco model 7-PS-70 all stainless-steel wall mounted hand sinks. Units are to be constructed from one sheet of heavy gauge stainless steel with no welded seams other than at corners. Welded areas are to be blended to match adjacent surfaces and to a satin finish. Unit to be equipped with 1-1/2" IPS stainless steel basket drain, chrome plated 1-1/2" P-Trap, 10" x 14" x 5" sink bowl and stainless-steel wall mounting brackets. Units to be equipped with T&S model B-1146-02A-WH4 ASA Compliant gooseneck faucet assemblies with hot and cold wrist action style handles. Paper towel and soap dispensers are to be furnished by Owner/UTRGV/Edinburg C.I.S.D. and installed by General Contractor.

#### ITEM K19: REFRIGERATION RACK

Reference Item K5/K6 Walk-in Cooler and Freezer for item specifications and requirements.

#### ITEM K20: TRASH CAN

Provide and install four (4) Rubbermaid Model No. 2632 BRUTE trash containers, complete with Model no. 2631 lids and Model No. 2640 dollies. Container and lids are to be gray in color. Verify clearance requirements under all working surfaces, as noted on plan, prior to ordering.

#### ITEM K21: DISPOSER

Provide one (1) InSinkErator model no. SS-300 sink mounted food waste disposers measuring 14-1/8" wide x 16-3/4" deep x 21" high. Unit to contain the following minimum features and accessories:

- Electrical Connection: 208v/60hz/3ph – 7.4A (short body model)
- Plumbing Connection: 1/2" Cold Water Connection, three (3") inch direct drain connection
- One (1) year parts and labor warranty (on-site), standard
- One (1) #7 Collar adapter kit with electrical control, and flow control valve (per unit)
- Seven (7) GPM reduced water flow
- One (1) InSinkErator model no. AS-101 AquaSaver® Control Center
- One (1) stainless-steel de-jamming prong (only one unit provided for entire campus)
- One (1) rubber scrap ring
- One (1) T&S Brass model no. B-0455 vacuum breaker with chrome sleeves and escutcheons for all vacuum breaker piping above splash (per unit).

## ITEM K22: POWERED POT WASH SINK

Provide and install one (1) Champion Bi-Line VWS Vortex Wash System powered pot wash sink system, the size and shape as detailed on plans. Power Soak and Hobart may be submitted as an approved alternate manufacturer. Unit is to be equipped with the following features and accessories:

- Direction: Left to Right
- Electrical Connection: 208v/60hz/3ph – 23A (30A Max Time Delay Fuse)
- 49” soiled drain board to incorporate factory hemmed edge end curb
- 24” scrap sink
- 13” transition drain board to house controls, pump and heater
- 60” wash sink
- 24” Rinse sink
- 24” Sanitizer sink
- 82” clean drain board with hemmed edge end curb
- Chemical Pump System
- Two (2) T&S model no. B-0291 Big-Flo faucet assemblies are to be provided by Kitchen Equipment Contractor and installed by Division 22.
- One (1) T&S model no. B-0133 Pre-Rinse faucet assembly is to be provided by Kitchen Equipment Contractor and installed by Division 22.
- Kitchen Equipment Contractor to provide three (3) Component Hardware “Encore” Series model no. DSS-8015 lever drain assemblies, or approved equal, at each compartment, as noted on plans. Division 22 to install fixtures as required.
- Utensil basket
- Sheet pan racking system
- Disposer collar assembly to be shipped to Manufacturer by Kitchen Equipment Contractor for proper installation prior to unit being shipped to jobsite.

Standard features to include the following:

- Factory Authorized Start-up after completion of installation.

- 14-gauge, 304 series, polished stainless-steel construction
- Backsplash to measure 9.5” high x 2-1/2” deep
- 21” deep wash tank – standard
- 18” deep rinse/sanitizer sinks
- 1-1/2” rolled edge front
- Hemmed edge both ends
- Stainless-steel legs and cross rails – fully welded
- Stainless-steel adjustable bullet feet
- Rear discharge with removable suction screen
- 3 HP TFEC wash pump motor with permanently sealed bearings
- SST impeller with overload protection and manual reset
- Low water protection for wash pump motor
- 5000w wash tank heater
- SST Front fascia panel for smooth front appearance
- One (1) year parts and labor warranty on pump, heater, and controls
- All Bi-Line (Champion) equipment is to be NSF/UL Listed and manufactured in Winston-Salem, North Carolina.

#### ITEM K23: WALL MOUNTED POT RACK AND DRYING SHELF

Provide and install one (1) custom fabricated 9’- 0” long x 12” deep wall mounted pot rack the size and shape as detailed on plans. Unit to be constructed entirely of 304 series stainless-steel. Mount top of pot rack at 80” A.F.F. Pot/Utensil racks to be constructed of 2” x 1/4” stainless-steel bar length as shown on plans with Standard-Keil No. 1576-1010-1351 pot hooks every 8” on center. General Contractor to provide concealed wall blocking, as required. Kitchen Equipment Contractor to field measure prior to fabrication.

Provide and install one (1) custom fabricated 9’- 0” long x 12” deep tubular wall mounted drying rack the size and shape as detailed on plans. Unit is to be constructed of three bars: 1” O.D. 18-gauge stainless-steel seamless welded tubing. Close ends with flat or spherical plugs of stainless or chrome plated steel. Brackets are to be one piece formed or die stamped 14-gauge stainless steel. Manufacturer is to remove all sharp edges from brackets before shipping unit. Brackets are to be fastened to wall

with stainless-steel fasteners, as required. Mount top of rack 56" above finished floor. General Contractor is to provide concealed wall blocking, as required.

#### ITEM K24: POT/PAN DRYING SHELF

Provide and install two (2) InterMetro Industries MetroMax® i Drying Rack Units. Dimensions are to be 50"L x 26"W x 68"H. Each rack unit is to be equipped with all standard features including:

- Microban® antimicrobial product protection shelves that are easily removable for easy fit in dishwasher.
- Three (3) vented shelves. Shelves are adjustable at 1/2" increments along the height of the numbered posts (per unit).
- Shelves are adjustable at 1" increments along the height of the numbered posts
- One (1) M4F2448 storage level frame with four (4) wedge connectors (per unit)
- One (1) stainless steel drop-ins. (per unit)
- One (1) cutting board & tray drying rack systems (per unit)
- All units to be mounted on 5" casters (two locking).
- Lifetime warranty against rust and corrosion.

#### ITEM K25: WORK TABLE

Provide and install four (4) custom fabricated 14-gauge, 304 series, stainless-steel work table as detailed on foodservice plans. Unit to measure 7'-0" wide x 2'-6" deep x 35-1/2" high. Unit to be constructed as described in the general specifications of this section. Unit to include the following minimum features and accessories:

- 14-gauge stainless-steel countertop with No. 4 finish.
- One (1) stainless-steel drawer assembly using Component Hardware parts to match and located as detailed on plans. Model S90-0020 stainless steel drawer assembly specifications. Refer to plans for drawer locations.
- 16-gauge, 304 series, stainless-steel 1-5/8" tubular base with adjustable flanged feet (DO NOT BOLT UNIT TO FLOOR).
- Provide 16-gauge, 304 series, stainless-steel fully welded undershelves.
- Table is to be pre-wired for single point final electrical connection to ceiling mounted receptacle. Table fabricator is to install one (1) 4" cube UL approved stainless-steel outlet box mounted on overself extension thru top of table (see plan for mounting side). Table fabricator

is to install twist lock receptacle, conduits, wiring, stainless-steel cover plate, NEMA twist-lock cord and plug, as required, to ceiling receptacle. Table fabricator is to provide and mount two (2) stainless-steel electrical receptacle boxes under tabletop, as shown on plans, equipped with 120V GFCI duplex receptacles and stainless-steel cover plates. All electrical conduits and wiring for complete electrical connections, on table, are to be provided and installed by table fabricator. All electrical devices and connections are to comply with local governing electrical codes and to include UL approval and listing as required. Reference worktable details on Sheets K2.02 and K4.01.

- Kitchen Equipment Contractor to field verify all dimensions prior to fabrication.

#### ITEM K26: WORK TABLE

Provide and install one (1) custom fabricated 14-gauge, 304 series, stainless-steel worktable, the size and shape as detailed on plans. Unit is to be 7'-0" long x 30" deep x 35-1/2" high. Top to include a six-inch rear splash as detailed on plans. Units to include the following minimum features:

- 14-gauge stainless-steel countertop with No. 4 finish.
- 16-gauge 1-5/8" stainless-steel tubular base with adjustable flanged feet (Do not secure to floor with stainless-steel bolts).
- One (1) each 20" x 20" stainless-steel drawer assembly using Component Hardware parts to match and located as detailed on plans. Model S90-0020 stainless-steel drawer assembly specifications. Unit to be modified as necessary to fit table assembly.
- 16-gauge all welded stainless-steel undershelf as shown on plans.
- All stainless-steel shall have a No. 4 finish.
- 14-gauge stainless-steel zee clips where abutting wall
- Division 11 to provide and install one (1) rubber grommeted hole for routing of utility connections of Item K50 Hot Water Dispenser as shown on plans.
- Kitchen Equipment Contractor to field measure prior to fabrication

#### ITEM K27: VEGETABLE PREP TABLE

Provide and install one (1) custom fabricated 14-gauge, 304 series, stainless-steel vegetable preparation table with two compartment sink assembly as detailed on plans. Unit to be 9'-8" long x 34" deep and 35-1/2" high with 8" rear backsplash (Field Measure). Unit to be constructed as described in the general specifications of this section. Unit is to include the following minimum features:

- Marine edge at front, right and left sides; 8" high back splash where adjacent to wall.

- One (1) 20" x 28" x 12" deep all covered stainless-steel sink compartment.
- One (1) 20" x 28" x 10" deep all covered stainless-steel sink compartment. Bottom of sink compartment is to include a mounting provision for Item K43 Disposer.
- Full-length, all-welded, stainless-steel front apron at sink compartments to conceal space between sink bowls
- Provide one (1) T&S Model B-2278-01 Pre-Rinse Faucet Assembly with add-a-faucet. Unit to include one (1) additional B-0109-01 wall bracket assembly and one (1) T&S Brass model no. B-0230-K installation kit.
- Provide one (1) Component Hardware “Encore” Series Model No. DSS-8015, lever drain assembly, or approved equal, at sink compartment, as noted on plans.
- 16-gauge 1-5/8" stainless-steel tubular base with adjustable flanged feet secured to floor with stainless-steel bolts.
- 16-gauge, all welded, stainless-steel undershelf as shown on plans.
- Stainless-steel bracket assembly for mounting Item K43 Disposer control assembly as per plans.
- Open base for storage of Item K20 Trash Can.
- Slanted splash penetrations for mounting T&S Brass model no. B-0455 Vacuum Breaker assembly as noted in Item K43 Disposer.
- All stainless-steel shall have a No. 4 finish.
- Unit to be secured to wall with 14-gauge stainless-steel zee clips, as detailed on plans.
- Kitchen Equipment Contractor to field verify all dimensions prior to fabrication.

#### ITEM K28: ICE MACHINE

Provide and install one (1) Manitowoc Ice model no. IYT0420A Indigo® NXT™ Series ice machine capable of producing 375-460 lbs. of half-dice shaped ice. Unit to be mounted on one (1) Manitowoc Ice model no. D-420 ice bin containing adjustable bin legs and comprised of a DuraTech® exterior. Scotsman and Ice-O-Matic may be submitted as an approved alternate manufacturer. Unit to contain the following minimum features and accessories:

- Electrical Connection: 120v/60hz/1ph – 11.3A (15A breaker minimum)
- Three (3) year parts and labor warranty – Ice Maker
- Five (5) year parts and labor warranty – Evaporator
- Five (5) year parts and three (3) year labor warranty – Compressor

- One (1) Artic Pure® Plus Water Filtration model no. AR-10000-P
- One (1) San Jamar® Model No. SI9000 Scoop Guardian™ System. Kitchen Equipment Contractor to coordinate mounting location with Owner/Edinburg CISD Foodservice Department.
- Stainless-steel braided water hose kit, as required, from water filtration outlet to ice machine inlet. Installation by Division 22.
- Division 22 responsible for insulation of all indirect drain lines.

#### ITEM K29A: WORK TABLE

Provide and install one (1) custom fabricated 14-gauge, 304 series, stainless-steel work table as detailed on foodservice plans. Unit to measure 10'-0" wide x 30" deep x 35-1/2" high. Unit to be constructed as described in the general specifications of this section. Unit to include the following minimum features and accessories:

- 14-gauge, 304 series, stainless-steel with a No. 4 finish.
- Two (2) stainless-steel drawer assemblies using Component Hardware parts to match and located as detailed on plans. Model S90-0020 stainless steel drawer assembly specifications. Refer to plans for drawer locations.
- 16-gauge, 304 series, stainless-steel 1-5/8" tubular base with adjustable flanged feet (Do not bolt to floor).
- Provide 16-gauge, 304 series, stainless-steel fully welded undershelves.
- Table is to be pre-wired for single point final electrical connection to ceiling mounted receptacle. Table fabricator is to install one (1) 4" cube UL approved stainless-steel outlet box mounted on overshelf extension thru top of table (see plan for mounting side). Table fabricator is to install twist lock receptacle, conduits, wiring, stainless-steel cover plate, NEMA twist-lock cord and plug, as required, to ceiling receptacle. Table fabricator is to provide and mount two (2) stainless-steel electrical receptacle boxes under tabletop, as shown on plans, equipped with 120V GFCI duplex receptacles and stainless-steel cover plates. All electrical conduits and wiring for complete electrical connections, on table, are to be provided and installed by table fabricator. All electrical devices and connections are to comply with local governing electrical codes and to include UL approval and listing as required. Reference worktable details on Sheets K2.02 and K4.02.
- Table is to be pre-wired for single point final electrical connection to ceiling mounted receptacle. Table fabricator is to install one (1) 4" cube UL approved stainless-steel outlet box mounted on overshelf extension thru top of table (see plan for mounting side). Table fabricator is to install twist lock receptacle, conduits, wiring, stainless-steel cover plate, NEMA twist-lock cord and plug, as required, to ceiling receptacle. Table fabricator is to provide and mount one (1) stainless-steel electrical receptacle boxes under tabletop, as shown on plans, equipped with 208V simplex receptacle and stainless-steel cover plate(s) for Item K31 Microwave. All electrical conduits and wiring for complete electrical connections, on table, are to be provided



and installed by table fabricator. All electrical devices and connections are to comply with local governing electrical codes and to include UL approval and listing as required. Reference worktable details on Sheets K2.02 and K4.02.

- Division 11 to provide and install one (1) rubber grommeted hole for routing of utility connections of Item K31 Microwave as shown on plans.
- Open base provision for one (1) Item K22 Trash Can, as per plan.
- Kitchen Equipment Contractor to field verify all dimensions prior to fabrication.

#### ITEM K29B: WORK TABLE

Provide and install one (1) custom fabricated 14-gauge, 304 series, stainless-steel work table as detailed on foodservice plans. Unit to measure 10'-0" wide x 30" deep x 35-1/2" high. Unit to be constructed as described in the general specifications of this section. Unit to include the following minimum features and accessories:

- 14-gauge, 304 series, stainless-steel with a No. 4 finish.
- Two (2) stainless-steel drawer assemblies using Component Hardware parts to match and located as detailed on plans. Model S90-0020 stainless steel drawer assembly specifications. Refer to plans for drawer locations.
- 16-gauge, 304 series, stainless-steel 1-5/8" tubular base with adjustable bullet feet
- Provide 16-gauge, 304 series, stainless-steel fully welded undershelves.
- Table is to be pre-wired for single point final electrical connection to ceiling mounted receptacle. Table fabricator is to install one (1) 4" cube UL approved stainless-steel outlet box mounted on overself extension thru top of table (see plan for mounting side). Table fabricator is to install twist lock receptacle, conduits, wiring, stainless-steel cover plate, NEMA twist-lock cord and plug, as required, to ceiling receptacle. Table fabricator is to provide and mount two (2) stainless-steel electrical receptacle boxes under tabletop, as shown on plans, equipped with 120V GFCI duplex receptacles and stainless-steel cover plates. All electrical conduits and wiring for complete electrical connections, on table, are to be provided and installed by table fabricator. All electrical devices and connections are to comply with local governing electrical codes and to include UL approval and listing as required. Reference worktable details on Sheets K2.02 and K4.02.
- Open base provision for one (1) Item K22 Trash Can, as per plan.
- Mounting provision for Item K30 Manual Can Opener.
- Kitchen Equipment Contractor to field verify all dimensions prior to fabrication.

#### ITEM K30: MANUAL CAN OPENER

Provide and install one (1) Edlund model no. SG-2L manual can opener comprised of all stainless-steel and is to include the following: a screw down stainless-steel base, cleaning tool, and extra knife/gear assembly. Reference Sheet K4.02 for unit placement on Item K29B Work Table.

#### ITEM K31: MICROWAVE

Provide and install one (1) Panasonic Model NE-2180 2100-Watt Commercial Microwave Oven. Electrical utility connection to be 208v/60hz/1ph and include NEMA 6-30P plug & cord assembly as required. Unit dimensions are not to exceed 25-3/8" W X 20-3/4" D X 18-9/16" H. Unit to include all standard features with a three (3) year parts, labor, and magnetron warranty. Amana may be submitted as an approved alternate.

#### ITEM K32A/K32B: EXHAUST HOOD

General Contractor to reference Division 23 Construction Documents for item specifications and requirements.

#### ITEM K33: FIRE SUPPRESSION SYSTEM

General Contractor to reference Division 23 Construction Documents for item specifications and requirements.

#### ITEM K34: DOUBLE STACKED COMBI OVEN

Provide and install one (1) Alto-Shaam Combitherm® CT Performance™ CTP7-20E boiler-free electric CombiOven stacked over CTP7-20E boiler-free electric CombiOven designed with EcoSmart® technology for reduced energy and water consumption. Unit to include operational modes for steam, convection, a combination of steam and convection heat, and retherm. Oven is to be constructed of 18-gauge stainless-steel interior cavity. PROtouch™ control features include a cool-down function, automatic cleaning function, recipe programming, two (2) power levels, 0-100% humidity levels, auto-reversing fan with five (5) fan speeds, multi-shelf timers, and sleep mode. Each oven is to include a USB port, HACCP data access, and accommodates up to eight (8) full-size sheet pans or sixteen (16) full-size hotel pans (GN 1/1), include standard right-hand door hinging, eight (8) non-tilt support rails, and four (4) stainless-steel shelves. The stacked configuration has four (4) adjustable stainless-steel legs. The following minimum features and accessories are to be included as follows:

- Electrical Connection (per unit): 480v/60hz/3ph – 22.9A (ECO Standard Option)
- Treated Plumbing Connection (per unit): 3/4" NPT (90 psi min. static pressure)

- Untreated Plumbing Connection (per unit): 3/4" NPT (90 psi min. static pressure)
- Alto-Shaam Reverse Osmosis System (model no. OPS175CR/16) and installation kit by manufacturer.
- Extended one (1) year warranty
- Alto-Shaam Combitherm® Factory Authorized Installation Program
- Removable, single-point, quick connect core temperature probe, standard.
- Automatic tablet-based cleaning system, standard.
- Dormont quick connect water hose kits provided by Division 11 and installed by Division 22.
- Reference Division 26 Construction Documents for Electrical Disconnect Switch Item Specifications. Unit to be equipped with extended length electrical leads to allow a minimum of 36" behind unit when pulled out for cleaning and servicing.
- Rational and Convotherm may be submitted as an approved alternate manufacturer.

#### ITEM K35: DOUBLE STACKED CONVECTION OVEN

Provide and install one (1) Blodgett® full-size convection oven model MARK V-100, double compartment as shown on plans. Each compartment shall have porcelainized steel liner and shall accept five (5) 18" x 26" standard full-size bake pans. Doors shall have dual pane thermal glass windows with single powder coated handle and simultaneous operation. Unit shall be electronically heated with three (3) tubular heaters. Air in baking chamber distributed by single inlet blower wheel powered by a two-speed, 1/2 HP motor with thermal overload protection. Each chamber shall be fitted with two (2) halogen lamps, five (5) chrome-plated removable racks, and removable crumb trays. Control panel shall be recessed with solid state infinite (manual) infinite thermostat and a 60-minute timer. Warranty: Two (2) year parts and labor, Three (3) year door warranty. Units are to be mounted on four (4) six-inch legs. Electrical connection for each oven is to be 480v/60hz/3ph, 14A. Reference Division 26 Construction Documents for Electrical Disconnect Switch Item Specifications. Unit to be equipped with extended length electrical leads to allow a minimum of 36" behind unit when pulled out for cleaning and servicing. Vulcan and Garland may be submitted as an approved alternate manufacturer.

#### ITEM K36: 15 GALLON TILTING BRAISING PAN

Provide and install one (1) Groen model no. BPM-15EC stainless-steel electrically heated, thermostatically controlled, 15-gallon braising pan. Unit to be mounted on rounded tubular leg stand with adjustable flanged feet. The pan body shall be of type 304 stainless-steel, solid one-piece welded heavy-duty construction, with a 10" deep pan depth with 3" radius coved corners as standard. Heavy 5/8" thick stainless-steel clad pan bottom with specially designed gas burner/combustion chamber and specially designed welded heat transfer fins. Electronic ignition is standard. The unit shall be equipped with controls that allow operation at a 7-degree tilt. The braising pan shall have a smooth-action,

quick-tilting body with manual crank tilt mechanism. A heavy gauge, fully adjustable one-piece cover is standard with torsion bar type counterbalance designed to maintain selected cover position and includes a condensate drip shield. Tilt mechanism and controls completely enclosed in stainless steel housings mounted to the braising pan body. Classic -C Models include: Power ON-OFF switch with indicator light, temperature control knob with 175°F to 425°F (79°C to 218°C) range increments and HEAT(ing) indicator light. All controls to be located in a right- front mounted water resistant IPX6 rated enclosure. Cleveland and Vulcan Range may be submitted as an approved alternate manufacturer.

Electrical Connection: 480v/60hz/3ph – 10A (Reference Division 26 Construction Documents for Electrical Disconnect Switch Item Specifications. Unit to be equipped with extended length electrical leads to allow a minimum of 36” behind unit when pulled out for cleaning and servicing.)

CSA design certified and NSF approved/listed. Single electric connection required. Unit to be made in the USA.

Included options are as follows:

- Etch marks at five (5) gallon increments
- One (1) pan carrier to hold 12” x 20” steam table pan at front pouring lip
- One (1) lip strainer
- One (1) year parts and labor warranty

#### ITEM K37: TRENCH DRAIN

Provide one (1) IMC/Teddy ASFT-1830 stainless-steel trench drain. Unit dimensions to be 18" wide x 30" long. Unit to be equipped with the following minimum features:

- Anti-spill design floor trough is to be constructed of 14-gauge, 18.8, type 304 stainless-steel with fully welded corners ground and polished smooth.
- Trough shall have anchor straps for securing unit to the floor, Trough shall have a stainless-steel waste cup with a removable stainless-steel basket for up to a 3” waste pipe.
- Unit to be equipped with New Age Industrial ADA compliant aluminum subway trough grating, with non-slip surface, sized accordingly.
- Unit is to be installed flush with finished floor. Verify finished floor material and modify units accordingly.
- Unit to be installed by Division 22 (Plumbing Contractor).

- Advance Tabco and Eagle Manufacturing may be submitted as an approved alternate manufacturer.

#### ITEM K38: POT/KETTLE FILLER WITH HOSE RACK

Provide and install one (1) stainless-steel wall rack, as detailed on plans and, is to include the following minimum features:

- Provide one (1) T&S Brass special model no. 43-042 assembly with ceramic cartridges. Unit to be equipped with B-0512 assembly complete with (2) VB hose assemblies. Provide Model B-0107 Self-Closing Spray Valve with 68" braided stainless-steel hose and Model B-0102-A Pot Filler with 68" braided stainless-steel hose.
- Provide and install two (2) T&S Brass model no. B-0166 hook assemblies, as per details on plans.
- Unit is to be installed on custom fabricated wall mounted cantilevered stainless-steel extension bracket as provided by kitchen equipment contractor. Mounting location is to allow for ease of accessibility to controls and hoses. See T&S Brass product description cut sheet B-0512 w/ two (2) VB Hose Assemblies.
- Top of unit is to be mounted at 42" above finished floor.

#### ITEM K39: GRIDDLE RANGE

Provide and install one (1) Vulcan model no. EV36S-2FP24G480 electric restaurant range consisting of two (2) French plates and a 24" wide griddle plate. Unit to contain the following minimum features and accessories:

- One (1) year parts and labor warranty, standard
- Cool to touch control knobs
- One (1) standard oven, interior to measure 26-1/2" (wide) x 26-3/8" (deep) x 14" (high)
- Unit to be mounted on six (6") inch adjustable legs
- Towel bar (factory installed)
- Stainless-steel back riser with plate shelf
- Electrical Connection: 480v/60hz/3ph – 22.4A (15.8 kW)
- Reference Division 26 Construction Documents for Electrical Disconnect Switch Item Specifications. Unit to be equipped with extended length electrical leads to allow a minimum of 36" behind unit when pulled out for cleaning and servicing.

- Garland and Imperial may be submitted as an approved alternate manufacturer.

#### ITEM K40: SINGLE SECTION PASS THRU HEATED CABINET

Provide and install two (2) Traulsen RHF132WP-HHS single-section section pass-thru heated cabinet comprised of stainless-steel exterior and interior with the following minimum features:

- Unit Dimensions: 29-7/8" wide x 37-15/16" deep x 83-1/4" high
- Electrical Connection: 208v/60hz/1ph – 7.8A
- Unit to be routed to a junction box with restraining device and means of disconnect, as provided, and installed by Division 26. Standard circuit breakers are to be provided and installed by Division 26 to ensure these units work as designed by the manufacturer.
- Half height stainless-steel doors on server side and full height stainless-steel door on kitchen side. Unit to be hinged as shown on plans.
- Traulsen Smart Control with LED display, advanced control algorithms and sophisticated diagnostic capabilities. Smart sensors to adapt the operation of the refrigeration system to a variety of environments and usage patterns. Complete with visual alarms to notify operator of critical events. Controls to be located on Kitchen side.
- Unit provided with thirteen (13) sets of Quick-Change universal tray slides per compartment.
- Provide door-locking hardware and EZ Clean door gaskets. Unit is to be keyed the same as Item K41 Two Section Pass Thru Refrigerator.
- Unit to be mounted on six (6") inch casters.
- Three (3) year parts and labor, standard
- Victory and True Refrigeration may be submitted as approved alternate manufacturers.

#### ITEM K41: TWO SECTION PASS THRU REFRIGERATOR

Provide and install one (1) Traulsen model no. RHT232WPUT-HHS two-section pass-thru refrigerator comprised of a stainless-steel exterior and interior with the following minimum features:

- Unit Dimensions: 58" wide x 37-15/16" deep x 83-1/4" high
- Electrical Connection: 120v/60hz/1ph – 8.6A (NEMA 5-15P plug and cord assembly)
- Half-height stainless-steel doors on server side and full height stainless-steel door on kitchen side. Unit to be hinged as shown on plans.
- Controls to be located on the Kitchen Side

- Traulsen Smart Control with LED display, advanced control algorithms and sophisticated diagnostic capabilities. Smart sensors to adapt the operation of the refrigeration system to a variety of environments and usage patterns. Complete with visual alarms to notify operator of critical events.
- Provide door-locking hardware and EZ Clean door gaskets. Unit is to be keyed the same as Item K38 Two Section Pass Thru Heated Cabinet.
- Unit provided with thirteen (13) sets of Quick-Change universal tray slides per compartment.
- Unit to be mounted on six (6") inch high casters.
- Top mounted, self-contained, balanced refrigeration system using environmentally friendly, not-flammable R-450A refrigerant.
- StayClear™ Condenser, finless design dramatically reduces build-up of grease, flour, dust and other environmental contaminants know to block air in traditional style condensers.
- Three-year parts and labor warranty, Five-year compressor warranty
- Victory and True Refrigeration may be submitted as an approved alternate manufacturer.

#### ITEM K42: SERVING COUNTER

Provide and install one (1) Mod-U-Serve (MUS) Custom Serving Counter the size and shape as detailed on plans. Units are to be constructed as listed below and each is to include the following counter components:

- Counter body to be comprised of 304 series stainless-steel. Galvanized frames or angle-iron frames are not permitted.
- Body panels are to be comprised of 18-gauge, 304 series, stainless-steel.
- 16-gauge, 304 series, stainless-steel undershelf
- Countertop/trayslide to be comprised of three (3) cm manufactured stone top with a finished height of 34" above finished floor. Ten (10") inch continuous countertop front to overhang and serve as a trayslide. Bull nose edge detail to be present on all sides of stone countertop. Final color selection to be provided by Architect/Owner prior to ordering.
- Front panels to be comprised of LED RGB illuminated acrylic panels including remote controls.
- Elite IV series breath guards with LED lights and heat lamps, as shown on plans.
- Item K42A: One (1) each Mod-U-Serve model no. MCT-H/CF4-IND; each well to be individually controlled with hot water fill faucet manifolded for each well with independent drain.

- Item K42B: Two (2) each Mod-U-Serve model no. DI-HCSP-1 hot/cold food sheet pan merchandisers with two (2) DI-HCSP-1-OS hot/cold units mounted in overshef.
- Electrical connection to be provided for Item K45 Refrigerated Merchandiser on counter. Final plug connection to be coordinated with Counter Manufacturer prior to ordering units.
- All components are to be NSF rated.
- Counters are to be mounted on six (6") inch high legs, with adjustable bullet feet, and include removable, flat, stainless-steel kick plates.
- Locking cashier drawer with removable cash till tray.
- Electrical Connection via Load Center Connection: 120/208v/60hz/3ph – 32A (80A direct circuit required).
- Master Fabricators and CounterCraft may be submitted as an approved alternate manufacturer.
- Mod-U-Serve to provide installation and coordination services. Installation and coordination services to include delivery, setting in place & onsite assembly, completing all field welds and joints, completing all final assembly, leveling, and start up. This includes all necessary site visits prior to and during fabrication including site visits for field dimensions.
- Kitchen Equipment Contractor to provide a submittal letter to the Consultant from Mod-U-Serve acknowledging the project name and proof that the Installation and Project Management Services have been purchased for the project. Failure to provide letter will result in submittal being rejected.

#### ITEM K43: DISPOSER

Provide one (1) InSinkErator model no. SS-200 sink mounted food waste disposers measuring 14-3/16" wide x 18-7/16" high. Unit to contain the following minimum features and accessories:

- Electrical Connection: 208v/60hz/3ph – 4.4A
- Plumbing Connection: 1/2" Cold Water Connection, two (2") inch direct drain connection
- One (1) year parts and labor warranty (on-site), standard
- One (1) #7 Collar adapter kit with electrical control, and flow control valve (per unit)
- Five (5) GPM reduced water flow
- One (1) InSinkErator model no. AS-101 Control Center AquaSaver®
- One (1) stainless-steel de-jamming prong (only one unit provided for entire campus)
- One (1) rubber scrap ring



- One (1) T&S Brass model no. B-0455 vacuum breaker with chrome sleeves and escutcheons for all vacuum breaker piping above splash (per unit).

#### ITEM K44: WALL MOUNTED SHELF

Provide and install two (2) custom fabricated 16-gauge wall-mounted stainless-steel overshef. Units are to be 3'-0" long x 12" deep and the shape as detailed on plans. Unit to be mounted 56" A.F.F. (verify height of Item K27 prior to installation) and to include 14-gauge stainless steel wall brackets with 1-1/2" flange at wall for proper mounting. Shelves are to be fabricated with 1" radius front edges and to include 1" turn down as detailed on plans. Units to be equipped with 1" turn-up at wall as detailed on plans. All wall fasteners are to be stainless steel and spaced as required. All stainless-steel shall have a No. 4 finish. Field measure prior to fabrication. General contractor is to provide concealed wall blocking where applicable. Upon completion of installation, Kitchen Equipment Contractor to install clear silicone where all bracket assemblies abut wall.

#### ITEM K45: REFRIGERATED MERCHANDISER

Provide and install one (1) Federal Industries Model VRSS6078S High Profile Self-Serve Refrigerated Merchandisers measuring 59.25" (W) x 33" (D) x 78" (H). Unit to include all standard features including stainless-steel display deck, black interior back panel, energy saving night curtain, R449A refrigerant, black metal front grill and black powder coated finish back. Unit to include four (4) tiers of adjustable black metal shelves with price tag molding. Unit to be UL safety and UL sanitation approved. Unit to contain the following minimum features and accessories:

- Electrical Connection: 208-240v/60hz/1ph – 13.7A (NEMA 6-20P plug and cord assembly)
- One (1) all black interior (including shelving) – per unit
- One (1) reflective end glass (square) – per unit – panel closest to wall
- One (1) LED light package below shelf – per unit
- One (1) sliding rear access door – per unit
- One (1) roll-up security cover (square end profile) – per unit
- One (1) set of recessed 2-1/2" casters – per unit
- Division 22 to route condensate drain line to nearest floor sink
- Division 11 to field verify all measurements prior to ordering unit(s).

#### ITEM K46: POINT OF SALE SYSTEM

General Contractor is to coordinate with UTRGV/Edinburg CISD for all point-of-sale register system requirements.

#### ITEM K47: SLIDING SECURITY GRILLE

General Contractor to reference Architectural Construction Documents for item specifications and requirements.

#### ITEM K48: SOAP/CLEANER SHELVING UNIT

Provide and install two (2) InterMetro Metro Max Q shelving units the sizes and shape as shown on plans (field measure), with all standard features; Units to consist of the following minimum features:

- Steel with electroplated substrate and exceptionally durable, abrasion-resistant epoxy finish. Epoxy finish has built-in Microban® antimicrobial product protection. Unit to include adjustable feet attached to a 74” post, reinforced with nylon.
- Unit(s) to be assembled with the use of tools; posts to contain numbered grooves located at one (1”) inch increments and include shelf edge lock connectors with window.
- Open grid shelving mats can be removed and interchanged for cleaning at any time. Open grid mats fit easily into commercial dishmachine. Industry Council on Food Safety Approved.
- Four (4) vented tiers per shelving assembly (KEC to coordinate spacing requirements with Owner/General Contractor prior to assembly).
- Kitchen Equipment Contractor responsible for field measurements prior to ordering.

#### ITEM K49: ELECTRIC CAN OPENER

Provide and install one (1) Edlund Model No. 203 electric can opener, as show on plans. Unit to include dual speed motor, removable knife and gear assemblies, electrical cord and plug length (as required). Unit electrical to be 115v/60hz/1ph – 3A (NEMA 5-15P plug and cord assembly)

#### ITEM K50: HOT WATER DISPENSER

Provide one (1) Hatco Corporation model no. AWD-12 Atmospheric Hot Water Dispenser measuring 13.36” wide x 27.47” deep x 28.06” high. Unit to supply water ranging from 75°F to 195°F, shall have the capacity to heat 12 GPH from 35°F to 195°F. Unit to contain the following minimum features and accessories:

- Electrical Connection: 208v/60hz/1ph – 24A (NEMA L6-30P plug and cord assembly)
- Plumbing Connection: 1/4" Inlet Flare Connection
- Plumbing Drain Connection: 3/4" hose connection mated to copper drain line routed to nearest floor sink by Division 22.
- Water Filtration Cartridge for premium quality water
- Division 11 to provide stainless-steel braided hose line for connection from filtration system to water inlet on unit. Division 22 to make final plumbing utility connections.
- One (1) year parts and labor warranty, standard.

#### ITEM K51: WALL MOUNTED OVERSHELF

Provide and install one (1) custom fabricated 16-gauge wall-mounted stainless-steel overshef. Unit is to be 5'-4" long x 12" deep and the shape as detailed on plans. Unit to be mounted 54" A.F.F. (verify height of Item K26 prior to installation) and to include 14-gauge stainless steel wall brackets with 1-1/2" flange at wall for proper mounting. Shelf is to be fabricated with 1" radius front edges and to include 1" turn down as detailed on plans. Unit to be equipped with 1" turn-up at wall as detailed on plans. All wall fasteners are to be stainless steel and spaced as required. All stainless-steel shall have a No. 4 finish. Field measure prior to fabrication. General contractor is to provide concealed wall blocking where applicable. Upon completion of installation, Kitchen Equipment Contractor to install clear silicone where all bracket assemblies abut wall.

END OF SECTION 114000

## SECTION 117610 - HOSPITAL CURTAINS

### PART 1 - GENERAL

#### RELATED DOCUMENTS:

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

#### DESCRIPTION OF WORK:

Extent of Hospital Curtains is shown on drawings.

#### SUBMITTALS:

Product Data: Submit manufacturer's data and template drawings for each type of curtain and track, including data indicating compliance with requirements.

Samples: Submit samples of metal finishes and colors.

#### PRODUCT HANDLING

Deliver products to project site in manufacturer's undamaged protective containers.

Delay delivery until spaces to receive them have been fully enclosed.

### PART 2 - PRODUCTS

#### ACCEPTABLE MANUFACTURERS:

Track: Clickeze – Optitrac  
Graber – 9-807 Track

Curtain: Clickeze – Shield by Panaz  
Staph Chek or Webb

Basis of Design: Track: Clickeze Optitrac (White)  
Curtain: Architect To Select from Shield by Panaz full range.

### PART 3 - EXECUTION

INSTALLATION: Install unit in accordance with manufacturer's instructions. Securely anchor to adjacent walls and ceilings.

#### CLEANING AND PROTECTION:

Ensure that operating parts work freely and fit neatly. Adjust hardware and moving parts as necessary.

Repair or replace damaged parts, dents, buckles, abrasions, or other defects affecting appearance or serviceability, so that hospital curtains are in undamaged condition at time of final acceptance.

END OF SECTION 11761

## SECTION 122400 – WINDOW SHADES

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Manual roller shades.
- B. Motorized roller shades.
- C. Shade accessories.
- D. Motorized shade controls.

#### 1.02 RELATED REQUIREMENTS

- A. Section **06 1000 - Rough Carpentry**: Concealed wood blocking for attachment of headrail brackets.
- B. Section **09 2116 - Gypsum Board Assemblies**: Substrate for window shade systems.
- C. Section **09 5100 - Acoustical Ceilings**: Shade pockets, pocket closures and accessories.
- D. Section **095113 – Perimeter Transition System**: Shade pockets, pocket closures and accessories.
- E. Section **26 0553 - Identification for Electrical Systems**: Identification products and requirements.
- F. Section **26 0936 – Modular Dimming Controls – Lutron QS**: Lighting control system for control of motorized window shades.
- G. Section **26 0943 - Network Lighting Controls – Lutron Quantum**: Lighting control system for control of motorized window shades.
- H. Section **26 2726 - Wiring Devices - Lutron**:
  - 1. Finish requirements for wall controls specified in this section.
  - 2. Accessory receptacles and wallplates, to match shade controls specified in this section.

#### 1.03 REFERENCE STANDARDS

- A. 47 CFR 15 – Radio Frequency Devices; **current edition**.
- B. ASTM D4674 - Standard Practice for Accelerated Testing for Color Stability of Plastics Exposed to Indoor Office Environments; **2002a (Reapproved 2010)**.
- C. ASTM E308 - Standard Practice for Computing the Colors of Objects by Using the CIE System; **2015**.
- D. ASTM E903 - Standard Test Method for Solar Absorptance, Reflectance, and Transmittance of Materials Using Integrating Spheres; **2012**.
- E. DIN EN 14500 - Blinds and Shutters - Thermal and Visual Comfort - Test and Calculation Methods; **2008**.
- F. IEC 61000-4-2 - Electromagnetic Compatibility (EMC) - Part 4-2: Testing and Measurement Techniques - Electrostatic Discharge Immunity Test; **2008**.
- G. ISO 9001 - Quality Management Systems-Requirements; **2008**.
- H. NECA 1 - Standard for Good Workmanship in Electrical Construction; **2015**.
- I. NECA 130 - Standard for Installing and Maintaining Wiring Devices; National Electrical Contractors Association; **2010**.
- J. NEMA WD 1 - General Color Requirements for Wiring Devices; National Electrical Manufacturers Association; **1999 (R 2015)**.
- K. NFPA 70 - National Electrical Code; **Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements**.
- L. UL 325 – Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems; **Current Edition, Including All Revisions**.
- M. WCMA A100.1 – Safety of Corded Window Covering Products; **Current Edition, Including All Revisions**.

#### 1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
  - 1. Motorized Shades:
    - a. Where motorized shades are to be controlled by control systems provided under other sections, coordinate the work with other trades to provide compatible products.

- b. Coordinate the work with other trades to provide rough-in for electrical wiring as required for installation of motorized shades.
  - 2. Notify **Architect** of any conflicts or deviations from the contract documents to obtain direction prior to proceeding with work.
- B. Preinstallation Meeting: Conduct on-site meeting with shade control system installer prior to commencing work to review:
  - 1. Low voltage wiring requirements.
  - 2. Separation of power and low voltage/data wiring.
  - 3. Wire labeling.
  - 4. Control locations.
  - 5. Connections to other equipment.
  - 6. Installer responsibilities.
  - 7. Pocket and/or mounting conditions.
- C. Sequencing:
  - 1. Do not fabricate shades until field dimensions for each opening have been taken.
  - 2. Do not install shades until final surface finishes and painting are complete.
  - 3. Motorized Shade Controls: Do not install wall controls until final surface finishes are complete.

### 1.05 SUBMITTALS

- A. See Section **01 3000 - Administrative Requirements**, 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.
- C. Shop Drawings:
  - 1. Include shade schedule indicating size, location and keys to details; head, jamb and sill details; mounting dimension requirements for each product and typical mounting conditions; and, operation direction.
  - 2. Manual Shades: Provide layout drawing showing locations of shade clutches.
  - 3. Motorized Shades:
    - a. Provide schematic system riser diagram indicating component interconnections. Include requirements for interface with other systems.
    - b. Provide shade drive layout drawing showing locations of shade drives, power supplies, and sensor modules.
- D. Certificates: Manufacturer's documentation that line voltage components are UL listed or UL recognized.
- E. Test Reports: Indicating compliance with specified fabric properties.
- F. Samples: Of each type of shade being provided.
- G. Manufacturer's Installation Instructions: Include application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- H. Project Record Documents: Record actual installed locations and settings for shade control system components.
- I. Operation and Maintenance Data: List of all components with part numbers, sources of supply, and operation and maintenance instructions; include copy of shop drawings.
- J. Warranty: Submit sample of manufacturer's warranty and documentation of final executed warranty completed in **Owner's** name and registered with manufacturer.

### 1.06 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Manufacturer Qualifications:
  - 1. Motorized Shades: Company with not less than twenty years of experience manufacturing low voltage motorized shading systems.
  - 2. Registered to ISO 9001, including in-house engineering for product design activities.

3. Qualified to supply specified products and to honor claims against product presented in accordance with warranty.
  4. Maintains technical support available 24 hours per day, 7 days per week, excluding manufacturer holidays.
  5. Maintains separate field service division responsible for startup, service, and troubleshooting of shading system and associated lighting control system, where applicable.
- D. Shade Installer Qualifications: Qualified to install and troubleshoot specified products by prior factory training, experience, demonstrated performance, and acceptance of any requirement of the manufacturer, subsidiary of the manufacturer, or licensed agent.
- 1.07 MOCK-UP**
- A. Mock-Up: Provide mock-up of window shade complete with selected shade fabric including sample of seam when applicable.
1. Obtain **Architect's** approval of aesthetics and control functionality prior to fabrication.
- 1.08 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.
- 1.09 FIELD CONDITIONS**
- A. Maintain field conditions within manufacturer's required service conditions during and after installation.
1. Basis of Design System Requirements - **Lutron**, Unless Otherwise Indicated:
    - a. Ambient Temperature: Between 32 and 104 degrees F (0 and 40 degrees C).
    - b. Relative Humidity: Less than 90 percent, non-condensing.
- 1.10 WARRANTY**
- A. See Section **01 7800 - Closeout Submittals**, for additional warranty requirements.
- B. Manufacturer's Warranty; **Lutron 8-Year Limited Warranty**:
1. Shade Control System Components (including shade electronic drive units, shade fabric, and shade hardware):
    - a. Years 1-5: 100 percent replacement parts coverage, no manufacturer labor coverage.
    - b. Years 6-8: 50 percent replacement parts coverage, no manufacturer labor coverage.
    - c. Telephone Technical Support: Available 24 hours per day, 7 days per week, excluding manufacturer holidays.
  2. External Shade Control System Components (including control stations, interfaces, and system accessories):
    - a. One year 100 percent replacement parts coverage, 100 percent manufacturer labor coverage to troubleshoot and diagnose a shade control issue.
    - b. Telephone Technical Support: Available 24 hours per day, 7 days per week, excluding manufacturer holidays.

## **PART 2 PRODUCTS**

### **2.01 MANUFACTURERS**

- A. Basis of Design Manufacturer: **Lutron Electronics Company, Inc; www.lutron.com**.
- B. Source Limitations:
1. Furnish products produced by a single manufacturer and obtained from a single supplier.
  2. Furnish manual and motorized shades produced by the same manufacturer, to provide matching appearance.
  3. Furnish products produced by the same manufacturer as the window shade control system as specified in Section **12 2509**.
  4. Furnish products produced by the same manufacturer as the lighting control system as specified in Division 26.

### **2.02 WINDOW SHADE FABRIC APPLICATIONS**

- A. Sheer Fabric for Roller Shades:
1. Sheer Shade Fabric:

- a. Fabric Family Name: The Performance Collection
  - b. Color: Architect to select from Manufactures full range.
  - c. Fabric Requirements
    - 1) Openness Factor: +/- .75%
- B. Blackout Fabric for Roller Shades
- 1. Blackout Shade Fabric:
    - a. Fabric Family Name: The Performance Collection
    - b. Color: Architect to select from Manufactures full range.
    - c. Fabric Requirements
      - 1) Openness Factor: 0%

## 2.03 ROLLER SHADES

- A. General Requirements:
- 1. Provide fully-factory assembled window shades complete with mounting brackets, roller tubes, hembars, hardware and accessories.
  - 2. Size and Location: As indicated on drawings
  - 3. Mounting: Pocket
  - 4. Roller Tube: Manufacturer's standard, selected for suitability for installation conditions, span, and weight of shades.
    - a. Material: Aluminum.
    - b. Aluminum Recycled Content for Roller Tubes and Top Treatments:
      - 1) 50 percent post-industrial recycled content.
      - 2) 25 percent post-consumer recycled content.
      - 3) 25 percent primary aluminum.
    - c. Designed to prevent rust stains.
  - 5. Fabric Drop: Regular Roll
  - 6. Fabric Attachment: Utilize double-sided adhesive strip with minimum of one turn of fabric on roller before working section of fabric starts.
  - 7. Hembars: Wall thickness designed for weight requirements and adaptation to uneven surfaces, to maintain bottom of shade straight and flat.
    - a. Style: Designer
    - b. Endcaps: Coordinate with architect
- B. Manual Shades:
- 1. Product: **Lutron Contract Roller Manual Shades.**
  - 2. Operating Mechanism: Clutch operated continuous loop with beaded ball pull chain.
  - 3. Clutch Construction:
    - a. Consists of three brake springs on a cylindrical metallic mandrel lubricated with silicone-based lubricant to ensure smooth and reliable operation.
    - b. Includes field-configurable chain routing clip designed to ensure chain is in constant contact with clip for smooth and quiet operation when raising shades.
  - 4. Provide pull chain tensioning device complying with WCMA A100.1.
  - 5. Clutch/Pull Chain Configuration: Right mounted unless otherwise indicated
- C. Motorized Shades:
- 1. Product(s):
    - a. Low-voltage wired shades with wired (low voltage) communications; **Lutron QS Motorized Shades.**
  - 2. Listed as complying with UL 325.
  - 3. Electromagnetic Interference/Radio Frequency Interference (EMI/RFI) Limits: Comply with FCC requirements of 47 CFR 15, for Class B application and with ICES-003, Class B.
  - 4. Audible Noise: Capable of operating at or below 44 dBA measured 3 feet (1 m) from center of the shade depending on the electronic drive unit selected; no audible clicks when motor starts and stops.
  - 5. Electronic Drive Units:
    - a. Low-voltage, for connection to NFPA 70, Class 2 power source.
    - b. Size and configuration as recommended by manufacturer for the type, size, and arrangement of shades to be operated.



- c. Concealed from interior view.
- 6. Integrated Wireless Communications: Communicates directly to compatible RF receiving devices through use of a radio frequency communications link; does not require communication wiring; RF range of 30 feet (9 m).
- 7. Coupling of Multiple Shades:
  - a. Where possible, minimize number of electronic drive units by coupling adjacent shades.
  - b. Utilize adjustable coupler that allows for precision adjustment of hembar levels without removing the installed roller or removing the fabric from the roller tube.
- 8. Adjustment Provisions:
  - a. Sub-brackets support shade during installation and allow for lateral position adjustment for consistent light gaps.
  - b. Level adjustment screws at each idler position allow for level adjustment without requiring shimming of shade brackets.

#### **2.04 SHADE ACCESSORIES**

- A. Brackets and Mounting Hardware: Size as recommended by manufacturer for mounting configuration and span indicated.
  - 1. Universal wall/ceiling/pocket mounting brackets.
  - 2. Brackets for mounting a shade and optional fascia.
  - 3. Dual wall/ceiling mounting brackets for mounting two shades in the same opening.
- B. Fasteners: Non-corrosive, and as recommended by shade manufacturer.
- C. Top Treatments:
  - 1. Provide top treatments consistent across manual and motorized shade products.
  - 2. Pocket: Size as required to conceal shade mounting
    - a. Color/Finish: Architect to select from manufacturer's full range.
  - 3. Fascia: Size as required to conceal shade mounting
- D. Light-Sealing Accessories for Blackout Shades: Provide side channels complete light seal.
  - 1. Color/Finish: Architect to select from manufacturer's full range.

#### **2.05 MOTORIZED SHADE CONTROLS**

- A. Motorized shades where indicated to be controlled by control stations and associated accessories as specified below, or to be controlled by lighting control system and associated control devices as specified in Division 26.
- B. General Requirements:
  - 1. Provide products listed, classified, and labeled by Underwriter's Laboratories Inc. (UL) as suitable for the purpose indicated.
  - 2. 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.
  - 3. System Capacity:
    - a. Supports up to 100 wired devices including shades, control stations, and power supplies.
    - b. Supports wireless devices within range of the wireless control.
    - c. Supports up to 100 wired zones.
  - 4. Shade Control Requirements:
    - a. Capable of operating shades and recalling shade presets via keypad, contact closure input, infrared receiver, lighting management system software, or other lighting control system interface.
    - b. Capable of operating any individual, group, or subgroup of shade electronic drive units within system without requiring separate group controllers.
    - c. Capable of assigning and reassigning individual, groups, and subgroups of shades to any control within system without requiring additional wiring or hardware changes.
    - d. Capable of controlling shade speed for tracking within plus or minus 0.125 inch (3.17 mm) throughout entire travel.

- e. Provide 10 year power failure memory for preset stops, open and close limits, shade grouping and subgrouping and system configuration.
  - f. Capable of synchronizing multiple shade electronic drive units regardless of drive or tube size to start, stop and move in unison.
  - g. Capable of stopping shades within accuracy of 0.125 inch (3.17 mm) at any point between open and close limits.
  - h. Capable of storing up to 250 programmable stop points, including open, close, and any other position.
5. Design shade control equipment for 10 year operational life while operating continually at any temperature in an ambient temperature range of 32 degrees F (0 degrees C) to 104 degrees F (40 degrees C) and 90 percent non-condensing relative humidity.
  6. Electrostatic Discharge Tolerance: Design and test equipment to withstand electrostatic discharges without impairment when tested according to IEC 61000-4-2.
  7. Device Finishes:
    - a. Wall Controls: match finishes specified for wiring devices in 26 2726, unless otherwise indicated
    - b. Standard Colors: Comply with NEMA WD1 where applicable.
    - c. Color Variation in Same Product Family: Maximum delta E of 1, CIE L\*a\*b color units per ASTM E308.
    - d. Visible Parts: Exhibit ultraviolet color stability when tested with multiple actinic light sources as defined in ASTM D4674. Provide proof of testing upon request.
  8. Provide all components and connections necessary to interface with other systems as indicated.
- C. **Wireless (Radio Frequency) Controls; *Lutron Pico Wireless Controls*:**
1. Product(s):
    - a. 3-Button with Raise/Lower Control; Lutron Pico Wireless Control Model PJ2-3BRL
      - 1) Button Marking: Shade icons
    - b. Wallplate Adapter; **Lutron Model PICO-WBX-ADAPT.**
  2. Quantity: as needed for adequate room control
  3. Communicates via radio frequency to compatible window treatments.
  4. Does not require external power packs, power or communication wiring.
  5. Allows for easy reprogramming without replacing unit.
  6. Single action button programming. Includes LED to indicate button press or programming mode status.
  7. Mounting:
    - a. Capable of being mounted with a table stand or directly to a wall under a faceplate.
    - b. Faceplates: Provide concealed mounting hardware.
  8. Power: Battery-operated with minimum ten-year battery life.
  9. Finish: White, or as specified to match lighting controls in Division 26
- D. **Power Supplies: Provide as indicated or as required to power system devices and accessories.**
1. Product(s):
    - a. Ten output power supply panel for shades, keypads and accessories, and for providing additional low voltage power to communication link; **Lutron Model QSPS-10PNL**; no replaceable fuses required for overload/miswire protection; automatically resets after overload trip; contains DOE Level VI Compliant power supplies.

## 2.06 SHADE FABRICATION

- A. Field measure finished openings prior to ordering or fabrication.
- B. Dimensional Tolerances: As recommended in writing by manufacturer.
- C. At openings requiring continuous multiple shade units with separate rollers, locate roller joints at window mullion centers; butt rollers end-to-end.
- D. Manual Shades:

1. Railroad fabric for applications that are wider than the usable fabric roll width.
- E. Motorized Shades:
  1. Fabricate horizontal sealed battens into the fabric for shade stability.
  2. Railroad and/or seam fabric for applications that are wider than the usable fabric roll width.

## 2.07 SOURCE QUALITY CONTROL

- A. See Section **01 4000 - Quality Requirements**, for additional requirements.
- B. Factory Testing; **Lutron Standard Factory Testing**:
  1. Perform full-function factory inspection and testing on all completed assemblies. Statistical sampling is not acceptable.
  2. Comprehensive factory inspection and testing on each shade includes, but is not limited to:
    - a. Mount and operate shades; examine for fabric flaws, hembar levelness, and telescoping.
    - b. Verify shade/fabric dimensions.
    - c. Verify synchronization/tracking within specified tolerance for motorized shades.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Motorized Shades and Controls: Verify that ratings and configurations of system components are consistent with the indicated requirements.
- B. Examine finished openings for deficiencies that may preclude satisfactory installation.
- C. If substrate preparation is the responsibility of another installer, notify **Architect** of unsatisfactory preparation before proceeding.
- D. Start of installation shall be considered acceptance of substrates.

### 3.02 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.

### 3.03 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Shade Installation:
  1. Install in accordance with approved shop drawings, using mounting devices as indicated.
  2. Adjust level, projection and shade centering from mounting bracket where applicable.
  3. Verify there is no telescoping of shade fabric. Ensure smooth shade operation.
- C. Motorized Shade Control Installation:
  1. Perform work in a neat and workmanlike manner in accordance with NECA 1 and, where applicable, NECA 130
  2. Adjust open and closed limits set by the manufacturer as required.
  3. Assign each shade to a shade group and set control functions.
  4. Identify system components in accordance with Section **26 0553**.

### 3.04 FIELD QUALITY CONTROL

- A. See Section **01 4000 - Quality Requirements**, for additional requirements.
- B. Manufacturer's startup services will not be required.
- C. Correct defective work, adjust for proper operation, and retest until entire system complies with contract documents.

### 3.05 CLEANING

- A. Clean soiled shades and exposed components as recommended by manufacturer.
- B. Replace shades that cannot be cleaned to "like new" condition.

### 3.06 CLOSEOUT ACTIVITIES

- A. See Section **01 7800 - Closeout Submittals**, for closeout submittals.
- B. See Section **01 7900 - Demonstration and Training**, for additional requirements.
- C. Training:
  1. Shade control system installer to perform on-site training of **Owner's** personnel on operation, adjustment, and maintenance of shade control system.

### 3.07 PROTECTION

- A. Protect installed products from subsequent construction operations.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

**3.08 CONTACT**

- A. For questions/clarifications on system requirements for window coverings, contact Carson Alsop, 484-719-9827, [calsop@lutron.com](mailto:calsop@lutron.com), or Lutron Electronics, 1-800-446-1503, [commercialshadecs@lutron.com](mailto:commercialshadecs@lutron.com).

**END OF SECTION**

## 123000 - MANUFACTURED CASEWORK

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Fixed modular casework furniture with finished interiors.
- B. Countertops.
- C. Fixtures.
- D. Sinks, faucets, and plumbing accessories.
- E. Electrical fixtures and accessories.
- F. Fume hoods.
- G. Utility-space closure panels between base cabinets and at exposed ends of utility spaces.
- H. Utility-space framing at backs of base cabinets and between backs of base cabinets.
- I. Related equipment.

#### 1.2 RELATED SECTIONS

- A. Section 06100 - Rough Carpentry: Framing and blocking in walls, floors and ceiling to support equipment.
- B. Section 09650 - Resilient Flooring: base for casework including floor cabinets and table legs.
- C. Section 15050 - Basic Mechanical Materials and Methods: Connections for drain lines, service piping, vents, re-vents, in-line vacuum breakers, special plumbing fixtures, traps and tailpieces to service fixtures.
- D. Section 16050 - Basic Electrical Materials and Methods: Connections for electrical service lines, wire and conduit to service fixtures.

#### 1.3 REFERENCES

- A. ADA (ATBCB ADAAG): Americans with Disabilities Act Accessibility Guidelines.
- B. ANSI/AIHA 9.5: American National Standard for Laboratory Ventilation.
- C. ANSI/ASHRAE 110: Method of Testing Performance of Laboratory Fume Hoods.
- D. ANSI 2358.1: Minimum Performance Requirements for Emergency Showers.
- E. ASTM A167: Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
- F. ASTM A 666: Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
- G. Architectural Woodwork Institute (AWI): Quality Standards.

- H. FS W-C-596: Electrical Power Connector, Plug, Receptacle, and Cable Outlet.
- I. NEMA WD 1: General Color Requirements for Wiring Devices.
- J. NEMA WD 6: Devices-Dimensional Requirements.
- K. NEMA LD 3: High Pressure Decorative Laminates.
- L. NFPA 30: Flammable and Combustible Liquids Code.
- M. NFPA-45: Standard for Fire Protection for Laboratories Using Chemicals.
- N. OSHA 29-CFR-1910.1450: Occupational Exposure to Hazardous Chemicals in Laboratories.
- O. SEFA 1: Laboratory Fume Hoods - Recommended Practices.
- P. SEFA 7: Laboratory and Hospital Fixtures--Recommended Practices.
- Q. SEFA 8: Laboratory Furniture--Casework, Shelving and Tables--Recommended Practices.
- R. UL 498: Attachment Plugs and Receptacles.
- S. UL 1805: Laboratory Hoods and cabinets, where applicable.
- T. FSC: Forest Stewardship Council.
- U. CARB: California Air Resources Board.
- V. "American Made": Casework wholly manufactured and assembled in USA.

#### 1.4 SUBMITTALS

- A. Submit under provisions of Section 01300.
- B. Manufacturer's data sheets on each product to be used, including:
  1. Test reports certifying that the casework finish complies with SEFA-8 standards for chemical and physical resistance performance requirements.
  2. Performance test reports from an independent testing lab on each specified top material.
  3. Preparation instructions and recommendations.
  4. Storage and handling requirements and recommendations.
  5. Installation methods.
- C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
  1. Indicate locations of blocking and reinforcements required for installing laboratory casework.
  2. Indicate locations and types of service fittings, together with associated service supply connection required.
  3. Include details of utility spaces.
  4. Include indicators of exposed conduits, if required, for service fittings.
  5. Indicate locations of and clearances from adjacent walls, doors, windows, other building components, and other laboratory equipment.
  6. Include coordinated dimensions for laboratory equipment specified in other Sections.

- D. Certificate of Origin: Manufacturer must supply with first submittal, an example of their Certificate of Origin declaring casework is wholly manufactured and assembled specifically in the United States, including city, county, and state locations. A notarized Certificate of Origin must be provided with closeout documents.
- E. Selection Samples: For each finish product specified, one complete set of color chips representing manufacturer's full range of available colors and patterns.
  - 1. One set of samples indicating full range of finishes for countertop specified.
  - 2. One set of casework samples indicating full range of finishes for casework specified.
- F. LEED Submittals: Provide documentation affirming that specific products listed in this section contribute to the following LEED Credits:
  - 1. MR Credit 4: Recycled Content.
  - 2. MR Credit 5: Regional Material.
  - 3. MR Credit 6: Rapidly Renewable Materials.
  - 4. MR Credit 7: Certified Wood.
  - 5. IEQ Credit 4.1: Low-emitting Materials – Adhesives & Sealants.
  - 6. IEQ Credit 4.2: Low-emitting Materials – Paints & Coatings.
  - 7. IEQ Credit 4.4: Low-emitting Materials – Composite Wood & Agrifiber Products.

#### 1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Not less than 5 years experience in the actual production of specified products. Casework shall be wholly manufactured and assembled in the USA: i.e. "American Made".
- B. Installer Qualifications: Firm with 5 years experience in installation or application of systems similar in complexity to those required for this Project, plus the following.
  - 1. Authorized distributor of manufacturer.
- C. Mock-Up: Provide a mock-up for evaluation of fabrication techniques and application workmanship.
  - 1. Installation in area designated by Architect.
  - 2. Do not proceed with remaining work until installation is approved by Architect.
  - 3. As selected and required by Architect's request for mock-up: Install base cabinet with drawer and cupboard, one adjustable shelf, hinged door and applicable hardware. Wall case with adjustable shelf, hinged door and applicable hardware. Tall case with adjustable shelves, fixed center shelf, hinged door and applicable hardware, including a 3-point latching system.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until project conditions are ready for installation.

#### 1.7 PROJECT CONDITIONS

- A. For delivery and installation of laboratory casework and equipment, building conditions shall comply with AWI Standard 10.5 and 10.6 and be as follows:
  - 1. Flooring required to be placed under casework and equipment installed.
  - 2. Wood or metal blocking (wall grounds) installed within partitions to allow for immediate installation upon delivery.
  - 3. Heating and air conditioning systems providing consistent temperature and humidity conditions to comply with by AWI Standard Section 2.
  - 4. Relative humidity not less than 40 percent, nor more than 60 percent.

5. Temperatures not less than 65 degrees F (18 degrees C) and not greater than 80 degrees F (27 degrees C) in areas of casework and equipment installation.
6. Overhead mechanical, electrical and plumbing rough-in work is complete.
7. Wet operations complete prior to delivery.
8. Ceiling grids (with or without ceiling tiles), overhead soffits, ductwork and lighting installed.
9. Painting complete.

## 1.8 WARRANTY

- A. Casework Manufacturer Warranty: 3 years from date of delivery. Warranty is for the conditions indicated below, and when notified in writing from Owner, manufacturer shall promptly investigate and address said deficiencies.
  1. Defects in materials and workmanship.
  2. Deterioration of material and surface performance below minimum SEFA 8W standards as certified by independent third party testing laboratory.
  3. Within the warranty period, we shall, at our option, repair, replace, or refund the purchase price of defective casework.
- B. Casework manufacturer shall be notified immediately of defective products, and be given a reasonable opportunity to inspect the goods prior to return. Casework manufacturer will not assume responsibility, or compensation, for unauthorized repairs or labor. Casework manufacturer makes no other warranty, expressed or implied, to the merchantability, fitness for a particular purpose, design, sale, installation, or use, of casework; and, shall not be liable for incidental or consequential damages, losses of or expenses, resulting from the use of their products.
  1. The warranty with respect to products from another company sold by the casework manufacturer is limited to the warranty extended by that other company.
- C. Casework manufacturer shall provide, with close-out documents, a Certificate of Warranty for products provided.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Acceptable Manufacturer: ICI (Institutional Casework Inc.) manufacturer of CampbellRhea, which is located at: 1865 Highway 641 North, Paris, TN 38242-8814; Tel: 731-642-4251; Fax: 731-642-4262; Email: To request information - [sales@iciscientific.com](mailto:sales@iciscientific.com); Web: [www.iciscientific.com](http://www.iciscientific.com)
- B. Product Designations: Drawings indicate sizes and configurations of laboratory casework by referencing designated manufacturer's catalog numbers. Other manufacturers' laboratory casework of similar sizes, similar door and drawer configurations, and complying with the Specifications, including certification to SEFA-8 standards for construction and chemical resistance, may be requested for approved substitution. Requests for substitutions will be considered in accordance with provisions of Section 01600. No exceptions will be made for casework that is not wholly manufactured and assembled in USA: i.e. "American Made".

### 2.2 APPLICATIONS/SCOPE

- A. Casework Group: Manufacturer shall offer an integrated product line serving the user function indicated with a coordinated design, supply and installation of



casework, equipment, work surfaces, and accessories:

1. Laboratory.
2. ADA compliant.

## 2.3 CONSTRUCTION

- A. Wood veneer on plywood core: ICI/CampbellRhea Casework. Options Red oak – plain sliced.
- B. Cabinet Finish, Interiors and Exteriors Match Finished:
  1. Finish: Standard factory finish, select from manufacturer's standard stains.
- C. Drawer and Door Styles:
  1. Classic Drawer and Door Styling: Both door and drawer fronts are 13/16-inch (20.6 mm) thick, have a squared back edge and a 13/32-inch (10.3mm) radius to the front edges. Drawers are solid hardwood with horizontal grain. Doors have particleboard core with internal hardwood stiles and rails, with vertical wood veneer face and back.
- D. Door and Drawer Hardware Style:
  1. Drawer and door pulls:  
AL-3BK: Black powder-coated extruded aluminum bow style rod design finger pull.
  2. Sliding wood door pulls:  
RS -1: Recessed, metal finger grip is nickel-plated pull.
  3. Sliding glass door pulls:  
RS-2: Recessed, metal two-piece, screw together style with a bright chrome finish.
  4. Hinges:  
BK-1: Heavy-duty, institutional type, 5-knuckle hospital tipped, and is made from 0.083 inch (2 mm) thick black powder-coated steel. Hinge is semi-concealed, 2 3/4 inches (70mm) high and has off-set wings; each wing has 5 screw holes for the door leaf and 4 screw holes for the case leaf, two of which are slotted for adjustability. Hinges are attached with Euro screws.
  5. Latching Handle:  
BK: Latching handle BK LH-1 is black powder-coated, 4 1/4 inches (108 mm) long and streamline in design. Handle operates with 1/4 turn. Double door cases have latching handles on the right door and dummy handles on the left door. A three point latching system provides a positive engagement at the top and bottom of the door with tapered aluminum rods, which pull the door snug when they engage plastic strike plates. The rods are 5/16 inch (8 mm) in diameter and move in nylon guides attached to the back of the door. The middle of the door is secured by a latch plate, which engages the side of the case, or latches behind the left door on cases with double doors.
  6. Locking Handle:  
BK: Black powder coated locking handle is a latching handle with a lock mechanism incorporated into the handle head. On double door cases, the left door has a dummy handle, and the right door has the locking handle. Lock is laboratory grade with a 5-disc tumbler mechanism with a black powder-coated face. Tumblers and keys are brass, while the plug and cylinder is die cast zinc alloy. There are 500 key changes standard. Locks are keyed differently, master keyed and furnished with 2 keys per lock. Locks and corresponding keys are alpha-numerically coded for a quick match.
  7. Locks: Removable core standards:  
BK: Lock BK SL-1 is laboratory grade, cylinder cam lock, with a 5-disc tumbler mechanism with a black powder-coated face. Tumblers and keys are brass, while plug and cylinder is die cast zinc alloy. A 180-degree turn of the

key moves the lock cam into, or out of, a slot cut to receive it. There are 500 key changes standard. Locks are keyed differently, master keyed and furnished with 2 keys per lock. Locks and corresponding keys are alpha-numerically coded for a quick match. Lock BK SL-1 is equipped with a removable core, keying control. With the use of a control key, the key core of the lock assembly can be removed and a new key core inserted, changing the entire locking system in a matter of minutes. Key cores can be held out of the lock assembly until the project is completed, removing the security risk of lost or stolen keys during installation and construction. Casework manufacturer can provide control keys and replacement cores as required. Locks are furnished only when specified.

8. Drawer Slides:
  - a. Drawer slides DS-1: Epoxy powder coated, cold rolled steel, bottom/side mount, heavy-duty with a 100 lbs (45 kilograms) load capacity. They are equipped with heavy-duty, nylon rollers for smooth effortless operation. Slides are self-closing; and have automatic positive stop to prevent drawer's accidental removal, but allow for quick removal without tools.
9. File Drawer Slides:
  - a. File drawer slides FD-1: Zinc plated, cold rolled steel, heavy-duty, side mounted, and have a 125 lbs (56.25 kg) load capacity. They are equipped with heavy-duty, precision ball bearings, for smooth effortless operation. Slides are full extension with a positive stop, and a trigger finger release.

## 2.4 MATERIALS

- A. Oak Lumber: Grade FAS or better, air-dried and kiln dried to 6 percent moisture content, then tempered to 7 to 8 percent prior to fabrication. Lumber exposed to view, is free of stains, splits, shakes, season checks and other similar defects. Other hardwoods are grade FAS or better, air dried to 6 percent moisture content, then tempered to 7 to 8 percent prior to fabrication. Other hardwoods are used in semi-exposed, or unexposed, areas and comply with NHLA grading for FAS or better lumber.
- B. Oak Plywood: Plywood is plain sliced, book-matched Oak, select grade A-1, cross-banded, and has a veneer core. The 1 inch (25 mm) plywood is minimum 9-ply, 3/4 inch (19 mm) plywood is a minimum of 7-ply, 1/2 inch (12 mm) is a minimum of 5 ply, 1/4 inch (6 mm) is minimum of 3 ply, and 3/32 inch (2.4 mm) is 3-ply. Other hardwood plywood is sound grade, has a solid core and is suitable for semi-exposed or unexposed areas. All plywood shall be CARB Phase 2 compliant.
- C. Hardboard used in drawer bottoms and unexposed backs, consists of super-refined wood fibers and chips, highly compressed into a hard, dense, 1/4 inch (6 mm) thick, homogeneous sheet, faced with white melamine on the exposed face. Physical properties: Average MOR is 5,000 lbs/sq inches (3.5 kgf/sq mm); density is 48 lbs/cu ft (0.6 kg/cu m); and MOE of 500,000 psi (350 kgf/sq mm). All hardboard shall be CARB Phase 2 compliant.

## 2.5 FABRICATION

- A. Units and configurations designated for accessibility by users shall comply with ATBCB ADAAG (ADA standards).
- B. Design, material and construction of casework, shelving and tables shall comply with SEFA 8W performance and resistance standards.

- C. 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 its intended use.
- D. Base cabinets have a 2-1/4 inches (57 mm) by 1 inch (25 mm), solid hardwood horizontal front top frame member and 2-1/8 inches (54 mm) by 1 inch (25 mm), solid hardwood horizontal rear and side top frame members. Front intermediate rails are 3/4 inch (19 mm) by 2-1/2 inches (64 mm) solid wood. Back intermediate rails are furnished only when drawer separators are specified. Exposed exterior backs are 3/4 inch (19 mm) plywood. Cabinets with exposed interiors but unexposed exteriors have 1/4 inch (6 mm) plywood backs. Backs are 1/4 inch (6 mm) finished plywood in cabinets with exposed interiors; and, in cabinets with unexposed interiors, backs are 1/4 inch (6 mm) thick hardboard with melamine face, color coordinated to the interior stain. Exposed end panels are 3/4 inch (19 mm) plywood. Unexposed end panels are 3/4 inch (19 mm) hardwood plywood. End panels with unexposed interior and unexposed exterior are 3/4 inch (19 mm) hardwood plywood. Bottom, shelves, and dividers in cabinets with exposed interiors are 3/4 inch (19 mm) plywood; with unexposed interiors is 3/4 inch (19 mm) hardwood plywood. If cabinet exceeds 36 inches (914 mm) in width, shelves shall be 1 inch (25mm) thick. Exposed edges of front top horizontal frame and intermediate rail members; end panels, bottom, shelves, and dividers are edged with 1/8 inch (3 mm) solid wood. Drawer separators, furnished only when specified, are 1/4 inch (6 mm) thick hardboard with wood grained melamine face.
- E. Cabinet construction is bored, doweled, dadoed, glued and screwed construction. Cabinets are enclosed without the use of common partitions. A full horizontal, mortise, tenon and glued, top frame is bored, doweled, glued, and reinforced with six (6) screws into the cabinet. Intermediate front rails and bottom rear horizontal parting rails are provided as required. Separators, where specified, are let into routed intermediate rails. Backs are recessed and encapsulated into dadoed end panels then screwed into the top and bottom case members. A standard enclosed toe space, 2-1/4 inches (57 mm) by 4 inches (102 mm) high, is provided, with toe rail bored, doweled and glued to end panels. Shelves are supported on heavy-duty, laboratory grade, twin pin plastic shelf clips, which fit into two double rows of holes drilled 1-1/4 inches (32 mm) on centers, in the case end panels for maximum shelf adjustability.
- F. Construction - Wall and Upper Cases: Wall and upper cases have a 1 inch (25 mm) plywood top and bottom panel. Adjustable shelves are 1 inch (25 mm) finished plywood in cases with exposed interiors and 1 inch (25 mm) hardwood plywood in cases with unexposed interiors. Backs are 1/4 inch (6 mm) finished plywood in cabinets with exposed interiors; and, in cabinets with unexposed interiors, backs are 1/4 inch (6 mm) thick hardboard with melamine face, color coordinated to the interior stain. End panels in cabinets with exposed interiors are 3/4 inch (19 mm) finished plywood; end panels in cabinets with unexposed interiors are 3/4 inch (19 mm) hardwood plywood. Exterior hanger rails are 4 inches (102 mm) by 3/4 inch (19 mm) hardwood plywood.
- G. Construction - Tall Cases: Top panels in tall cases with exposed interiors are 1 inch (25 mm) hardwood plywood; tall cases with unexposed interiors have top panels of 1 inch (25 mm) plywood. Bottom panels in tall cases with exposed interiors are 3/4 inch (19 mm) hardwood plywood; and unexposed interiors have 3/4 inch (19 mm) plywood. Interiors, whether exposed or unexposed, are stain color matched to the exterior finish. Adjustable shelves are 1 inch (25 mm) thick hardwood plywood if

exposed; 1 inch (25 mm) plywood if unexposed. Shelves are edged with 1/8 inch (3 mm) solid hardwood edging. Backs in tall cases with exposed interiors and exposed exteriors, are 1/4 inch (6 mm) hardwood plywood. Backs are 1/4 inch (6 mm) finished plywood in cabinets with exposed interiors; and, in cabinets with unexposed interiors, backs are 1/4 inch (6 mm) thick hardboard with melamine face, color coordinated to the interior stain. End panels in tall cases with exposed end panels have 3/4 inch (19 mm) hardwood plywood. End panels in cases with unexposed end panels have 3/4 inch (19 mm) plywood. All exposed edges of hardwood plywood components and plywood components are edged with 1/8 inch (3mm) solid hardwood edging. Tall cases have two exterior hardwood plywood cross rails, 4 inches by 3/4 inch (102 mm x 19 mm). Tall cases are rigidly constructed, integral units with the strongest, most advanced joinery methods utilized of bored, doweled, dadoed, glued and screwed construction. Each case is completely enclosed without the use of common partitions and has flush construction with overlapping doors to provide a dust resistant interior. The top panel is bored, doweled and glued into end panels; and the bottom panel is bored, doweled and glued into end panels and glued and screwed to the back. Additional back cross rails are provided as required. Backs are recessed and encapsulated into dadoed end panels and screwed to the top and bottom tall case members. An enclosed toe space 2-1/4 inch by 4 inches (57 mm by 102 mm) is provided with toe rail securely bored, doweled and glued to end panels and bottom panel. Adjustable shelves are supported on heavy-duty laboratory grade, twin pin plastic shelf clips, which fit into two rows of holes drilled 1-1/4 inches (32 mm) on centers in the end panels, for maximum shelf adjustability.

- H. Drawer front is 13/16 inch (20.6 mm) thick. Squared edged styles drawer faces are screwed to the face of a full drawer box. Drawer box front, sides and back are 1/2 inch (12 mm), 9-ply laminated hardwood plywood, FSC 100% and CARB Phase 2 compliant. Drawer bottom is 1/4 inch (6 mm) thick hardboard with white melamine face. All four corners of the drawer are dovetailed and glued. The top edges of drawer box are radiused. Drawer bottom is let in on four sides, and securely glued underneath with a continuous bead of glue around the perimeter of the drawer bottom. In cabinets 24 inches (610 mm) or less in width, drawers have one pull. In cabinets over 24 inches (610 mm) wide, drawers have two pulls.
- I. Construction - Hinged Doors:
  - 1. Hinged solid doors 48 inches (1219 mm) or less in height, 13/16 inch (20.6 mm) thick and overlap the opening on all sides. Doors have one pull. Door has two heavy-duty, institutional type, and 5-knuckle hinges. Doors are secured by a friction roller catch and a metal strike plate.
  - 2. Hinged solid doors over 48 inches (1219 mm) in height, 13/16 inch (20.6 mm) thick and overlap the opening on all sides. Single doors and right door of double doors have a latching handle. A three point latching system provides single doors and right door of double doors positive engagements at the top and bottom of the door with tapered aluminum rods, which engage plastic, strike plates and pull the door snug. The rods are 5/16-inch (8 mm) in diameter and move in nylon guides attached to the back of the door. The middle of the door is secured by a latch plate, which engages the side of the case, or latches behind the left door on cases with double doors and securely hold the door shut. Right door of double doors lap over an applied astragal on the left door. Doors have four hinges. On double doors left door is additionally secured with two friction roller catches with metal strike plates
  - 3. Hinged glazed doors, 48 inches (1219 mm) or less in height, have a solid wood frame 1-1/16 inches (27 mm) by 3 inches (76 mm) with glass panel. The hardwood rail and stile frame joints are bored, doweled and glued. Right door of double doors laps an applied astragal on the left door. Doors have one pull, two hinges and are secured by friction roller catches with metal

strike plate. Glass panels are held in place by a press-fit, flexible and removable, rubber strip.

- a. Glass is tempered safety glass is specially heat-treated glass, 1/4 inch (6 mm) thick with a minimum of 88 percent clarity.
  - b. Glass is DSB glass is double strength, grade "B", and 1/8 inch (3 mm) thick.
- 4 Hinged glazed doors, over 48 inches (1219 mm) in height, same construction with a 1-1/16 inch (27 mm) by 3 inch (76 mm) center cross frame member with glass panel. Single doors and right door of double doors have a latching handle. Left door of double doors has a fixed handle, which is the same size and finish as a latching handle. A three point latching system provides single doors and right door of double doors positive engagement at the top and bottom of the door with tapered aluminum rods, which engage plastic, strike plates and pulls the door snug. The rods are 5/16-inch (8 mm) in diameter and move in nylon guides attached to the back of the door. The middle of the door is secured by a latch plate, which engages the side of the case, or latches behind the left door on cases with double doors and securely hold the door shut. Right door of double doors laps an applied astragal on the left door. Doors have four hinges. The left door of double doors is additionally secured by two friction roller catches and metal strike plates. Glass panels are held in place by a press-fit, flexible and removable, rubber strip.
- a. Glass is tempered safety glass is specially heat-treated glass, 1/4 inch (6 mm) thick with a minimum of 88 percent clarity.
  - b. Glass is DSB glass is double strength, grade "B", and 1/8 inch (3 mm) thick.

J. Construction - Sliding Doors:

1. Sliding solid doors are 13/16 inch (20.6 mm) thick with squared edges; plastic laminate style sliding doors are 3/4 inch (19 mm) laminated particleboard core and operate in an overhead aluminum sliding door track assembly with adjustable nylon roller hangers. Doors are secured at the bottom of the cabinet with two plastic guides per door that operate in recessed, channels. Each door has one recessed pull with finger grip. Pull is located on outside edge of the door face. Lock is furnished when specified.
2. Sliding glazed doors, 48 inches (1219 mm) or less in height, have a 1 1/16 inches (27 mm) by 3 inches (76 mm), solid wood frame with 1/8 inch (3 mm) thick DSB glass. Door frames have joints bored, doweled and glued. Doors operate in an overhead aluminum sliding door track assembly with adjustable nylon roller hangers. Doors are secured at the bottom of the cabinet with two plastic guides per door, which operate in recessed channels. Each door has one pull recessed nickel-plated metal pull with finger grip. Pull is located on outside edge of the door face. Lock is furnished when specified. Glass panels are held in place by a press-fit, flexible and removable, rubber strip.
  - a. Glass is tempered safety glass is specially heat-treated glass, 1/4 inch (6 mm) thick with a minimum of 88 percent clarity.
  - b. Glass is DSB glass is double strength, grade "B", and 1/8 inch (3 mm) thick.
3. Sliding glazed doors, over 48 inches (1219 mm), have a 1 1/16 inches (27 mm) by 3 inches (76 mm), solid wood frame with a center cross frame member and 1/4 inch (6 mm) tempered glass. Doors have solid wood frames with joints bored, doweled and glued. The balance of the door is glass. Doors operate in an overhead aluminum sliding door track assembly with adjustable nylon roller hangers. Doors are secured at the bottom of the cabinet with two plastic guides per door, which operate in recessed channels. Each door has one recessed nickel-plated metal pull with finger grip. Pull is located on outside edge of the door face. Lock is furnished when specified. Glass panels

are held in place by a press-fit, flexible and removable, rubber strip. Glass is tempered safety glass is specially heat-treated glass, 1/4 inch (6 mm) thick with a minimum of 88 percent clarity.

4. Sliding glass doors are 1/4 inch (6 mm) thick float glass. Doors have polished vertical edges and swiped horizontal edges. Doors operate in sliding aluminum door track assembly, which has an aluminum track at the bottom, and an aluminum channel mounted at the top of the cabinet. The glass rests in aluminum shoes with nylon rollers. The top swiped edge of the glass is fitted with plastic glide clips to assure smooth movement in the channel. Each door has one two-piece recessed round pull. Pull is located on outside edge of the door face. Lock is furnished when specified.
- K. Construction - Tables: Open Frame Table exterior rails are 4-13/16 inches (122 mm) by 13/16 inch (21 mm), solid hardwood lumber. Interior rails are a minimum of 3/4 inch (19 mm) hardwood plywood. Compartment bottoms are 1/4 inch (6 mm) plywood. Legs are 2 1/4 inches (57 mm) square solid hardwood; legs are not laid up. Leg stretchers, when specified, are 2-1/8 inches (54 mm) by 1 inch (25 mm) thick, solid hardwood. Openings are routed in the one-piece rail when drawers or compartments are required. A minimum of two interior cross rails are doweled and glued into exterior rails. Compartment bottoms are let into dadoed grooves in cross rails and the front and back rails, then glued on all four edges. Exterior rails are grooved to receive 3/8 inch (9 mm) flanges on the 13 gauge steel corner stabilizing bracket. Legs are secured to the stabilizing bracket with a 5/16 inch (8 mm) threaded hanger bolt, machine screwed into the solid leg a depth of at least 1-1/2 inches. The stabilizing bracket is attached to the leg bolt by a 5/16" locking nut with serrated flange. Tightening the locking nut on the bolt, draws the stabilizing bracket flanges against the solid hardwood rail, and clamps them against the solid hardwood leg. The stabilizing bracket is further secured to the solid hardwood rails by four (4) Euro screws. Legs have molded black polyethylene, closed bottom, leg shoes. Exterior rails are also grooved to accept Z- clips for attaching the top.

## 2.6 FINISHES

- A. Wood Cabinets: Exterior and interior surfaces of cabinets receive the full finishing process consisting of baked on: specified NGR stain, two coats of protective moisture resistant sealer and two applications of a topcoat of clear catalyzed chemical resistant lacquer.
1. Interior Surfaces: The unexposed interior surfaces of cupboards, wall cases, upper cases, and tall cases must match exterior color and receive stain (color coat), a protective coat of moisture resistant sealer, and two applications of a clear, catalyzed, chemical resistant conversion varnish topcoat.
  2. Other Surfaces: Unexposed surfaces such as unexposed end panels, unexposed backs, drawer sides and drawer bottoms are processed through standard finishing steps and receive a baked on protective coat of moisture resistant sealer, baked on clear catalyzed chemical resistant conversion varnish, but no stain (color coat).
  3. Finish shall comply with SEFA-8W resistance standard acceptable levels for casework surfaces. An independent 3rd party testing facility's written certification must be provided to establish that final finish has no more than four, SEFA-8W "Level 3" conditions.
  4. Any deviations from the specified finishing procedures will be considered defective Work and rejected by the Architect.

## 2.7 CABINET HARDWARE

- A. Provide laboratory casework manufacturer's standard finish, commercial-quality, heavy-duty hardware complying with requirements indicated for each type.

- B. Lock GL-1 is ratchet type glass door lock, with a disc tumbler mechanism and a polished nickel plate finish. The ratchet bar adjusts from 1 inch (25 mm) to 3 3/8 inches (86 mm). Two keys are provided; master keying is not available. Locks are furnished only when specified.
- C. Friction roller catch is zinc plated steel catch with a spring cushioned; polyethylene roller, and a metal strike plate. Screw mounted catches and strike plate have slotted holes for adjustability.
- D. Sliding door track assembly DT-1 has an overhead aluminum track and adjustable, nylon roller hangers. The lipped edge of the upper aluminum track prevents rollers from jumping track. Two hard plastic guides are mounted on the bottom interior of the door and operate in recessed channels.
- E. Sliding glass door track assembly GT-1 has an aluminum bottom track, and an aluminum channel mounted at the top of the cabinet. The glass rests in aluminum shoes with nylon rollers, which operate in the bottom track. The top swiped edge of the glass is fitted with plastic glide clips to assure smooth movement in the channel.
- F. Shelf clips are made from clear polycarbonate and are laboratory standard grade. Clips have double, 3/16 inch (5 mm) diameter pins and are equipped with shelf lock hold down tabs for 3/4 inch (18 mm) or 1 inch (25 mm) thick shelves.
- G. Sliding door lock, when specified, 5-disc tumbler mechanism with a dull chrome plated face. Tumblers and keys are brass, while plug and cylinder are die cast steel. Pushing in on the lock while turning the key, engages a lock bolt into the strike plate; a turn of the key, unlocks the bolt. There are 200 key changes standard. Locks are keyed differently, master keyed and furnished with 2 keys per lock. Locks and corresponding keys are alpha-numerically coded for a quick match.
- H. Leg shoes are closed-bottom style, 2 1/4 inches (57 mm) square, and molded of 1/8 inch (3 mm) black polyethylene.

## 2.8 COUNTER TOPS

- A. Epoxy resin (Rhearesin) is 1 inch (25 mm) thick, molded from a modified epoxy resin. Exposed edges and corners are radiused, and a drip groove is provided under surface in areas where sinks are installed. Curb is 4 inches (102 mm) high.
  1. Standard Color: Black.

## 2.9 ACCESSORIES:

- A. Burette Rods: 1/2-inch (12 mm) diameter, anodized aluminum, and either 18 inches (457 mm) or 24 inches (610 mm) long. Rods are furnished with a tapered aluminum adapter to fit rod socket.
- B. Clamps: 1-inch (25 mm) square aluminum stock, with two, 3/4-inch (19 mm) diameter openings, at right angles to each other, bored through sides. Openings are for upright rods and crossbars, or Greenlaw Arms. Thumb screw into each end of the clamp; tighten against the rods to hold positions.
- C. Crossbars and Greenlaw Arms: 3/4-inch (19 mm) diameter, anodized aluminum rods, with ends rounded.
- D. Rod Sockets: Mushroom type, machined from a solid aluminum rod. Sockets are held in place by a heavy aluminum lock nut and washer.
- E. Upright Rods: 3/4 inch (19 mm) diameter, anodized aluminum, 36 inches long with

a rounded top and a tapered bottom to fit rod sockets.

- F. Reagent Shelves: Provide as indicated, fabricated from same material as adjacent countertop, unless otherwise indicated.
- G. Adjustable Wall Shelf Supports: Standard is anodized chrome standard and shelf brackets. Epoxy powder coating is an option and must be specified.
- H. Metal Key Cabinets.
- I. Plastic Tote Tray.
- J. Pegboards: Clear acrylic, epoxy, or phenolic-composite pegboards with removable polypropylene pegs and stainless-steel drip troughs with drain outlet.

## 2.10 SERVICE FIXTURES

- A. Electrical Components, Devices, and Accessories shall be labeled to comply with NFPA 70, Article 100 and marked for its intended use.
- B. Provide service fixtures and fittings that comply with SEFA 7.
  - 1. Provide service fixtures and fittings that comply with recommendations of SEFA 7.
- C. Electrical Fixtures are 3-wire grounded, 20 A, 125V AC, with stainless steel cover plates and cadmium-plated steel boxes. Pedestal boxes are black, cast aluminum with conduit nipples and lock nuts. When specified, G.F.C.I., ground fault circuit interrupter fixtures are available. G.F.C.I. fixtures are 20 A, 125V AC, with black nylon faceplate.
  - 1. Receptacles: Comply with NEMA WD 1, NEMA WD 6, FS W-C-596, and UL 498. Duplex type, Configuration 5 20R.
- D. Epoxy resin sinks are drop-in style, non-glaring black, and specially modified epoxy resins, molded in one solid piece or optimum physical and chemical resistance. Inside corners are coved and the bottom is dish to the outlet. Outlets are polypropylene with 1 1/2 inch (38 mm) NPS threads.
- E. Gas, Air and Vacuum Cocks: Ground key cocks, made from high grade, brass forgings have integral ten-serration, non-slip hose end. Wing or knob handle has color-coded index, is one-piece construction, precision ground, and lapped to fit cock chamber. Handle operates with a 1/4 turn, and is spring-loaded for constant pressure and automatic take up. Provide needlepoint valves for high pressures and oxygen service where scheduled.
- F. Multiple Service Fixtures: Triple chrome plated or electro-statically applied polyester powder coated fixtures have one cold water faucet and two ground key cocks for gas, air, or vacuum services. Faucet has a rigid gooseneck, one four-arm or knob handle, and serrated hose nozzle. Vacuum breaker furnished when specified. Faucet with integral vacuum breaker is furnished, when specified. Ground key cocks have serrated non-slip hose end and color-coded, spring-loaded wing handles.
- G. Service Fixtures: Triple chrome plating or electro-statically applied polyester powder coating, heavy-duty construction for water, gas, steam, or other services and specifically designed for laboratory use. Hot and/or cold Water Faucets are cast from red brass with color-coded index handles. Faucets have serrated hose nozzles, unless specified otherwise. Goosenecks are rigid. Fixture outlets are tapped 3/8-inch (10 mm) I.P.S. for aerators, vacuum breakers, hose connections, or other accessories. Standard: Faucets with an integral vacuum breaker.



- H. Stainless steel sinks have a satin finish. Sink is 18 gauge, type 304, 18-8 stainless steel, with heavily undercoated bottoms and positive pitch drains. Outlets are chrome-plated brass. Drain holes are 3 1/2 inches (89 mm) diameter for 4 1/2 inches (114 mm) stainless steel cup strainers. The cup strainer has a neoprene stopper.
- I. Vacuum Breakers: Watts NLF-9 or comparable, vacuum breakers are brass with polished chrome plating, screw-in type with stainless steel working parts, and durable rubber diaphragm and disc. Vacuum breaker is for hot or cold faucet and has a primary valve with a soft disc that seat against mating part. The secondary check valve utilizes a soft disc to metal seating. Breaker is tapped 3/8-inch (10 mm) N.P.T. Vacuum breaker is not intended for constant high pressures. Vacuum breakers shall be furnished where scheduled.

## 2.11 EQUIPMENT AND APPLIANCES

- A. Flammable Liquid Storage Cabinets: Provide units that comply with requirements of NFPA 30.
  - 1. Wood, UL rated cabinet.

## 2.12 FUME HOODS

- A. Provide Fume Hood identified on Drawings.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
  - 1. Walls and openings are plumb, straight and square.
  - 2. Concrete floors level within 1/8-inch (3 mm) level per 10 foot (3000 mm) run, non-accumulative, when tested with a straight edge in any one direction.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

### 3.2 COORDINATION

- A. Laboratory equipment contractor shall furnish equipment to the building, setting in place, leveling and scribing to walls and floors. Furnish plumbing and electrical fixtures, including nipples and lock nuts needed to secure each fixture to the equipment.
- B. Coordination with mechanical contractor who shall furnish, install and connect drain lines, service piping, vents, re-vents, in-line vacuum breakers, special plumbing fixtures, traps and tailpieces. Work to be completed through, under or along backs of working surfaces as required and complete final connection of services. Assemble, install and make final connections of service fixtures furnished by casework contractor, including service fixtures in fume hoods. Furnish, install and connect fume hood blowers, motors and all related ductwork. Furnish, install and connect service piping within fume hoods, including final connection.
- C. Coordination with electrical contractor who shall furnish, install and connect electrical service lines, wire and conduit within the equipment, including reagent racks and fume hoods. Work to be completed through, under or along backs of working surfaces as required and complete final connection of services. Install and make final connections of electrical fixtures provided by casework installer, including

electrical fixtures in fume hoods.

### 3.3 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.

### 3.4 INSTALLATION

- A. Install casework in accordance with manufacturer's instructions.
  - 1. Installation of casework shall be plumb, level, true and straight, with no distortions.
  - 2. Use concealed shims as required.
  - 3. Where laboratory casework or equipment butts against other finished work, scribe and cut for an accurate fit.
  - 4. Lubricate operating hardware as recommended by the manufacturer.
- B. Install countertop and edge surfaces in one plane with flush hairline seams. Locate seams where shown on Shop Drawings.
  - 1. Provide required holes and cutouts for service fittings as shown on Shop Drawings.
  - 2. Seal unfinished edges and cutouts in plastic-laminate countertops.
  - 3. Provide scribe moldings for closures at junctures of countertop, curb, and splash, with walls as recommended by manufacturer for materials involved. Match materials and finish to adjacent laboratory casework. Use chemical-resistant, permanently elastic sealing compound where recommended by manufacturer.
  - 4. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
- C. Coordination with Mechanical, Plumbing and Electrical Contractors: Coordinate work of this Section with work of other Sections including but not limited to:
  - 1. Water and laboratory gas service fittings, piping, electrical devices, and wiring.
  - 2. Installation of fittings according to Shop Drawings and manufacturer's written instructions.
  - 3. Setting bases and flanges of sink and countertop-mounted fittings in sealant recommended by manufacturer of sink or countertop material.
  - 4. Anchorage of fittings, piping, and conduit to laboratory casework, unless otherwise indicated.

### 3.5 PROTECTION

- A. Cover installed casework and equipment with 4-mil polyethylene.
- B. Protect installed products until completion of project.
- C. Touch-up, repair or replace damaged products before Substantial Completion.
- D. A qualified manufacturer representative shall demonstrate operation and maintenance procedures of the installed casework and equipment to the Owners personnel.

END OF SECTION

## **SECTION 127000 MULTIPLE SEATING SYSTEMS**

### **PART 1 GENERAL**

#### Section 1.01 SUMMARY

- A. Table systems with swingout seating
  - 1. Fixed Table System with swingout seating: Symmetra Plus System
  - 2. Extent: Systems to be as indicated on drawings and as specified

#### Section 1.02 PRODUCT DESCRIPTION

- A. Seat/Table Requirements:
  - 1. Pedestal: provide table and supports providing fixed work surface with open access, supported by pedestals.
  - 2. Seating: Provide modular seating supported by swing arms on either side of each support pedestal, seats to independently swing out for access and swing back adjacent to table top when unoccupied. Auto-height auto-return seat cylinder allowing seat height adjustment, chair rotation and center return. Height adjustment mechanism and cylinder utilize precision taper fit, which eliminates requirement of tools and set screws. All seats must spin 360 degrees with standard spacing.
  - 3. Power and Data Distribution System: Modular data and electrical system housed in flexible conduit. All power system components shall be UL approved, including the steel pedestal table leg used for power entry, which shall be certified as a "UL Recognized Component," and will have appropriate labeling documenting that approval.

#### Section 1.03 SUBMITTALS

- A. General: Submit listed submittals in accordance with Contract and standard Submittals Procedures.
- B. Product Data: Submit manufacturers' product data, including product specification sheets, for products specified.
- C. Shop Drawings: Submit shop drawings showing seating layout, seat-numbering scheme, chair sizes and aisle widths. Must meet all current ADA requirements.
- D. Samples: Submit verification samples of finishes, colors and textures specified for each exposed material.

- E. Quality Assurance Submittals; Submit the following:
  - 1. Certificates: Product certificates signed by manufacturer certifying materials comply with specify performance characteristics and criteria and physical requirements.
  - 2. Installer Qualifications: Submit certification indicating installer is qualified to install manufacturer's seating. Must have a minimum of 5 years of experience.
  - 3. Bidder Qualifications: Submit certification, prior to drawing completion, indicating site has been inspected for any conditions that may affect the assembly or installation of products required.

Section 1.04 WARRANTY

- A. Project Warranty: Refer to "Conditions of the Contract" to project warranty provisions.
- B. Manufacturer's Warranty: Submit, for Owners acceptance:
  - 1. Manufacturer's standard warranty documents executed by authorized company official. Manufacturer's warranty is in addition to, and not a limitation of, other rights Owners may have under Contract Documents.
  - 2. Warranty period; Ten (10) year warranty on understructure and seating shells (when utilized) from defects of manufacture and workmanship, commencing on Date of Substantial Completion.
  - 3. Warranty will be null and void if products are installed on flooring not meeting minimum structural requirements as specified by manufacturer.

**PART 2 PRODUCTS**

Section 2.01 TABLE SYSTEM

- A. Manufacturer: Navetta division of Shuttlesystem LLC
- B. Product: Symmetra Fixed Table System
- C. Product specifications
  - 1. Pedestal Support  
Construction: Pedestals shall be constructed of 11-gauge steel tubing of oval cross-section measuring 3.15" x 1.57".
  - 2. Floor mount  
Pedestal shall be computer-controlled welded to a .25" thick steel base

plate measuring 8" x 4" with four slotted holes for mounting pedestal to floor with anchor bolts.

3. **Base cover**  
Base plate to be fully covered after mounting with two-piece cover constructed of injection molded toughened nylon, attached with two machine screws.
4. **Table mount**  
Top mount bracket shall be constructed of 11-gauge steel with four attaching bolts allowing attachment to pedestal and adjustment for variations in floor surface to provide alignment of adjacent tabletops without shimming tops. Bracket shall provide six mounting holes for attaching table top and designed to accept optional power and/or data electrical system. Four pre-drilled holes to be used with set screws to set worksurface at level.
5. **Top shroud**  
Top mount bracket will be covered by shroud with rounded edges constructed of injection molded ABS, attached with machine screws.
6. **Metal Finish**  
Metal components shall have powder-coat finish in finish specified.
7. **Table Configuration**  
Table tops shall be designed to be assembled into continuous surface in straight, radius, or segmented configuration. Adjacent tops to be joined with two mechanical clamping fasteners. Tops shall have cutouts for tabletop power modules when specified. Manufacturer shall be FSC (Forest Stewardship Council) chain-of-custody Certified.
8. **Table Top Construction**  
Table tops shall be nominal 1.25" thick warp-resistant construction with 1.125" particleboard center core sandwiched between .040" high pressure laminate top surface and phenolic backing surface. Assembly to be permanently bonded under continuous pressure in hot press.
9. **Table Top Edge treatment**  
Edges shall be finished as specified, using 3mm PVC, "T" cross-section vinyl continuous molding, wood surface, or bonded resin edging.
10. **Table Top Attachment**  
Table tops to attach to pedestal brackets with six #12 lag bolts.
11. **Modesty Panel Construction**  
Modesty panels shall be constructed of .8" thick nominal particle board sandwiched with bonded high-pressure laminate as specified and phenolic backing sheet, or available perforated metal of specified material, pattern and finish.

12. Modesty Panel Attachment  
Modesty panels shall interlock into machined recess in underside of table top surface and attach with supplied rigid metal brackets and hardware. Standard configuration provides .5" clearance between adjacent modesty panels, continuous configuration optional.
13. End Panel Construction  
If specified, end panels shall be constructed of .8" thick nominal particle board sandwiched with bonded high-pressure laminate as specified and phenolic backing sheet, or available perforated metal of specified material, pattern and finish.
14. End Panel Attachment  
End Panels shall attach with supplied rigid metal brackets and hardware.
15. Seat Support Mechanism  
Seat support arms shall be constructed of 11 gauge oval steel tubing formed to a radius, with industry-standard taper receiver to accept chair cylinder. Arms on either side of the support pedestal shall pivot independently from a steel kingpin mounted in a die cast aluminum housing with powder coat finish. A field-adjustable torsion spring shall be implemented to automatically return the seat adjacent to the table top when not occupied. Must meet static load test requirement of 600 lbs. Auto-height auto-return seat cylinder allowing seat height adjustment, chair rotation and center return. Height adjustment mechanism and cylinder utilize precision taper fit, which eliminates requirement of tools and set screws.
16. Seat Specifications  
A large selection of standard seats are available with the Symmetra Plus system, and virtually any other seat can be used with the system, including plastic, mesh back, and wood construction, upholstered or not, as the customer prefers. See specified seat documentation for detailed specification. All seats spin 360 degrees.

### **PART 3      INSTALLATION, EXECUTION AND WORKMANSHIP**

#### Section 3.1      MANUFACTURER'S INSTRUCTIONS

- A. Comply with manufacturer's installation instructions, including bulletins, product catalog, installation instructions and product carton instructions for installation.

#### Section 3.2      EXAMINATION

- A. Site Verification: Prior to installation verify, with installer present, that substrates and conditions comply with the requirements for construction tolerances and materials properties as they affect anchors and fasteners

and location of junction boxes.

- B. Repair: Do not proceed until unsatisfactory components or facility conditions have been corrected.

### Section 3.3 INSTALLATION

- A. Installation: Install following manufacturers printed instructions for installation and using manufacturer recommended hardware and fasteners. Tables in curbed rows shall be installed at smooth radius.
- B. Repair: Repair minor abrasions and imperfections in painted surfaces with a coating that matches the factory- applied finish.

### Section 3.4 CLEANING AND PROTECTION

- A. Cleaning: Clean Product in accordance with manufacturer instruction prior to Owner's acceptance. Remove construction debris, including cartons from project site and legally dispose of debris.
- B. Protection: Protect installed product and finished surfaces from damage during construction.

\* \* \* \* \*

END OF DOCUMENT

## **SECTION 142400 - MACHINE ROOM-LESS HYDRAULIC ELEVATORS**

### **PART 1 GENERAL**

#### **1.01 SUMMARY**

- A. Section includes: Hydraulic passenger elevators as shown and specified. Elevator work includes:
1. Standard pre-engineered hydraulic passenger elevators.
  2. Elevator car enclosures, hoistway entrances and signal equipment.
  3. Jack(s).
  4. Operation and control systems.
  5. Accessibility provisions for physically disabled persons.
  6. Equipment, machines, controls, systems and devices as required for safely operating the specified elevators at their rated speed and capacity.
  7. Materials and accessories as required to complete the elevator installation.
- B. Related Sections:
1. Division 1 General Requirements: Meet or exceed all referenced sustainability requirements.
  2. Division 3 Concrete: Installing inserts, sleeves and anchors in concrete.
  3. Division 4 Masonry: Installing inserts, sleeves and anchors in masonry.
  4. Division 5 Metals:
    - a. Providing hoist beams, pit ladders, steel framing, auxiliary support steel and divider beams for supporting guide-rail brackets.
    - b. Providing steel angle sill supports and grouting hoistway entrance sills and frames.
  5. Division 9 Finishes: Providing elevator car finish flooring and field painting unfinished and shop primed ferrous materials.
  6. Division 22 Plumbing:
    - a. Sump pit and oil interceptor.
  7. Division 23: Heating and Ventilation:
    - a. Heating and ventilating hoistways.
  8. Division 16 Sections:
    - a. Providing electrical service to elevators. (note: fused disconnect switch to be provided as part of elevator manufacture product, see section 2.11 Miscellaneous elevator components for further details.)
    - b. Emergency power supply, transfer switch and auxiliary contacts.
    - c. Heat and smoke sensing devices.
    - d. Convenience outlets and illumination in hoistway and pit.
- C. Work Not Included: General contractor shall provide the following in accordance with the requirements of the Model Building Code and ANSI A17.1 Code. For specific rules, refer to ANSI A17.1, Section 300 for hydraulic elevators. State or local requirements must be used if more stringent.
1. Elevator hoist beam to be provided at top of elevator shaft. Beam must be able to accommodate proper loads and clearances for elevator installation and operation.
  2. Supply in ample time for installation by other trades, inserts, anchors, bearing plates, brackets, supports and bracing including all setting templates and diagrams for placement.
  3. Hatch walls require a minimum two hours of fire rating. Hoistway should be clear and plumb with variations not to exceed 1/2" at any point.
  4. Elevator hoistways shall have barricades, as required.
  5. Install bevel guards at 75° on all recesses, projections or setbacks over 2" (4" for A17.1 2000 areas) except for loading or unloading.
  6. Provide rail bracket supports at pit, each floor and roof. For guide rail bracket supports, provide divider beams between hoistway at each floor and roof.
  7. Pit floor shall be level and free of debris. Reinforce dry pit to sustain normal vertical forces from rails and buffers.



8. Where pit access is by means of the lowest hoistway entrance, a vertical ladder of non-combustible material extending 42" minimum, (48" minimum for A17.1-2000 areas) shall be provided at the same height, above sill of access door or handgrips.
9. All wire and conduit should run remote from the hoistways.
10. When heat, smoke or combustion sensing devices are required, connect to elevator control cabinet terminals. Contacts on the sensors should be sided for 12 volt D.C.
11. Install and furnish finished flooring in elevator cab.
12. Finished floors and entrance walls are not to be constructed until after sills and door frames are in place. Consult elevator contractor for rough opening size. The general contractor shall supply the drywall framing so that the wall fire resistance rating is maintained, when drywall construction is used.
13. Where sheet rock or drywall construction is used for front walls, it shall be of sufficient strength to maintain the doors in true lateral alignment. Drywall contractor to coordinate with elevator contractor.
14. Before erection of rough walls and doors; erect hoistway sills, headers, and frames. After rough walls are finished; erect fascias and toe guards. Set sill level and slightly above finished floor at landings.
15. To maintain legal fire rating (masonry construction), door frames are to be anchored to walls and properly grouted in place.
16. The elevator wall shall interface with the hoistway entrance assembly and be in strict compliance with the elevator contractor's requirements.
17. General Contractor shall fill and grout around entrances, as required.
18. All walls and sill supports must be plumb where openings occur.
19. Locate a light fixture (200 lx / 19 fc) and convenience outlet in pit with switch located adjacent to the access door.
20. As indicated by elevator contractor, provide a light outlet for each elevator, in center of hoistway.
21. For signal systems and power operated door: provide ground and branch wiring circuits.
22. For car light and fan: provide a feeder and branch wiring circuits to elevator control cabinet.
23. Controller landing wall thickness must be a minimum of 8 inches thick. This is due to the controller being mounted on the second floor landing in the door frame on the return side of the door. For center opening doors, the controller is located on the right hand frame (from inside the elevator cab looking out). These requirements must be coordinated between the general contractor and the elevator contractor.
24. Cutting, patching and recesses to accommodate hall button boxes, signal fixtures, etc.

## 1.02 SUBMITTALS

- A. Product data: When requested, the elevator contractor will provide standard cab, entrance and signal fixture data to describe product for approval.
- B. Shop drawings:
  1. Show equipment arrangement in the pit and hoistway. Provide plans, elevations, sections and details of assembly, erection, anchorage, and equipment location.
  2. Indicate elevator system capacities, sizes, performances, safety features, finishes and other pertinent information.
  3. Show floors served, travel distances, maximum loads imposed on the building structure at points of support and all similar considerations of the elevator work.
  4. Indicate electrical power requirements and branch circuit protection device recommendations.
- C. Powder Coat Paint selection: Submit manufacturer's standard selection charts for exposed finishes and materials.

- D. Plastic laminate selection: Submit manufacturer's standard selection charts for exposed finishes and materials.
- E. Metal Finishes: Upon request, standard metal samples provided.
- F. Operation and maintenance data. Include the following:
  - 1. Owners Manual and Wiring Diagrams.
  - 2. Parts list, with recommended parts inventory.

### 1.03 QUALITY ASSURANCE

- A. Manufacturer Qualifications: An approved manufacturer with minimum fifteen years experience in manufacturing, installing, and servicing commercial elevators.
  - 1. Must be the manufacturer of the power unit, controller, signal fixtures, door operators cab, entrances, and all other major parts of the elevator operating equipment.
    - a. The major parts of the elevator equipment shall be manufactured in the United States, and not be an assembled system.
  - 2. The manufacturer shall have a documented, on-going quality assurance program.
  - 3. ISO-9001:2000 Manufacturer Certified.
  - 4. ISO-14001:2004 Environmental Management System Certified.
  - 5. LEED Gold certified elevator manufacturing facility.
- B. Installer Qualifications: The manufacturer or an authorized agent of the manufacturer with not less than fifteen years of satisfactory experience installing elevators equal in character and performance to the project elevators.
- C. Regulatory Requirements:
  - 1. ASME/ANSI A17.1 Safety Code for Elevators and Escalators, latest edition or as required by the local building code.
  - 2. Building Code: National.
  - 3. NFPA 70 National Electrical Code.
  - 4. NFPA 80 Fire Doors and Windows.
  - 5. Americans with Disabilities Act Accessibility Guidelines (ADAAG).
  - 6. CAN/CSA C22.1 Canadian Electrical Code.
  - 7. CAN/CSA B44 Safety Code for Elevators and Escalators.
  - 8. California Department of Public Health Standard Method V1.1–2010, CA Section 01350
- D. Fire-rated Entrance Assemblies: Opening protective assemblies including frames, hardware, and operation shall comply with ASTM E2074, CAN4-S104 (ULC-S104), UL10(B), and NFPA 80. Provide entrance assembly units bearing Class B or 1 1/2 hour label by a Nationally Recognized Testing Laboratory (2 hour label in Canada).
- E. Inspection and testing: Elevator Installer shall obtain and pay for all required inspections, tests, permits and fees for elevator installation.
  - 1. Arrange for inspections and make required tests.
  - 2. Deliver to the Owner upon completion and acceptance of elevator work.
- F. Product Qualifications:
  - 1. LCA, EPD and HPD data must be provided for all major components of the elevator system.
  - 2. LCA data must be compatible with GaBI Software.
  - 3. Environmental Product Declaration (EPD): Publicly available, critically reviewed life cycle analysis having at least a cradle-to-gate scope.
  - 4. GreenScreen Chemical Hazard Analysis: All ingredients of 100 parts-per-million or greater evaluated using GreenScreen for Safer Chemicals Method v1.2.

5. Health Product Declarations (HPD v2 or later): Complete, published declaration with full disclosure of known hazards, prepared using the Health Product Declaration Collaborative's "HPD builder" on-line tool; Unknown hazard listed will not be considered acceptable.

#### 1.04 DELIVERY, STORAGE AND HANDLING

- A. Manufacturing will deliver elevator materials, components and equipment and the contractor is responsible to provide secure and safe storage on job site.

#### 1.05 PROJECT CONDITIONS

- A. Prohibited Use: Elevators shall not be used for temporary service or for any other purpose during the construction period before Substantial Completion and acceptance by the purchaser unless agreed upon by Elevator Contractor and General Contractor with signed temporary agreement.

#### 1.06 WARRANTY

- A. Warranty: Submit elevator manufacturer's standard written warranty agreeing to repair, restore or replace defects in elevator work materials and workmanship not due to ordinary wear and tear or improper use or care for 12 months after completion of installation or acceptance thereof by beneficial use, whichever is earlier.

#### 1.07 MAINTENANCE

- A. Furnish maintenance and call back service for a period of 12 months for each elevator after completion of installation or acceptance thereof by beneficial use, whichever is earlier, during normal working hours, excluding callbacks. Service shall consist of periodic examination of the equipment, adjustment, lubrication, cleaning, supplies and parts to keep the elevators in proper operation.
  1. Manufacturer shall have a service office and full time service personnel within a 100 mile radius of the project site.

### PART 2 PRODUCTS

#### 2.01 MANUFACTURERS

- A. Manufacturer: ThyssenKrupp Elevator enduraMRL  
Otis Elevator

#### 2.02 MATERIALS, GENERAL

- A. All Elevator Cab materials including frame, buttons, lighting, wall and ceiling assembly, laminates and carpet shall have an EPD and an HPD, and shall meet the California Department of Public Health Standard Method V1.1-2010, CA Section 01350 as mentioned in 1.03.9 of this specification.
- B. Colors, patterns, and finishes: As selected by the Architect from manufacturer's standard colors, patterns, and finish charts.
- C. Steel:
  1. Shapes and bars: Carbon.
  2. Sheet: Cold-rolled steel sheet, commercial quality, Class 1, matte finish.
  3. Finish: Factory-applied baked enamel for structural parts, powder coat for architectural parts. Color selection must be based on elevator manufacture's standard selections.
- D. Plastic laminate: Decorative high-pressure type, complying with NEMA LD3, Type GP-

50 General Purpose Grade, nominal 0.050" thickness. Laminate selection must be based on elevator manufacture's standard selections.

E. Flooring: Radial Tile Flooring – See Section 09650.

## 2.03 HOISTWAY EQUIPMENT

- A. Platform: Fabricated frame of formed or structural steel shapes, gusseted and rigidly welded with a wood subfloor. Underside of the platform shall be fireproofed. The car platform shall be designed and fabricated to support one-piece loads weighing up to 25% of the rated capacity.
- B. Sling: Steel stiles affixed to a steel crosshead and bolstered with bracing members to remove strain from the car enclosure.
- C. Guide Rails: Steel, omega shaped, fastened to the building structure with steel brackets.
  - 1. Guide Shoes: Slide guides shall be mounted on top and bottom of the car.
  - 2. Buffers: Provide substantial buffers in the elevator pit. Mount buffers on a steel template that is fastened to the pit floor. Provide extensions if required by project conditions.
  - 3. Jack: Jack unit shall be of sufficient size to lift the gross load the height specified. Factory test jack to insure adequate strength and freedom from leakage. Brittle material, such as gray cast iron, is prohibited in the jack construction. Provide the following jack type: Twin post holeless telescopic 2-stage. Two jacks piped together, mounted one on each side of the car with each having two telescopic sections designed to extend in a synchronized manner when oil is pumped into the Assembly. Each jack section will be guided from within the casing or the plunger assembly used to house the section. Each plunger shall have a high pressure sealing system which will not allow for seal movement or displacement during the course of operation. Each Jack Assembly shall have a check valve built into the assembly to allow for automatically re-syncing the two plunger sections by moving the jack to its fully contracted position. The jack shall be designed to be mounted on the pit floor or in a recess in the pit floor. Each jack section shall have a bleeder valve to discharge any air trapped in the section.
  - 4. Automatic Self-Leveling: Provide each elevator car with a self-leveling feature to automatically bring the car to the landings and correct for overtravel or undertravel. Self-leveling shall, within its zone, be automatic and independent of the operating device. The car shall be maintained approximately level with the landing irrespective of its load.
  - 5. Wiring, Piping, and Oil: Provide all necessary hoistway wiring in accordance with the National Electrical Code. All necessary code compliant pipe and fittings shall be provided to connect the power unit to the jack unit. Provide proper grade readily biodegradable oil as specified by the manufacturer of the power unit (see Power Unit section 2.04.G for further details).
  - 6. Pit moisture/water sensor located approximately 1 foot above the pit floor to be provided. Once activated, elevator will perform "flooded pit operation", which will run the car up to the designated floor, cycle the doors and shut down and trip the circuit breaker shunt to remove 3 phase power from all equipment, including pit equipment.
  - 7. Motorized oil line shut-off valve shall be provided that can be remotely operated from the controller landing service panel. Also a means for manual operation at the valve in the pit is required.

## 2.04 POWER UNIT

- A. Power Unit (Oil Pumping and Control Mechanism): A self-contained unit located in the elevator pit consisting of the following items:
1. NEMA 4/Sealed Oil reservoir with tank cover including vapor removing tank breather
  2. An oil hydraulic pump.
  3. An electric motor.
  4. Electronic oil control valve with the following components built into single housing; high pressure relief valve, check valve, automatic unloading up start valve, lowering and leveling valve, and electro-magnetic controlling solenoids.
- B. Pump: Positive displacement type pump specifically manufactured for oil-hydraulic elevator service. Pump shall be designed for steady discharge with minimum pulsation to give smooth and quiet operation. Output of pump shall not vary more than 10 percent between no load and full load on the elevator car.
- C. Motor: Standard manufacture motor specifically designed for oil-hydraulic elevator service. Duty rating – motors shall be capable of 80 starts per hour with a 30% motor run time during each start.
- D. Oil Control Unit: The following components shall be built into a single housing. Welded manifolds with separate valves to accomplish each function are not acceptable. Adjustments shall be accessible and be made without removing the assembly from the oil line.
1. Relief valve shall be adjustable and be capable of bypassing the total oil flow without increasing back pressure more than 10 percent above that required to barely open the valve.
  2. Up start and stop valve shall be adjustable and designed to bypass oil flow during start and stop of motor pump assembly. Valve shall close slowly, gradually diverting oil to or from the jack unit, ensuring smooth up starts and up stops.
  3. Check valve shall be designed to close quietly without permitting any perceptible reverse flow.
  4. Lowering valve and leveling valve shall be adjustable for down start speed, lowering speed, leveling speed and stopping speed to ensure smooth "down" starts and stops. The leveling valve shall be designed to level the car to the floor in the direction the car is traveling after slowdown is initiated.
  5. Provided with constant speed regulation in both up and down direction. Feature to compensate for load changes, oil temperature, and viscosity changes.
  6. Solid State Starting: Provide an electronic starter featuring adjustable starting currents.
  7. A secondary hydraulic power source (powered by 110VAC single phase) must be provided. This is required to be able to raise (reposition) the elevator in the event of a system component failure (i.e. pump motor, starter, etc.)
  8. Oil Type: Readily biodegradable that is USDA certified biobased product, ultra low toxicity, readily biodegradable, energy efficient, high performing fluid made from canola oil with antioxidant, anticorrosive, antifoaming, and metal-passivating additives. Especially formulated for operating in environmentally sensitive areas. USDA certified biobased product, 95% bio-based content, per ASTM D6866.

## 2.05 HOISTWAY ENTRANCES

- A. Doors and Frames: Provide complete hollow metal type hoistway entrances at each hoistway opening bolted\knock down construction.
1. Manufacturer's standard entrance design consisting of hangers, doors, hanger supports, hanger covers, fascia plates, sight guards, and necessary hardware.
  2. Main landing door & frame finish: ASTM A1008 steel panels, factory applied powder coat finish.
  3. Typical door & frame finish: ASTM A 366 steel panels, factory applied powder coat

enamel finish.

- B. Integrated Control System: the elevator controller to be mounted to hoistway entrance above 1<sup>st</sup> landing. The entrance at this level, shall be designed to accommodate the control system and provide a means of access to critical electrical components and troubleshooting features. See section 2.09 Control System for additional requirements.
- C. At the controller landing, the hoistway entrance frame shall have space to accommodate and provide a lockable means of access (group 2 security) to a 3 phase circuit breaker. See section 2.11 Miscellaneous Elevator Components for further details.
- D. Interlocks: Equip each hoistway entrance with an approved type interlock tested as required by code. Provide door restriction devices as required by code.
- E. Door Hanger and Tracks: Provide sheave type two point suspension hangers and tracks for each hoistway horizontal sliding door.
  - 1. Sheaves: Polyurethane tires with ball bearings properly sealed to retain grease.
  - 2. Hangers: Provide an adjustable device beneath the track to limit the up-thrust of the doors during operation.
  - 3. Tracks: Drawn steel shapes, smooth surface and shaped to conform to the hanger sheaves.
- F. Hoistway Sills: Extruded metal, with groove(s) in top surface. Provide mill finish on aluminum.

## 2.06 CAR ENCLOSURE

- A. Car Enclosure:
  - 1. Walls: Cab type TKLP, durable wood core finished on both sides with high pressure plastic laminate.
  - 2. Canopy: Cold-rolled steel with hinged exit.
  - 3. Ceiling: Downlight type, metal pans with suspended LED downlights.
  - 4. Cab Fronts, Return, Transom, Soffit and Strike: Provide panels faced with brushed stainless steel.
  - 5. Doors: Horizontal sliding car doors reinforced with steel for panel rigidity. Hang doors on sheave type hangers with polyurethane tires that roll on a polished steel track and are guided at the bottom by non-metallic sliding guides.
    - a. Door Finish: ASTM A1008 steel panels, factory applied powder coat enamel finish.
    - b. Cab Sills: Extruded aluminum, mill finish.
  - 6. Handrail: Provide 1.5" diameter cylindrical metal on side and rear walls on front opening cars and side walls only on front and rear opening cars. Handrails shall have a stainless steel, no. 4 brushed finish.
  - 7. Ventilation: Manufacturer's standard exhaust fan, mounted on the car top.
- B. Car Top Inspection: Provide a car top inspection station with an "Auto-Inspection" switch, an "emergency stop" switch, and constant pressure "up and down" direction and safety buttons to make the normal operating devices inoperative. The station will give the inspector complete control of the elevator. The car top inspection station shall be mounted in the door operator assembly.

## 2.07 DOOR OPERATION

- A. Door Operation: Provide a direct current motor driven heavy duty operator designed to operate the car and hoistway doors simultaneously. Door movements shall be electrically cushioned at both limits of travel and the door operating mechanism shall be arranged for manual operation in event of power failure. Doors shall automatically open when the car arrives at the landing and automatically close after an adjustable time

interval or when the car is dispatched to another landing. Closed-loop, microprocessor controlled motor-driven linear door operator, with adjustable torque limits, also acceptable. AC controlled units with oil checks or other deviations are not acceptable.

1. No Un-Necessary Door Operation: The car door shall open only if the car is stopping for a car or hall call, answering a car or hall call at the present position or selected as a dispatch car.
  2. Door Open Time Saver: If a car is stopping in response to a car call assignment only (no coincident hall call), the current door hold open time is changed to a shorter field programmable time when the electronic door protection device is activated.
  3. Double Door Operation: When a car stops at a landing with concurrent up and down hall calls, no car calls, and no other hall call assignments, the car door opens to answer the hall call in the direction of the car's current travel. If an onward car call is not registered before the door closes to within 6 inches of fully closed, the travel will reverse and the door will reopen to answer the other call.
  4. Nudging Operation: The doors shall remain open as long as the electronic detector senses the presence of a passenger or object in the door opening. If door closing is prevented for a field programmable time, a buzzer will sound. When the obstruction is removed, the door will begin to close at reduced speed. If the infra-red door protection system detects a person or object while closing on nudging, the doors will stop and resume closing only after the obstruction has been removed.
  5. Limited Door Reversal: If the doors are closing and the infra-red beam(s) is interrupted, the doors will reverse and reopen partially. After the obstruction is cleared, the doors will begin to close.
  6. Door Open Watchdog: If the doors are opening, but do not fully open after a field adjustable time, the doors will recycle closed then attempt to open six times to try and correct the fault.
  7. Door Close Watchdog: If the doors are closing, but do not fully close after a field adjustable time, the doors will recycle open then attempt to close six times to try and correct the fault.
  8. Door Close Assist: When the doors have failed to fully close and are in the recycle mode, the door drive motor shall have increased torque applied to possibly overcome mechanical resistance or differential air pressure and allow the door to close.
- B. Door Protection Devices: Provide a door protection system using 150 or more microprocessor controlled infra-red light beams. The beams shall project across the car opening detecting the presence of a passenger or object. If door movement is obstructed, the doors shall immediately reopen.

## 2.08 CAR OPERATING STATION

- A. Car Operating Station, General: The main car control in each car shall contain the devices required for specific operation mounted in an integral swing return panel requiring no applied faceplate. Swing return shall have a brushed stainless steel finish. The main car operating panel shall be mounted in the return and comply with handicap requirements. Pushbuttons that illuminate using long lasting LED's shall be included for each floor served, and emergency buttons and switches shall be provided per code. Switches for car light and accessories shall be provided.
- B. Emergency Communications System: Integral phone system provided.
- C. Auxiliary Operating Panel: Not Required
- D. Column Mounted Car Riding Lantern: A car riding lantern shall be installed in the elevator cab and located in the entrance. The lantern, when illuminated, will indicate the intended direction of travel. The lantern will illuminate and a signal will sound when the car arrives at a floor where it will stop. The lantern shall remain illuminated until the door(s) begin to close.
- E. Special Equipment: Limited Access Operation: Keyswitch and card reader space.(card

reader by others)

## 2.09 CONTROL SYSTEMS

- A. Controller: Shall be integrated in a hoistway entrance jamb. Should be microprocessor based, software oriented and protected from environmental extremes and excessive vibrations in a NEMA 1 enclosure. Control of the elevator shall be automatic in operation by means of push buttons in the car numbered to correspond to floors served, for registering car stops, and by "up-down" push buttons at each intermediate landing and "call" push buttons at terminal landings.
- B. Service Panel – to be located outside the hoistway in the controller entrance jamb and shall provide the following functionality/features:
  - 1. Access to main control board and CPU
  - 2. Main controller diagnostics
  - 3. Main controller fuses
  - 4. Universal Interface Tool (UIT)
  - 5. Remote valve adjustment
  - 6. Electronic motor starter adjustment and diagnostics
  - 7. Operation of pit motorized shut-off valve with LED feedback to the state of the valve in the pit
  - 8. Operation of auxiliary pump/motor (secondary hydraulic power source)
  - 9. Operation of electrical assisted manual lowering
  - 10. Provide male plug to supply 110VAC into the controller
  - 11. Run/Stop button
- C. Automatic Light and Fan shut down: The control system shall evaluate the system activity and automatically turn off the cab lighting and ventilation fan during periods of inactivity. The settings shall be field programmable.
- D. Special Operation: Limited Access Operation: A key switch shall be provided to initiate the Limited Access Operation. The activation of this operation shall restrict the operation of the elevator car calls to selected floors on a per-floor, per elevator basis. Travel to the restricted floors shall be allowed after the entry of the required access code via a card reader device supplied by others. The card reader entry shall override the car call restrictions and allow entry of a car call to a restricted floor.
- E. Emergency Power Operation: (Battery Lowering 10-DOC) When the loss of normal power is detected, a battery lowering feature is to be activated. The elevator will lower to a predetermined level and open the doors. After passengers have exited the car, the doors will close and the car will shutdown. When normal power becomes available, the elevator will automatically resume operation. The battery lowering feature is included in the elevator contract and does not utilize a building-supplied standby power source.

## 2.10 HALL STATIONS

- A. Hall Stations, General: Provide buttons with red-illuminating LED halos to indicate that a call has been registered at that floor for the indicated direction. Provide 1 set of pushbutton risers.  
Provide one pushbutton riser with faceplates having a brushed stainless steel finish.
  - 1. Phase 1 firefighter's service key switch, with instructions, shall be incorporated into the hall station at the designated level.
  - 2. Provide ON/OFF key switch for Owner operation on first floor station.
- B. Floor Identification Pads: Provide door jamb pads at each floor. Jamb pads shall comply with Americans with Disabilities Act (ADA) requirements.
- C. Hall Position Indicator: An electronic dot matrix position indicator shall be provided and mounted for optimum viewing. As the car travels, its position in the hoistway shall be indicated by the illumination of the alphanumeric character corresponding to the landing



which the elevator is stopped or passing. When hall lanterns are provided, the position indicator shall be combined with the hall lanterns in the same faceplate. Faceplates shall match hall stations. Provide at all typical landings.

- D. Hall lanterns: Not Applicable
- E. Special Equipment: Not Applicable

## 2.11 MISCELLANEOUS ELEVATOR COMPONENTS

- A. Oil Hydraulic Silencer: Install multiple oil hydraulic silencers (muffler device) at the power unit location. The silencers shall contain pulsation absorbing material inserted in a blowout proof housing.
- B. Lockable three phase circuit breaker with auxiliary contact with shunt trip capability to be provided. Circuit breaker to be located behind locked panel (Group 2 security access) at controller landing entrance jamb and should be sized according to the National Electrical Code.
- C. Lockable single phase 110V circuit breaker for cab light and fan to be provided. Circuit breaker to be located behind locked panel (Group 2 security access) at controller landing entrance jamb should be sized according to the National Electrical Code.
- D. Elevator Phone Cellular Interface: Provide cellular interface equal to Rath Microtech Series 2100 for GSM cellular technology. Confirm cellular carrier with Owner. Sim card and Voice Only plan will be provided by the Owner.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Before starting elevator installation, inspect hoistway, hoistway openings, pits and control space, as constructed and verify all critical dimensions, and examine supporting structures and all other conditions under which elevator work is to be installed. Do not proceed with elevator installation until unsatisfactory conditions have been corrected in a manner acceptable to the installer.
- B. Installation constitutes acceptance of existing conditions and responsibility for satisfactory performance.

### 3.02 INSTALLATION

- A. Install elevator systems components and coordinate installation of hoistway wall construction.
  - 1. Work shall be performed by competent elevator installation personnel in accordance with ASME A17.1, manufacturer's installation instructions and approved shop drawings.
  - 2. Comply with the National Electrical Code for electrical work required during installation.
- C. Coordination: Coordinate elevator work with the work of other trades, for proper time and sequence to avoid construction delays. Use benchmarks, lines, and levels designated by the Contractor, to ensure dimensional coordination of the work.
- D. Alignment: Coordinate installation of hoistway entrances with installation of elevator guide rails for accurate alignment of entrances with cars. Where possible, delay final adjustment of sills and doors until car is operable in shaft. Reduce clearances to minimum safe, workable dimensions at each landing.
- E. Lubricate operating parts of system where recommended by manufacturer.

### 3.03 FIELD QUALITY CONTROL

- A. Acceptance testing: Upon completion of the elevator installation and before permitting use of elevator, perform acceptance tests as required by A17.1 Code and local authorities having jurisdiction. Perform other tests, if any, as required by governing regulations or agencies.
- B. Advise Owner, Contractor, Architect, and governing authorities in advance of dates and times tests are to be performed on the elevator.

### 3.04 ADJUSTING

- A. Make necessary adjustments of operating devices and equipment to ensure elevator operates smoothly and accurately.

### 3.05 CLEANING

- A. Before final acceptance, remove protection from finished surfaces and clean and polish surfaces in accordance with manufacturer's recommendations for type of material and finish provided. Stainless stall shall be cleaned with soap and water and dried with a non-abrasive surface; shall not be cleaned with bleached-based cleansers.
- B. At completion of elevator work, remove tools, equipment, and surplus materials from site. Clean equipment rooms and hoistway. Remove trash and debris.
  - 1. Use environmentally preferable and low VOC emitting cleaners for each application type. Cleaners that contain solvents, pine and/or citrus oils are not permitted.

### 3.06 PROTECTION

- A. At time of Substantial Completion of elevator work, or portion thereof, provide suitable protective coverings, barriers, devices, signs, or other such methods or procedures to protect elevator work from damage or deterioration. Maintain protective measures throughout remainder of construction period.

### 3.07 DEMONSTRATION

- A. Instruct Owner's personnel in proper use, operations, and daily maintenance of elevators. Review emergency provisions, including emergency access and procedures to be followed at time of failure in operation and other building emergencies. Train Owner's personnel in normal procedures to be followed in checking for sources of operational failures or malfunctions.
- B. Make a final check of each elevator operation, with Owner's personnel present, immediately before date of substantial completion. Determine that control systems and operating devices are functioning properly.

### 3.08 ELEVATOR SCHEDULE

- A. Elevator Qty. 1
  - 1. Elevator Model: Thyssen Krupp endura MRL
  - 2. Rated Capacity: 2100 lbs.
  - 3. Rated Speed: 100 ft./min.
  - 4. HP: 20
  - 5. Travel: 14'-6"
  - 6. Landings: 2 total
  - 7. Openings:
    - a. Front: 2
    - b. Rear: 0
  - 8. Clear Car Inside: 5' - 8" wide x 4' - 3" deep

9. Cab Height: 7'-9"
10. Floor Recess: 5/16"
11. Hoistway Entrance Size: 3' - 0" wide x 7'-0" high
12. Door Type: Single Speed
13. Power Characteristics: 460 volts, 3 Phase, 60 Hz.
14. Seismic Requirements: Zone 1
15. Fixture & Button Style: Brushed Stainless, Mounted in Jamb, flat, Button with illuminated Halo.
16. Special Operations: Limited Access with card readers by others.

END OF SECTION

## SECTION 210517 - SLEEVES AND SLEEVE SEALS FOR FIRE-SUPPRESSION 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. Sleeves.
  - 2. Stack-sleeve fittings.
  - 3. Sleeve-seal systems.
  - 4. Sleeve-seal fittings.
  - 5. Grout.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

### PART 2 - PRODUCTS

#### 2.1 SLEEVES

- A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.
- C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.
- D. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

#### 2.2 STACK-SLEEVE FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Smith, Jay R. Mfg. Co.
  - 2. Zurn Industries, LLC.

## SECTION 210517 - SLEEVES AND SLEEVE SEALS FOR FIRE-SUPPRESSION PIPING

- B. Description: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring, bolts, and nuts for membrane flashing.
  - 1. Underdeck Clamp: Clamping ring with setscrews.

### 2.3 SLEEVE-SEAL SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. [Advance Products & Systems, Inc.](#)
  - 2. [CALPICO, Inc.](#)
  - 3. [Metraflex Company \(The\).](#)
  - 4. [Pipeline Seal and Insulator, Inc.](#)
  - 5. [Proco Products, Inc.](#)
- B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
  - 1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
  - 2. Pressure Plates: Carbon steel.
  - 3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

### 2.4 SLEEVE-SEAL FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - 1. [HOLDRITE.](#)
- B. Description: Manufactured plastic, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall. Unit has plastic or rubber waterstop collar with center opening to match piping OD.

### 2.5 GROUT

- A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Nonshrink; recommended for interior and exterior applications.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

## SECTION 210517 - SLEEVES AND SLEEVE SEALS FOR FIRE-SUPPRESSION PIPING

### PART 3 - EXECUTION

#### 3.1 SLEEVE INSTALLATION

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.
  - 1. Sleeves are not required for core-drilled holes.
- C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
  - 1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
  - 2. Cut sleeves to length for mounting flush with both surfaces.
    - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
  - 3. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.
- D. Install sleeves for pipes passing through interior partitions.
  - 1. Cut sleeves to length for mounting flush with both surfaces.
  - 2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
  - 3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Section 079200 "Joint Sealants."
- E. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

#### 3.2 STACK-SLEEVE-FITTING INSTALLATION

- A. Install stack-sleeve fittings in new slabs as slabs are constructed.
  - 1. Install fittings that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
  - 2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Section 076200 "Sheet Metal Flashing and Trim."
  - 3. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level.
  - 4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.

## SECTION 210517 - SLEEVES AND SLEEVE SEALS FOR FIRE-SUPPRESSION PIPING

5. Using grout, seal the space around outside of stack-sleeve fittings.

B. Fire-Barrier Penetrations: Maintain indicated fire rating of floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

### 3.3 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.

B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

### 3.4 SLEEVE-SEAL-FITTING INSTALLATION

A. Install sleeve-seal fittings in new walls and slabs as they are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.

C. Secure nailing flanges to concrete forms.

D. Using grout, seal the space around outside of sleeve-seal fittings.

### 3.5 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Exterior Concrete Walls above Grade: Cast-iron wall sleeves.

2. Exterior Concrete Walls below Grade: Cast-iron wall sleeves with sleeve-seal system.

a. Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

3. Concrete Slabs-on-Grade: Cast-iron wall sleeves with sleeve-seal system.

a. Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

4. Concrete Slabs above Grade: Galvanized-steel-pipe sleeves

5. Interior Partitions: Galvanized-steel-pipe sleeves

END OF SECTION 210517

## SECTION 210518 - ESCUTCHEONS FOR FIRE-SUPPRESSION 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. Escutcheons.
  - 2. Floor plates.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

### PART 2 - PRODUCTS

#### 2.1 ESCUTCHEONS

- A. One-Piece, Cast-Brass Type: With polished, chrome-plated and rough-brass finish and setscrew fastener.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.
- C. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.
- D. Split-Casting Brass Type: With polished, chrome-plated and rough-brass finish and with concealed hinge and setscrew.

#### 2.2 FLOOR PLATES

- A. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.
- B. Split-Casting Floor Plates: Cast brass with concealed hinge.



## SECTION 210518 - ESCUTCHEONS FOR FIRE-SUPPRESSION PIPING

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
- B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
  - 1. Escutcheons for New Piping:
    - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
    - b. Insulated Piping: One-piece, stamped-steel type.
    - c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
    - d. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
    - e. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with rough-brass finish.
    - f. Bare Piping in Equipment Rooms: One-piece, cast-brass type with rough-brass finish.
- C. Install floor plates for piping penetrations of equipment-room floors.
- D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
  - 1. New Piping: One-piece, floor-plate type.
  - 2. Existing Piping: Split-casting, floor-plate type.

#### 3.2 FIELD QUALITY CONTROL

- A. Replace broken and damaged escutcheons and floor plates using new materials.

END OF SECTION 210518

## SECTION 211313 - WET-PIPE SPRINKLER SYSTEMS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

##### A. Section Includes:

1. Pipes, fittings, and specialties.
2. Cover system for sprinkler piping.
3. Specialty valves.
4. Sprinklers.
5. Alarm devices.
6. Manual control stations.
7. Control panels.
8. Pressure gages.

- B. Verify fire line flow and pressure test data with Civil Engineer. If available flow and pressure are not adequate, provide a fire pump as required.

##### C. Related Requirements:

1. Section 211119 "Fire Department Connections" for exposed-, flush-, and yard-type fire department connections.

#### 1.3 DEFINITIONS

- A. Standard Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure higher than standard 175 psig.

#### 1.4 ACTION SUBMITTALS

##### A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

##### B. Shop Drawings: For wet-pipe sprinkler systems.

1. Include plans, elevations, sections, and attachment details.
2. Include diagrams for power, signal, and control wiring.

## SECTION 211313 - WET-PIPE SPRINKLER SYSTEMS

- C. Delegated-Design Submittal: For wet-pipe sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

### 1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Sprinkler systems, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  - 1. Domestic water piping.
  - 2. Compressed air piping.
  - 3. HVAC hydronic piping.
  - 4. Ductwork.
  - 5. Plumbing systems.
  - 6. Items penetrating finished ceiling include the following:
    - a. Lighting fixtures.
    - b. Air outlets and inlets.
- B. Qualification Data: For qualified Installer and professional engineer.
- C. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.
- D. Welding certificates.
- E. Fire-hydrant flow test report.
- F. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."
- G. Field quality-control reports.

### 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For wet-pipe sprinkler systems and specialties to include in emergency, operation, and maintenance manuals.

### 1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler used on Project.

## SECTION 211313 - WET-PIPE SPRINKLER SYSTEMS

### 1.8 QUALITY ASSURANCE

#### A. Installer Qualifications:

1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.
  - a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional certified at NICET Level 3 or higher.

#### B. Welding Qualifications: Qualify procedures and operators according to 2010 ASME Boiler and Pressure Vessel Code.

### 1.9 FIELD CONDITIONS

#### A. Interruption of Existing Sprinkler Service: Do not interrupt sprinkler service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary sprinkler service according to requirements indicated:

1. Notify Architect no fewer than 7 days in advance of proposed interruption of sprinkler service.
2. Do not proceed with interruption of sprinkler service without Architect's written permission.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

#### A. Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:

1. NFPA 13.
2. NFPA 13R.

#### B. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.

#### C. Delegated Design: Engage a qualified professional, as defined in Section 014000 "Quality Requirements," to design wet-pipe sprinkler systems.

1. Coordinate fire-hydrant flow test records with Architect and Civil Engineer.
2. Sprinkler system design shall be approved by authorities having jurisdiction.
  - a. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.
  - b. Sprinkler Occupancy Hazard Classifications:
    - 1) Building Service Areas: Ordinary Hazard, Group 1.
    - 2) Electrical Equipment Rooms: Ordinary Hazard, Group 1.

## SECTION 211313 - WET-PIPE SPRINKLER SYSTEMS

- 3) General Storage Areas: Ordinary Hazard, Group 1.
  - 4) Libraries except Stack Areas: Light Hazard.
  - 5) Library Stack Areas: Ordinary Hazard, Group 2.
  - 6) Mechanical Equipment Rooms: Ordinary Hazard, Group 1.
  - 7) Office and Public Areas: Light Hazard.
  - 8) Classrooms: Light Hazard.
3. Minimum Density for Automatic-Sprinkler Piping Design:
    - a. Light-Hazard Occupancy: 0.10 gpm over 1500-sq. ft. area.
    - b. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft. area.
    - c. Ordinary-Hazard, Group 2 Occupancy: 0.20 gpm over 1500-sq. ft. area.
    - d. Special Occupancy Hazard: As determined by authorities having jurisdiction.
  4. Maximum Protection Area per Sprinkler: According to UL listing.
  5. Maximum Protection Area per Sprinkler:
    - a. Office Spaces: 120 sq. ft.
    - b. Storage Areas: 130 sq. ft.
    - c. Mechanical Equipment Rooms: 130 sq. ft.
    - d. Electrical Equipment Rooms: 130 sq. ft.
    - e. Other Areas: According to NFPA 13 recommendations unless otherwise indicated.
  6. Total Combined Hose-Stream Demand Requirement: According to NFPA 13 unless otherwise indicated:
    - a. Light-Hazard Occupancies: 100 gpm for 30 minutes.
    - b. Ordinary-Hazard Occupancies: 250 gpm for 60 to 90 minutes.

### 2.2 STEEL PIPE AND FITTINGS

- A. Standard-Weight, Galvanized- and Black-Steel Pipe: ASTM A 53/A 53M, Type E, Grade B. Pipe ends may be factory or field formed to match joining method.
- B. Schedule 30, Galvanized- and Black-Steel Pipe: ASTM A 135/A 135M; ASTM A 795/A 795M, Type E; or ASME B36.10M wrought steel, with wall thickness not less than Schedule 30 and not more than Schedule 40. Pipe ends may be factory or field formed to match joining method.
- C. Galvanized- and Black-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, standard-weight, seamless steel pipe with threaded ends.
- D. Galvanized- and Uncoated-Steel Couplings: ASTM A 865/A 865M, threaded.
- E. Malleable- or Ductile-Iron Unions: UL 860.
- F. Cast-Iron Flanges: ASME 16.1, Class 125.
- G. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.
- H. Steel Welding Fittings: ASTM A 234/A 234M and ASME B16.9.
  1. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

## SECTION 211313 - WET-PIPE SPRINKLER SYSTEMS

### I. Grooved-Joint, Steel-Pipe Appurtenances:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Anvil International.
    - b. Corcoran Piping System Co.
    - c. Shurjoint Piping Products.
    - d. Tyco Fire & Building Products LP.
    - e. Victaulic Company.
  2. Pressure Rating: 175-psig minimum.
  3. Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting, with dimensions matching steel pipe.
  4. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213 rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.
- J. Steel Pressure-Seal Fittings: UL 213, FM Global-approved, 175-psig pressure rating with steel housing, rubber O-rings, and pipe stop; for use with fitting manufacturers' pressure-seal tools.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - a. Victaulic Company.

### 2.3 PIPING JOINING MATERIALS

- A. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- B. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.
- C. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

### 2.4 LISTED FIRE-PROTECTION VALVES

#### A. General Requirements:

1. Valves shall be UL listed or FM approved.
2. Minimum Pressure Rating for Standard-Pressure Piping: 175 psig.

#### B. Ball Valves:

1. Manufacturers:
  - a. Anvil International, Inc.
  - b. Victaulic Company.

## SECTION 211313 - WET-PIPE SPRINKLER SYSTEMS

2. Standard: UL 1091 except with ball instead of disc.
  3. Valves NPS 1-1/2 and Smaller: Bronze body with threaded ends.
  4. Valves NPS 2 and NPS 2-1/2: Bronze body with threaded ends or ductile-iron body with grooved ends.
  5. Valves NPS 3: Ductile-iron body with grooved ends.
- C. Bronze Butterfly Valves:
1. Manufacturers:
    - a. Fivalco Inc.
    - b. Global Safety Products, Inc.
    - c. Milwaukee Valve Company.
  2. Standard: UL 1091.
  3. Pressure Rating: 175 psig.
  4. Body Material: Bronze.
  5. End Connections: Threaded.
- D. Iron Butterfly Valves:
1. Manufacturers:
    - a. Anvil International, Inc.
    - b. Fivalco Inc.
    - c. Global Safety Products, Inc.
    - d. Kennedy Valve; a division of McWane, Inc.
    - e. Milwaukee Valve Company.
    - f. NIBCO INC.
    - g. Pratt, Henry Company.
    - h. Shurjoint Piping Products.
    - i. Tyco Fire & Building Products LP.
    - j. Victaulic Company.
  2. Standard: UL 1091.
  3. Pressure Rating: 175 psig.
  4. Body Material: Cast or ductile iron.
  5. Style: wafer.
  6. End Connections: Grooved.
- E. Check Valves:
1. Manufacturers:
    - a. AFAC Inc.
    - b. American Cast Iron Pipe Company; Waterous Company Subsidiary.
    - c. Anvil International, Inc.
    - d. Crane Co.; Crane Valve Group; Crane Valves.
    - e. Crane Co.; Crane Valve Group; Jenkins Valves.
    - f. Crane Co.; Crane Valve Group; Stockham Division.
    - g. Fire Protection Products, Inc.
    - h. Fivalco Inc.
    - i. Globe Fire Sprinkler Corporation.
    - j. Groeniger & Company.

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- k. Kennedy Valve; a division of McWane, Inc.
  - l. Matco-Norca.
  - m. Metraflex, Inc.
  - n. Milwaukee Valve Company.
  - o. Mueller Co.; Water Products Division.
  - p. NIBCO INC.
  - q. Potter Roemer.
  - r. Reliable Automatic Sprinkler Co., Inc.
  - s. Shurjoint Piping Products.
  - t. Tyco Fire & Building Products LP.
  - u. United Brass Works, Inc.
  - v. Venus Fire Protection Ltd.
  - w. Victaulic Company.
  - x. Viking Corporation.
  - y. Watts Water Technologies, Inc.
- 2. Standard: UL 312.
  - 3. Pressure Rating: 250 psig minimum.
  - 4. Type: Swing check.
  - 5. Body Material: Cast iron.
  - 6. End Connections: Flanged or grooved.
- F. Bronze OS&Y Gate Valves:
- 1. Manufacturers:
    - a. Crane Co.; Crane Valve Group; Crane Valves.
    - b. Crane Co.; Crane Valve Group; Stockham Division.
    - c. Milwaukee Valve Company.
    - d. NIBCO INC.
    - e. United Brass Works, Inc.
  - 2. Standard: UL 262.
  - 3. Pressure Rating: 175 psig.
  - 4. Body Material: Bronze.
  - 5. End Connections: Threaded.
- G. Iron OS&Y Gate Valves:
- 1. Manufacturers:
    - a. American Cast Iron Pipe Company; Waterous Company Subsidiary.
    - b. American Valve, Inc.
    - c. Clow Valve Company; a division of McWane, Inc.
    - d. Crane Co.; Crane Valve Group; Crane Valves.
    - e. Crane Co.; Crane Valve Group; Jenkins Valves.
    - f. Crane Co.; Crane Valve Group; Stockham Division.
    - g. Hammond Valve.
    - h. Milwaukee Valve Company.
    - i. Mueller Co.; Water Products Division.
    - j. NIBCO INC.
    - k. Shurjoint Piping Products.
    - l. Tyco Fire & Building Products LP.



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- m. United Brass Works, Inc.
    - n. Watts Water Technologies, Inc.
  - 2. Standard: UL 262.
  - 3. Pressure Rating: 250 psig minimum.
  - 4. Body Material: Cast or ductile iron.
  - 5. End Connections: Flanged or grooved.
- H. Indicating-Type Butterfly Valves:
- 1. Manufacturers:
    - a. Anvil International, Inc.
    - b. Fivalco Inc.
    - c. Global Safety Products, Inc.
    - d. Kennedy Valve; a division of McWane, Inc.
    - e. Milwaukee Valve Company.
    - f. NIBCO INC.
    - g. Shurjoint Piping Products.
    - h. Tyco Fire & Building Products LP.
    - i. Victaulic Company.
  - 2. Standard: UL 1091.
  - 3. Pressure Rating: 175 psig minimum.
  - 4. Valves NPS 2 and Smaller:
    - a. Valve Type: Ball or butterfly.
    - b. Body Material: Bronze.
    - c. End Connections: Threaded.
  - 5. Valves NPS 2-1/2 and Larger:
    - a. Valve Type: Butterfly.
    - b. Body Material: Cast or ductile iron.
    - c. End Connections: Flanged, grooved, or wafer.
  - 6. Valve Operation: Integral electrical, 115-V ac, prewired, single-circuit, supervisory switch indicating device.
- I. NRS Gate Valves:
- 1. Manufacturers:
    - a. American Cast Iron Pipe Company; Waterous Company Subsidiary.
    - b. American Valve, Inc.
    - c. Clow Valve Company; a division of McWane, Inc.
    - d. Crane Co.; Crane Valve Group; Stockham Division.
    - e. Kennedy Valve; a division of McWane, Inc.
    - f. Mueller Co.; Water Products Division.
    - g. NIBCO INC.
    - h. Tyco Fire & Building Products LP.
  - 2. Standard: UL 262.

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3. Pressure Rating: 250 psig minimum
4. Body Material: Cast iron with indicator post flange.
5. Stem: Nonrising.
6. End Connections: Flanged or grooved.

### J. Indicator Posts:

1. Manufacturers:
  - a. American Cast Iron Pipe Company; Waterous Company Subsidiary.
  - b. American Valve, Inc.
  - c. Clow Valve Company; a division of McWane, Inc.
  - d. Crane Co.; Crane Valve Group; Stockham Division.
  - e. Kennedy Valve; a division of McWane, Inc.
  - f. Mueller Co.; Water Products Division.
  - g. NIBCO INC.
  - h. Tyco Fire & Building Products LP.
2. Standard: UL 789.
3. Type: Horizontal for wall mounting.
4. Body Material: Cast iron with extension rod and locking device.
5. Operation: Hand wheel.

## 2.5 TRIM AND DRAIN VALVES

### A. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating: 175 psig minimum.

## 2.6 SPECIALTY VALVES

### A. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."

### B. Pressure Rating:

1. Standard-Pressure Piping Specialty Valves: 175-psig minimum.

### C. Body Material: Cast or ductile iron.

### D. Size: Same as connected piping.

### E. End Connections: Flanged or grooved.

### F. Alarm Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Globe Fire Sprinkler Corporation.

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- b. [Reliable Automatic Sprinkler Co., Inc. \(The\)](#).
    - c. [Tyco Fire & Building Products LP](#).
    - d. [Victaulic Company](#).
  2. Standard: UL 193.
  3. Design: For horizontal or vertical installation.
  4. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gages, retarding chamber, and fill-line attachment with strainer.
  5. Drip Cup Assembly: Pipe drain without valves and separate from main drain piping.
  6. Drip Cup Assembly: Pipe drain with check valve to main drain piping.
  7. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application
- G. Automatic (Ball Drip) Drain Valves:
1. [Manufacturers](#): Subject to compliance with requirements, provide products by one of the following:
    - a. [Reliable Automatic Sprinkler Co., Inc. \(The\)](#).
    - b. [Tyco Fire & Building Products LP](#).
  2. Standard: UL 1726.
  3. Pressure Rating: 175-psig minimum.
  4. Type: Automatic draining, ball check.
  5. Size: NPS 3/4.
  6. End Connections: Threaded.

## 2.7 HOSE CONNECTIONS

- A. Manufacturers:
1. AFAC Inc.
  2. Central Sprinkler Corp.
  3. Elkhart Brass Mfg. Co., Inc.
  4. Fire-End and Croker Corp.
  5. Fire Protection Products, Inc.
  6. GMR International Equipment Corporation.
  7. Grinnell Fire Protection.
  8. Guardian Fire Equipment Incorporated.
  9. McWane, Inc.; Kennedy Valve Div.
  10. Mueller Company.
  11. Potter-Roemer; Fire-Protection Div.
  12. United Brass Works, Inc.
- B. Description: UL 668, brass or bronze, 300-psig minimum pressure rating, hose valve for connecting fire hose. Include **angle or gate** pattern design; female NPS inlet and male hose outlet; and lugged cap, gasket, and chain. Include NPS 1-1/2 or NPS 2-1/2 as indicated, and hose valve threads according to NFPA 1963 and matching local fire department threads.

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1. Valve Operation: Nonadjustable type, unless pressure-regulating type is indicated.
2. Finish: Rough chrome-plated.

### 2.8 FIRE-DEPARTMENT CONNECTIONS

#### A. Exposed-Type, Fire-Department Connection:

1. Manufacturers:
  - a. AFAC Inc.
  - b. Elkhart Brass Mfg. Company, Inc.
  - c. Fire-End & Croker Corporation.
  - d. Fire Protection Products, Inc.
  - e. GMR International Equipment Corporation.
  - f. Guardian Fire Equipment, Inc.
  - g. Tyco Fire & Building Products LP.
  - h. Wilson & Cousins Inc.
2. Standard: UL 405.
3. Type: Exposed, projecting, for wall mounting.
4. Pressure Rating: 175 psig minimum.
5. Body Material: Corrosion-resistant metal.
6. Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
7. Caps: Brass, lugged type, with gasket and chain.
8. Escutcheon Plate: Round, brass, wall type.
9. Outlet: Back, with pipe threads.
10. Escutcheon Plate Marking: Similar to "AUTO SPKR & STANDPIPE, or AUTO SPKR."
11. Finish: Rough brass or bronze.

#### B. Flush-Type, Fire-Department Connection:

1. Manufacturers:
  - a. AFAC Inc.
  - b. Elkhart Brass Mfg. Company, Inc.
  - c. GMR International Equipment Corporation.
  - d. Guardian Fire Equipment, Inc.
  - e. Potter Roemer.
2. Standard: UL 405.
3. Type: Flush, for wall mounting.
4. Pressure Rating: 175 psig minimum.
5. Body Material: Corrosion-resistant metal.
6. Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
7. Caps: Brass, lugged type, with gasket and chain.
8. Escutcheon Plate: Rectangular, brass, wall type.
9. Outlet: With pipe threads.
10. Escutcheon Plate Marking: Similar to "AUTO SPKR & STANDPIPE or AUTO SPKR."

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11. Finish: Polished chrome plated.

### C. Yard-Type, Fire-Department Connection:

1. Manufacturers:

- a. AFAC Inc.
- b. Elkhart Brass Mfg. Company, Inc.
- c. Fire-End & Croker Corporation.
- d. Fire Protection Products, Inc.
- e. GMR International Equipment Corporation.
- f. Guardian Fire Equipment, Inc.
- g. Wilson & Cousins Inc.

2. Standard: UL 405.

3. Type: Exposed, freestanding.

4. Pressure Rating: 175 psig minimum.

5. Body Material: Corrosion-resistant metal.

6. Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.

7. Caps: Brass, lugged type, with gasket and chain.

8. Escutcheon Plate: Round, brass, floor type.

9. Outlet: Bottom, with pipe threads.

10. Sleeve: Brass.

11. Sleeve Height: 18 inches.

12. Escutcheon Plate Marking: Similar to "AUTO SPKR & STANDPIPE or AUTO SPKR."

13. Finish, Including Sleeve: Rough brass or bronze.

## 2.9 SPRINKLER PIPING SPECIALTIES

### A. Branch Outlet Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Anvil International.
- b. Shurjoint Piping Products.
- c. Tyco Fire & Building Products LP.
- d. Victaulic Company.

2. Standard: UL 213.

3. Pressure Rating: 175-psig minimum.

4. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.

5. Type: Mechanical-tee and -cross fittings.

6. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.

7. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.

8. Branch Outlets: Grooved, plain-end pipe, or threaded.

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### B. Flow Detection and Test Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. AGF Manufacturing Inc.
  - b. Reliable Automatic Sprinkler Co., Inc. (The).
  - c. Tyco Fire & Building Products LP.
  - d. Victaulic Company.
2. Standard: UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
3. Pressure Rating: 175-psig minimum.
4. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.
5. Size: Same as connected piping.
6. Inlet and Outlet: Threaded or grooved.

### C. Branch Line Testers:

1. Standard: UL 199.
2. Pressure Rating: 175 psig.
3. Body Material: Brass.
4. Size: Same as connected piping.
5. Inlet: Threaded.
6. Drain Outlet: Threaded and capped.
7. Branch Outlet: Threaded, for sprinkler.

### D. Sprinkler Inspector's Test Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. AGF Manufacturing Inc.
  - b. Tyco Fire & Building Products LP.
  - c. Victaulic Company.
2. Standard: UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
3. Pressure Rating: 175-psig minimum.
4. Body Material: Cast- or ductile-iron housing with sight glass.
5. Size: Same as connected piping.
6. Inlet and Outlet: Threaded.

### E. Adjustable Drop Nipples:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - a. Corcoran Piping System Co.

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2. Standard: UL 1474.
3. Pressure Rating: 250-psig minimum.
4. Body Material: Steel pipe with EPDM-rubber O-ring seals.
5. Size: Same as connected piping.
6. Length: Adjustable.
7. Inlet and Outlet: Threaded.

### F. Flexible Sprinkler Hose Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. FlexHead Industries, Inc.
  - b. Victaulic Company.
2. Standard: UL 1474.
3. Type: Flexible hose for connection to sprinkler, and with bracket for connection to ceiling grid.
4. Pressure Rating: 175-psig minimum.
5. Size: Same as connected piping, for sprinkler.

## 2.10 SPRINKLERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Globe Fire Sprinkler Corporation.
  2. Reliable Automatic Sprinkler Co., Inc. (The).
  3. Tyco Fire & Building Products LP.
  4. Victaulic Company.
- B. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
- C. Pressure Rating for Residential Sprinklers: 175-psig maximum.
- D. Pressure Rating for Automatic Sprinklers: 175-psig minimum.
- E. Pressure Rating for High-Pressure Automatic Sprinklers: 250-psig minimum.
- F. Automatic Sprinklers with Heat-Responsive Element:
  1. Early-Suppression, Fast-Response Applications: UL 1767.
  2. Nonresidential Applications: UL 199.
  3. Residential Applications: UL 1626.
  4. Characteristics: Nominal 1/2-inch orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.
- G. Open Sprinklers with Heat-Responsive Element Removed: UL 199.

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- H. Sprinkler Finishes: Chrome plated, bronze and painted. Coordinate with Architect.
- I. Special Coatings: Wax, and corrosion-resistant paint. Coordinate with Architect.
- J. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.
  - 1. Ceiling Mounting: Chrome-plated steel, two piece, with 1-inch vertical adjustment.
  - 2. Sidewall Mounting: Chrome-plated steel, one piece, flat.
- K. Sprinkler Guards:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Reliable Automatic Sprinkler Co., Inc. (The).
    - b. Tyco Fire & Building Products LP.
    - c. Victaulic Company.
  - 2. Standard: UL 199.
  - 3. Type: Wire cage with fastening device for attaching to sprinkler.

### 2.11 ALARM DEVICES

- A. Alarm-device types shall match piping and equipment connections.
- B. Water-Motor-Operated Alarm:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Globe Fire Sprinkler Corporation.
    - b. Tyco Fire & Building Products LP.
    - c. Victaulic Company.
  - 2. Standard: UL 753.
  - 3. Type: Mechanically operated, with Pelton wheel.
  - 4. Alarm Gong: Cast aluminum with red-enamel factory finish.
  - 5. Size: 8-1/2-inches diameter.
  - 6. Components: Shaft length, bearings, and sleeve to suit wall construction.
  - 7. Inlet: NPS 3/4.
  - 8. Outlet: NPS 1 drain connection.
- C. Electrically Operated Alarm Bell:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:



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- a. [Fire-Lite Alarms, Inc.; a Honeywell International company.](#)
  - b. [Notifier.](#)
  - c. [Potter Electric Signal Company, LLC.](#)
2. Standard: UL 464.
  3. Type: Vibrating, metal alarm bell.
  4. Finish: Red-enamel factory finish, suitable for outdoor use.
  5. 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
- D. Water-Flow Indicators:
1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
    - a. [Potter Electric Signal Company, LLC.](#)
    - b. [Watts; a Watts Water Technologies company.](#)
  2. Standard: UL 346.
  3. Water-Flow Detector: Electrically supervised.
  4. Components: Two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.
  5. Type: Paddle operated.
  6. Pressure Rating: 250 psig.
  7. Design Installation: Horizontal or vertical.
- E. Pressure Switches:
1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
    - a. [Potter Electric Signal Company, LLC.](#)
    - b. [Tyco Fire & Building Products LP.](#)
  2. Standard: UL 346.
  3. Type: Electrically supervised water-flow switch with retard feature.
  4. Components: Single-pole, double-throw switch with normally closed contacts.
  5. Design Operation: Rising pressure signals water flow.
- F. Valve Supervisory Switches:
1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
    - a. [Fire-Lite Alarms, Inc.; a Honeywell International company.](#)
    - b. [Potter Electric Signal Company, LLC.](#)

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2. Standard: UL 346.
3. Type: Electrically supervised.
4. Components: Single-pole, double-throw switch with normally closed contacts.
5. Design: Signals that controlled valve is in other than fully open position.
6. 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

### 2.12 MANUAL CONTROL STATIONS

- A. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide" for hydraulic operation, with union, NPS 1/2 pipe nipple, and bronze ball valve.
- B. Include metal enclosure labeled "MANUAL CONTROL STATION," with operating instructions and cover held closed by breakable strut to prevent accidental opening.

### 2.13 CONTROL PANELS

- A. Description: Single-area, two-area, or single-area cross-zoned control panel as indicated, including NEMA ICS 6, Type 1 enclosure, detector, alarm, and solenoid-valve circuitry for operation of deluge valves.
  1. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide" when used with thermal detectors and Class A detector circuit wiring.
  2. Electrical characteristics are 120-V ac, 60 Hz, with 24-V dc rechargeable batteries.
  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
- B. Manual Control Stations: Electric operation, metal enclosure, labeled "MANUAL CONTROL STATION," with operating instructions and cover held closed by breakable strut to prevent accidental opening.
- C. Manual Control Stations: Hydraulic operation, with union, NPS 1/2 pipe nipple, and bronze ball valve. Include metal enclosure labeled "MANUAL CONTROL STATION," with operating instructions and cover held closed by breakable strut to prevent accidental opening.
- D. Panels Components:
  1. Power supply.
  2. Battery charger.
  3. Standby batteries.
  4. Field-wiring terminal strip.
  5. Electrically supervised solenoid valves and polarized fire-alarm bell.
  6. Lamp test facility.
  7. Single-pole, double-throw auxiliary alarm contacts.
  8. Rectifier.

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### 2.14 PRESSURE GAGES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. AGF Manufacturing Inc.
  - 2. AMETEK, Inc.
  - 3. Ashcroft Inc.
- B. Standard: UL 393.
- C. Dial Size: 3-1/2- to 4-1/2-inch diameter.
- D. Pressure Gage Range: 0- to 250-psig minimum.
- E. Label: Include "WATER" label on dial face.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.
- B. Report test results promptly and in writing.

### 3.2 SERVICE-ENTRANCE PIPING

- A. Connect sprinkler piping to water-service piping for service entrance to building. Comply with requirements for exterior piping in Section 211100 "Facility Fire-Suppression Water-Service Piping" for exterior piping.
- B. Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories indicated at connection to water-service piping. Comply with requirements for backflow preventers in Section 211100 "Facility Fire-Suppression Water-Service Piping." Coordinate with Civil Engineer.
- C. Install shutoff valve, check valve, pressure gage, and drain at connection to water service.

### 3.3 WATER-SUPPLY CONNECTIONS

- A. Connect sprinkler piping to building's interior water-distribution piping. Comply with requirements for interior piping in Section 221116 "Domestic Water Piping."
- B. Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories indicated at connection to water-distribution piping. Comply with requirements for backflow preventers in Section 221119 "Domestic Water Piping Specialties."

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- C. Install shutoff valve, check valve, pressure gage, and drain at connection to water supply.

### 3.4 PIPING INSTALLATION

- A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated on approved working plans.
  - 1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.
  - 2. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.
- B. Piping Standard: Comply with NFPA 13 requirements for installation of sprinkler piping.
- C. Install seismic restraints on piping. Comply with NFPA 13 requirements for seismic-restraint device materials and installation.
- D. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- E. Install unions adjacent to each valve in pipes NPS 2 and smaller.
- F. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
- G. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.
- H. Install sprinkler piping with drains for complete system drainage.
- I. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.
- J. Install automatic (ball drip) drain valve at each check valve for fire-department connection, to drain piping between fire-department connection and check valve. Install drain piping to and spill over floor drain or to outside building.
- K. Install alarm devices in piping systems.
- L. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13. In seismic-rated areas, refer to Section 210548 "Vibration and Seismic Controls for Fire-Suppression Piping and Equipment."
- M. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 and with soft-metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they are not subject to freezing.
- N. Fill sprinkler system piping with water.

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- O. Install electric heating cables and pipe insulation on sprinkler piping in areas subject to freezing.
- P. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 210517 "Sleeves and Sleeve Seals for Fire-Suppression Piping."
- Q. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 210517 "Sleeves and Sleeve Seals for Fire-Suppression Piping."
- R. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 210518 "Escutcheons for Fire-Suppression Piping."

### 3.5 JOINT CONSTRUCTION

- A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.
- B. Install unions adjacent to each valve in pipes NPS 2 and smaller.
- C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
- D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.
- 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.
  - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- H. Twist-Locked Joints: Insert plain end of steel pipe into plain-end-pipe fitting. Rotate retainer lugs one-quarter turn or tighten retainer pin.
- I. Steel-Piping, Pressure-Sealed Joints: Join lightwall steel pipe and steel pressure-seal fittings with tools recommended by fitting manufacturer.
- J. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.
  - 1. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.

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- K. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.
- L. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.
- M. Steel-Piping, Pressure-Sealed Joints: Join Schedule 5 steel pipe and steel pressure-seal fittings with tools recommended by fitting manufacturer.
- N. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" Chapter.
- O. Extruded-Tee Connections: Form tee in copper tube according to ASTM F 2014. Use tool designed for copper tube; drill pilot hole, form collar for outlet, dimple tube to form seating stop, and braze branch tube into collar.
- P. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.
  - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements. Apply primer.
  - 2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.

### 3.6 INSTALLATION OF COVER SYSTEM FOR SPRINKLER PIPING

- A. Install cover system, brackets, and cover components for sprinkler piping according to manufacturer's "Installation Manual" and NFPA 13 or NFPA 13R for supports.

### 3.7 VALVE AND SPECIALTIES INSTALLATION

- A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.
- B. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.
- C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.
- D. Specialty Valves:
  - 1. Install valves in vertical position for proper direction of flow, in main supply to system.
  - 2. Install alarm valves with bypass check valve and retarding chamber drain-line connection.

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### 3.8 SPRINKLER INSTALLATION

- A. Install sprinklers in suspended ceilings in center of acoustical ceiling panels.
- B. Install sprinklers into flexible, sprinkler hose fittings, and install hose into bracket on ceiling grid.

### 3.9 FIRE-DEPARTMENT CONNECTION INSTALLATION

- A. Coordinate with AHJ and Civil Engineer to coordinate FDC type.
- B. Install wall-type, fire-department connections.
- C. Install freestanding, yard-type, fire-department connections in concrete slab support. Comply with requirements for concrete in Division 03 Section "Cast-in-Place Concrete."
  - 1. Install protective pipe bollards around each fire-department connection. Comply with requirements for bollards in Division 05 Section "Metal Fabrications."
- D. Install automatic (ball drip) drain valve at each check valve for fire-department connection.

### 3.10 IDENTIFICATION

- A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.
- B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

### 3.11 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
  - 1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
  - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
  - 3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
  - 4. Energize circuits to electrical equipment and devices.
  - 5. Coordinate with fire-alarm tests. Operate as required.
  - 6. Coordinate with fire-pump tests. Operate as required.
  - 7. Verify that equipment hose threads are same as local fire department equipment.
- B. Sprinkler piping system will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

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### 3.12 CLEANING

- A. Clean dirt and debris from sprinklers.
- B. Only sprinklers with their original factory finish are acceptable. Remove and replace any sprinklers that are painted or have any other finish than their original factory finish.

### 3.13 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain specialty valves and pressure-maintenance pumps.

### 3.14 PIPING SCHEDULE

- A. Piping between Fire Department Connections and Check Valves: Galvanized, standard-weight steel pipe with threaded ends, cast-iron threaded fittings, and threaded grooved ends, grooved-end fittings, grooved-end-pipe couplings, and grooved joints.
- B. Sprinkler specialty fittings may be used, downstream of control valves, instead of specified fittings.
- C. Standard-pressure, wet-pipe sprinkler system shall be the following:
  - 1. NPS 2" and smaller: Standard-weight, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
  - 2. NPS 2-1/2 and larger: Standard-weight, black-steel pipe with grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
- D. Paint exposed piping. Coordinate with Architect.

### 3.15 SPRINKLER SCHEDULE

- A. Use sprinkler types in subparagraphs below for the following applications:
  - 1. Rooms without Ceilings: Upright sprinklers.
  - 2. Rooms with Suspended Ceilings: Recessed sprinklers.
  - 3. Wall Mounting: Sidewall sprinklers.
  - 4. Spaces Subject to Freezing: Upright, pendent, dry sprinklers; and sidewall, dry sprinklers as indicated. Coordinate with Architect.
  - 5. Special Applications: Extended-coverage, flow-control, and quick-response sprinklers where indicated.
- B. Provide sprinkler types in subparagraphs below with finishes indicated.
  - 1. Concealed Sprinklers: Rough brass, with factory-painted white cover plate.
  - 2. Flush Sprinklers: Bright chrome, with painted white escutcheon.
  - 3. Recessed Sprinklers: Bright chrome, with bright chrome escutcheon.
  - 4. Residential Sprinklers: Dull chrome.



## SECTION 211313 - WET-PIPE SPRINKLER SYSTEMS

5. Upright Pendent and Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes.
- C. Match finishes and paint colors with architectural elements. Request Architect for final approval on finishes

END OF SECTION 211313

## SECTION 220010 – SUMMARY OF PLUMBING WORK

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 22 Specification Sections, apply to this Section.

#### 1.2 WORK COVERED BY CONTRACT DOCUMENTS

- A. The following Summary of Work is intended as an aid to achieve an understanding of the various elements of work included in the project, and is not intended to be all-inclusive. Detailed descriptions of work and requirements are given in drawings and specifications.
- B. Contract Documents were prepared for the Project by:
  - Ethos Engineering,
  - 1126 South Commerce
  - Harlingen, Texas 78550
  - Phone Number: (956) 230-3435
- C. Scope of Work: Refer to drawings for a detailed Scope of Work.
  - 1. Provide all materials and labor associated with new fully-operational plumbing systems for the project “[UTRGV/HCISD Early College High School](#)”, including but not limited to the following:
    - a. Plumbing fixtures and appliances such as water closets, lavatories, faucets, drinking fountains, instantaneous and storage type electric domestic water heaters, floor drains, valves, fittings, hardware and specialties.
    - b. Potable water distribution piping and service connections to site utilities.
    - c. Sanitary wastewater and vent piping and service line connections to site utilities.
    - d. Storm water piping and service line connections to site utilities.
    - e. Compressed air system, including air compressor and piping.
    - f. Domestic water booster pump.
    - g. Water softener for the whole building, and Reverse Osmosis (RO) System, and De-Ionized (DI) Water systems for biology and chemistry labs. See drawings.
    - h. Painting: See Division 9 specifications. Paint all exposed piping, insulation, hangers, accessories in interior exposed areas. Paint exterior pipe supports. Coordinate paint type, color and scope of work with Architect.

#### 1.3 ALLOWANCES

- A. See Division 0 Specifications.

## SECTION 220010 – SUMMARY OF PLUMBING WORK

### 1.4 COORDINATION

- A. All plumbing work shall be done under sub-contract to a General Contractor. Plumbing Contractor shall coordinate all work through General Contractor, who is ultimately responsible for the entire project.
- B. Prior to bidding, Plumbing Contractor shall coordinate all work in Division-22 for integration with civil work, mechanical work, electrical work, irrigation work and general construction. A detailed list of inclusion and exclusions shall be provided to General Contractors at least three days prior to the end of the period set aside to request clarifications so that coordination of any missing items may be addressed and clarified by Architect/Engineer as needed.
  - 1. Coordinate water line diameter, tap size, meter size and backflow preventer size with MEP Engineer. While meter size may be smaller, water line diameter, tap, backflow preventer sizes shall match or be larger than the connection sizes shown on Plumbing drawings. If the distance from the water mains is too large, contact Civil Engineer and MEP Engineer for assistance in upsizing line, valve sizes to minimize pressure drops. Coordinate details with Engineer.
- C. All electrical work required for operation of plumbing systems shall be coordinated through the General Contractor prior to bidding to ensure that all starters, disconnects, conduit and wiring are provided as part of the project. All components needed for a full operational installation of systems shall be provided.
- D. All Building Automation Systems (BAS) required for operation of plumbing systems shall be coordinated through the General Contractor prior to bidding, to ensure that all equipment, materials, valves, sensors, devices and labor are provided as part of the project. All components needed for a full operational installation of systems shall be provided.
- E. Plumbing Contractor shall coordinate and supervise installation of all controls systems, and coordinate with electrical contractors and equipment suppliers as needed. All components needed for a full operational installation of systems shall be provided.
- F. Contractor shall coordinate with other divisions for power and control of plumbing systems. It is not the intent of this specification to dictate who will conduct work, only to state the requirements of conducting the work.
- G. Cooperate fully with other contractors so that work under those contracts may be carried out smoothly, without interfering with or delaying work under this Contract.
- H. Coordinate with Div. 1 for work sequence and optimization of construction schedule.
- I. Coordinate with Div. 21 for Fire Suppression System.
- J. Coordinate with Div. 23 for Mechanical System.
- K. Coordinate with Div. 26 electrical contractor for providing power to plumbing equipment, and for Fire Alarm Systems interface with plumbing systems.
- L. Issue written notification of the following tasks and allow five (5) days for Engineer to respond and schedule an inspection as required. Failure to issue written notification may result in work having to be redone to allow for proper inspection. It is contractor's responsibility to make sure Engineer receives notification.

## SECTION 220010 – SUMMARY OF PLUMBING WORK

1. Upon completion of underground piping installation and prior to testing or covering up.
2. Upon completion of all water piping installation and prior to insulation and/or testing.
3. Upon completion of ductwork and prior to testing and insulating.
4. Above ceiling inspections prior to ceiling tile installation.
5. When ready to request manufacturer's start-up of each piece of equipment.
6. When ready for Substantial Completion Inspection.
7. When ready for Final Inspection.

### M. General

1. The Contractor shall execute all work hereinafter specified or indicated on accompanying Drawings. Contractor shall provide all equipment necessary and usually furnished in connection with such work and systems whether or not mentioned specifically herein or on the Drawings.
2. The Contractor shall be responsible for fitting his material and apparatus into the building and shall carefully lay out his work at the site to conform to the structural conditions, to avoid all obstructions, to conform to the details of the installation and thereby to provide an integrated satisfactory operating installation.
3. The Mechanical, Electrical, Plumbing, and associated Drawings are necessarily diagrammatic by their nature, and are not intended to show every connection in detail or every pipe or conduit in its exact location. These details are subject to the requirements of standards referenced elsewhere in these specifications, and 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 organized and 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. All exposed work shall be installed parallel or perpendicular to the lines of the building unless otherwise noted.
4. When the mechanical, electrical and plumbing 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 proper grades for the functioning of the system involved. Piping, exposed conduit and the duct systems 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, control lines, pilot lines and other location details. Work shall be concealed in all finished areas.

## 1.5 WORK SEQUENCE

### A. Locate Utilities:

1. Coordinate with power, water, sewer, telephone, communications, and other utilities as well as designated Owner's personnel to locate all utilities prior to digging in any area.
2. Obtain any approvals required from utilities to relocate utilities.
3. Cost of relocating or bypassing utilities indicated on drawings shall be included in Base Bid.

### B. Coordinate with Division 1 requirements to optimize construction schedule.

### C. Provide equipment and material submittals, coordination drawings and shop drawings as required by specifications.

## SECTION 220010 – SUMMARY OF PLUMBING WORK

- D. Submit detailed plumbing Schedule of Values with Submittals. Plumbing Submittals will not be accepted without a detailed Schedule of Values.
- E. Sequence construction in coordination with work by other disciplines.

### 1.6 CONTRACTOR USE OF PREMISES

- A. Use of the Site: Limit use of the premises to work in areas indicated. Confine operations to areas within contract limits indicated. Do not disturb portions of the site beyond the areas in which the Work is indicated.
  - 1. Driveways and Entrances: Keep driveways and entrances to construction site clear and available to other Contractors, Owner, and A/E personnel at all times. Do not use these areas for parking or storage of materials. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.
- B. Site Safety: Take every precaution to ensure the site does not present a threat to the safety of occupants and/or workers. Minimal safety requirements include, but are not limited to the following:
  - 1. Temporary fencing around construction areas.
  - 2. Yellow caution tape and construction barricades along open trenches during the day. Trenches shall be covered at night and warning lights provided on construction barricades.
  - 3. Temporary fencing around equipment while site work is in progress.

### 1.7 SUBMITTALS

- A. Manufacturer's standard dimensioned drawings, performance and product data shall be edited to delete reference to equipment, features, or information which is not applicable to the equipment being supplied for this project.
- B. Provide all plumbing submittals at the same time in one or multiple bound volumes. Include originals from manufacturer. **All submittals shall be in native pdf and searchable format.** Faxes and copies of faxes are not acceptable.
- C. Provide sufficient copies of approved data, with the engineer's approved stamp, for inclusion in the operations and maintenance manuals.
- D. Provide detailed coordination drawings showing how plumbing system components will be installed in coordination with work by others. Engineer's drawing files will be made available to Contractor for producing coordination and as-built drawings upon request.

### 1.8 SCHEDULE OF VALUES -Special Requirements

- A. Plumbing Contractor shall submit a Schedule of Values reflecting the total value of Plumbing Work in the Contract, and broken down into the following items as a minimum, with a line-item for Materials/Equipment and another for Labor:
  - 1. Plumbing fixtures and equipment

## SECTION 220010 – SUMMARY OF PLUMBING WORK

2. Plumbing materials
3. Plumbing labor
4. Allowances.
5. Miscellaneous
6. Administrative and project management.

- B. Schedule of Values shall be included with bound submittals. Submittals without a Schedule of Values shall not be reviewed.

### 1.9 EQUIPMENT MANUFACTURERS

- A. Plumbing design is based on equipment and materials scheduled and specified. These are used as the basis for performance characteristics, quality, and physical dimensions/weight.
- B. Equipment and materials by other APPROVED manufacturers may be provided by Contractor. In doing so, Contractor assumes responsibility for the performance, quality, and physical dimensions of the proposed units.
- C. Any costs associated with modifications to the design due to submittal of equipment and/or materials other than those used as the basis of design are the Contractor's responsibility. This includes any design time, production of drawings, and time delays.
- D. Where use of equipment and/or materials other than those used as the basis of design impact other disciplines, Contractor shall assume responsibility for all costs associated with any APPROVED modifications. This may include resizing of electrical circuits, modifying openings in the structure, relocating floor drains, etc.

### 1.10 OPERATIONS AND MAINTENANCE MANUALS & TRAINING

- A. Submit Operations and Maintenance Manuals two weeks prior to Substantial Completion Inspection. Engineer will not conduct a Substantial Completion Inspection without having reviewed Operations and Maintenance Manuals.
- B. Use Operations and Maintenance Manuals as a guide for conducting training of Owner's personnel.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 220010

## SECTION 220517 - SLEEVES AND SLEEVE SEALS 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. Sleeves.
  - 2. Stack-sleeve fittings.
  - 3. Sleeve-seal systems.
  - 4. Sleeve-seal fittings.
  - 5. Grout.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

### PART 2 - PRODUCTS

#### 2.1 SLEEVES

- A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.
- C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.
- D. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

#### 2.2 STACK-SLEEVE FITTINGS

- A. Manufacturers:
  - 1. Smith, Jay R. Mfg. Co.
  - 2. Zurn Specification Drainage Operation; Zurn Plumbing Products Group.

## SECTION 220517 - SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

- B. Description: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring, bolts, and nuts for membrane flashing.
  - 1. Underdeck Clamp: Clamping ring with setscrews.

### 2.3 SLEEVE-SEAL SYSTEMS

- A. Manufacturers:
  - 1. Advance Products & Systems, Inc.
  - 2. CALPICO, Inc.
  - 3. Metraflex Company (The).
  - 4. Pipeline Seal and Insulator, Inc.
  - 5. Proco Products, Inc.
- B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
  - 1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
  - 2. Pressure Plates: Carbon steel.
  - 3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating of length required to secure pressure plates to sealing elements.

### 2.4 SLEEVE-SEAL FITTINGS

- A. Manufacturers:
  - 1. Presealed Systems.
- B. Description: Manufactured plastic, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall. Unit has plastic or rubber waterstop collar with center opening to match piping OD.

### 2.5 GROUT

- A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Nonshrink; recommended for interior and exterior applications.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.



## SECTION 220517 - SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

### PART 3 - EXECUTION

#### 3.1 SLEEVE INSTALLATION

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.
  - 1. Sleeves are not required for core-drilled holes.
- C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
  - 1. Cut sleeves to length for mounting flush with both surfaces.
    - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
  - 2. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.
- D. Install sleeves for pipes passing through interior partitions.
  - 1. Cut sleeves to length for mounting flush with both surfaces.
  - 2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
  - 3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Section 079200 "Joint Sealants."
- E. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

#### 3.2 STACK-SLEEVE-FITTING INSTALLATION

- A. Install stack-sleeve fittings in new slabs as slabs are constructed.
  - 1. Install fittings that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
  - 2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Section 076200 "Sheet Metal Flashing and Trim."
  - 3. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level.
  - 4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
  - 5. Using grout, seal the space around outside of stack-sleeve fittings.

## SECTION 220517 - SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

- B. Fire-Barrier Penetrations: Maintain indicated fire rating of floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

### 3.3 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.
- B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

### 3.4 SLEEVE-SEAL-FITTING INSTALLATION

- A. Install sleeve-seal fittings in new walls and slabs as they are constructed.
- B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.
- C. Secure nailing flanges to concrete forms.
- D. Using grout, seal the space around outside of sleeve-seal fittings.

### 3.5 SLEEVE AND SLEEVE-SEAL SCHEDULE

- A. Use sleeves and sleeve seals for the following piping-penetration applications:
  - 1. Exterior Concrete Walls above Grade: Cast-iron wall sleeves
  - 2. Exterior Concrete Walls below Grade: Cast-iron wall sleeves with sleeve-seal system.
    - a. Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system
  - 3. Concrete Slabs-on-Grade: Cast-iron wall sleeves with sleeve-seal system.
    - a. Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
  - 4. Concrete Slabs above Grade: Galvanized-steel-pipe sleeves
  - 5. Interior Partitions: Galvanized-steel-pipe sleeves

END OF SECTION 220517

## SECTION 220518 - ESCUTCHEONS 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. Escutcheons.
  - 2. Floor plates.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

### PART 2 - PRODUCTS

#### 2.1 ESCUTCHEONS

- A. One-Piece, Cast-Brass Type: With polished, chrome-plated and rough-brass finish and setscrew fastener.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.
- C. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.
- D. Split-Casting Brass Type: With polished, chrome-plated and rough-brass finish and with concealed hinge and setscrew.

#### 2.2 FLOOR PLATES

- A. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.
- B. Split-Casting Floor Plates: Cast brass with concealed hinge.

## SECTION 220518 - ESCUTCHEONS FOR PLUMBING PIPING

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
- B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of insulated piping and with OD that completely covers opening.
  - 1. Escutcheons for New Piping:
    - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
    - b. Insulated Piping: One-piece, stamped-steel type.
    - c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
    - d. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
    - e. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with rough-brass finish.
    - f. Bare Piping in Equipment Rooms: One-piece, cast-brass type with rough-brass finish.
- C. Install floor plates for piping penetrations of equipment-room floors.
- D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
  - 1. New Piping: One-piece, floor-plate type.
  - 2. Existing Piping: Split-casting, floor-plate type.

#### 3.2 FIELD QUALITY CONTROL

- A. Replace broken and damaged escutcheons and floor plates using new materials.

END OF SECTION 220518

## SECTION 220519 – METERS AND GAUGES 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. Liquid-in-glass thermometers.
  - 2. Thermowells.
  - 3. Dial-type pressure gages.
  - 4. Gage attachments.
  - 5. Test plugs and test plug kits.

#### 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Product Certificates: For each type of meter and gauge, from manufacturer.
- C. Operation and Maintenance Data: For meters and gauges to include in operation and maintenance manuals.

### PART 2 - PRODUCTS

#### 2.1 LIQUID-IN-GLASS THERMOMETERS

- A. Metal-Case, Industrial-Style, Liquid-in-Glass Thermometers:
  - 1. Manufacturers:
    - a. Terice, H. O. Co.
    - b. Weiss Instruments, Inc.
    - c. Winters Instruments - U.S.
  - 2. Standard: ASME B40.200.
  - 3. Case: Cast aluminum; 9-inch nominal size unless otherwise indicated.
  - 4. Case Form: Adjustable angle unless otherwise indicated.
  - 5. Tube: Glass with magnifying lens and blue or red organic liquid.
  - 6. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F.
  - 7. Window: Glass.
  - 8. Stem: Aluminum and of length to suit installation.

## SECTION 220519 – METERS AND GAUGES FOR PLUMBING PIPING

- a. Design for Air-Duct Installation: With ventilated shroud.
  - b. Design for Thermowell Installation: Bare stem.
9. Connector: 1-1/4 inches, with ASME B1.1 screw threads.
  10. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

### 2.2 THERMOWELLS

#### A. Thermowells:

1. Standard: ASME B40.200.
2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
3. Material for Use with Copper Tubing: brass.
4. Material for Use with Steel Piping: stainless steel.
5. Type: Stepped shank unless straight or tapered shank is indicated.
6. Bore: Diameter required to match thermometer bulb or stem.
7. Insertion Length: Length required to match thermometer bulb or stem.
8. Lagging Extension: Include on thermowells for insulated piping and tubing.
9. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

#### B. Heat-Transfer Medium: Mixture of graphite and glycerin.

### 2.3 PRESSURE GAGES

#### A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Trerice, H. O. Co.
  - b. Weiss Instruments, Inc.
  - c. Weksler Glass Thermometer Corp.
2. Standard: ASME B40.100.
3. Case: Liquid-filled type(s); cast aluminum or drawn steel; 4-1/2-inch nominal diameter.
4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
5. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
6. Movement: Mechanical, with link to pressure element and connection to pointer.
7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.
8. Pointer: Dark-colored metal.
9. Window: Glass.
10. Ring: Stainless steel.
11. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

## SECTION 220519 – METERS AND GAUGES FOR PLUMBING PIPING

### 2.4 GAGE ATTACHMENTS

- A. Snubbers: ASME B40.100, brass; with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and surge-dampening device. Include extension for use on insulated piping.
- B. Siphons: Loop-shaped section of stainless-steel pipe with NPS 1/4 or NPS 1/2 pipe threads.
- C. Valves: Brass or stainless-steel needle, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads.

### 2.5 TEST PLUGS

- A. Manufacturers
  - 1. Flow Design, Inc.
  - 2. Trerice, H. O. Co.
  - 3. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
  - 4. Weiss Instruments, Inc.
- B. Description: Test-station fitting made for insertion into piping tee fitting.
- C. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.
- D. Thread Size: NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe thread.
- E. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.
- F. Core Inserts: Chlorosulfonated polyethylene synthetic and EPDM self-sealing rubber.

### 2.6 TEST-PLUG KITS

- A. Manufacturers:
  - 1. Flow Design, Inc.
  - 2. Trerice, H. O. Co.
  - 3. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
  - 4. Weiss Instruments, Inc.
- B. Furnish one test-plug kit(s) containing one thermometer(s), one pressure gauge and adapter, and carrying case. Thermometer sensing elements, pressure gauge, and adapter probes shall be of diameter to fit test plugs and of length to project into piping.
- C. Low-Range Thermometer: Small, bimetallic insertion type with 1- to 2-inch-diameter dial and tapered-end sensing element. Dial range shall be at least 25 to 125 deg F.
- D. Pressure Gauge: Small, Bourdon-tube insertion type with 2- to 3-inch-diameter dial and probe. Dial range shall be at least 0 to 200 psig.
- E. Carrying Case: Metal or plastic, with formed instrument padding.

## SECTION 220519 – METERS AND GAUGES FOR PLUMBING PIPING

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Install thermowells with socket extending to center of pipe and in vertical position in piping tees.
- B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.
- C. Install thermowells with extension on insulated piping.
- D. Fill thermowells with heat-transfer medium.
- E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.
- F. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.
- G. Install valve and snubber in piping for each pressure gage for fluids (except steam).
- H. Install test plugs in piping tees.
- I. Install thermometers in the following locations:
  - 1. Inlets and outlets of each domestic water heater.
- J. Install pressure gages in the following locations:
  - 1. Main water connection piping into the building.
  - 2. Discharge of each pressure-reducing valve.
  - 3. Inlet and outlet of each storage type water heater.
  - 4. Suction and discharge of each pump.

#### 3.2 CONNECTIONS

- A. Install meters and gauges adjacent to machines and equipment to allow service and maintenance of meters, gauges, machines, and equipment.

#### 3.3 ADJUSTING

- A. Adjust faces of meters and gauges to proper angle for best visibility.

#### 3.4 THERMOMETER SCHEDULE

- A. Thermometers at inlet and outlet of each domestic water heater shall be the following:
  - 1. Industrial-style, liquid-in-glass type.
  - 2. Test plug with EPDM self-sealing rubber inserts.
- B. Thermometer stems shall be of length to match thermowell insertion length.



SECTION 220519 – METERS AND GAUGES FOR PLUMBING PIPING

3.5 SCALE-RANGE SCHEDULE

- A. Scale Range for Domestic Hot-Water Piping: 0 to 200 deg F.
- B. Pressure Gauge Scale Range for Chilled-Water Piping: 0 to 60 PSI.

END OF SECTION 22 05 19

## SECTION 220523 - GENERAL-DUTY VALVES 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. Bronze ball valves.
  - 2. Bronze gate valves.
  - 3. Bronze globe valves.
- B. Related Sections:
  - 1. Division 22 plumbing piping Sections for specialty valves applicable to those Sections only.
  - 2. Division 22 Section "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

#### 1.3 DEFINITIONS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene copolymer rubber.
- C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- D. NRS: Nonrising stem.
- E. OS&Y: Outside screw and yoke.
- F. RS: Rising stem.

#### 1.4 SUBMITTALS

- A. Product Data: For each type of valve indicated. Include body, seating, and trim materials; valve design; pressure and temperature classifications; end connections; arrangement; dimensions; and required clearances. Include list indicating valve and its application. Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories.

## SECTION 220523 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

### 1.5 QUALITY ASSURANCE

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:
  - 1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
  - 2. ASME B31.9 for building services piping valves.
- C. NSF Compliance: NSF 61 for valve materials for potable-water service.

### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
  - 1. Protect internal parts against rust and corrosion.
  - 2. Protect threads, flange faces, grooves, and weld ends.
  - 3. Set angle, gate, and globe valves closed to prevent rattling.
  - 4. Set ball and plug valves open to minimize exposure of functional surfaces.
  - 5. Set butterfly valves closed or slightly open.
  - 6. Block check valves in either closed or open position.
- B. Use the following precautions during storage:
  - 1. Maintain valve end protection.
  - 2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

## PART 2 - PRODUCTS

### 2.1 GENERAL REQUIREMENTS FOR VALVES

- A. Refer to valve schedule articles for applications of valves.
- B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- C. Valve Sizes: Same as upstream piping unless otherwise indicated.
- D. Valve Actuator Types:
  - 1. Gear Actuator: For quarter-turn valves NPS 8 and larger.
  - 2. Handwheel: For valves other than quarter-turn types.
  - 3. Handlever: For quarter-turn valves NPS 6 and smaller.

## SECTION 220523 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

4. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every 5 plug valves, for each size square plug-valve head.
- E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:
  1. Gate Valves: With rising stem.
  2. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
- F. Valve-End Connections:
  1. Solder Joint: With sockets according to ASME B16.18.
  2. Threaded: With threads according to ASME B1.20.1.
- G. Valve Bypass and Drain Connections: MSS SP-45.

### 2.2 BRONZE BALL VALVES

- A. One-Piece, Reduced-Port, Bronze Ball Valves with Bronze Trim:
  1. Manufacturers:
    - a. NIBCO INC.
    - b. Watts Industries, Inc.; Water Products Div.
    - c. Kitz Corporation
    - d. Apollo
  2. Description:
    - a. Standard: MSS SP-110.
    - b. CWP Rating: 400 psig.
    - c. Body Design: One piece.
    - d. Body Material: Bronze.
    - e. Ends: Threaded.
    - f. Seats: PTFE or TFE.
    - g. Stem: Bronze.
    - h. Ball: Chrome-plated brass.
    - i. Port: Reduced.

### 2.3 BRONZE GATE VALVES

- A. Class 150, Bronze Gate Valves:
  1. Manufacturers:
    - a. NIBCO INC.
    - b. Hammond Valve.
    - c. Kitz Corporation.
    - d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
    - e. Apollo

## SECTION 220523 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

2. Description:
  - a. Standard: MSS SP-80, Type 1.
  - b. CWP Rating: 300 psig.
  - c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
  - d. Ends: Threaded.
  - e. Stem: Bronze.
  - f. Disc: Solid wedge; bronze.
  - g. Packing: Asbestos free.
  - h. Handwheel: Malleable iron, **bronze, or aluminum.**

### 2.4 BRONZE GLOBE VALVES

#### A. Class 150, Bronze Globe Valves with Nonmetallic Disc:

1. Manufacturers:
  - a. Hammond Valve.
  - b. Milwaukee Valve Company.
  - c. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
  - d. Kitz Corporation.
  - e. Apollo
2. Description:
  - a. Standard: MSS SP-80, Type 2.
  - b. CWP Rating: 300 psig.
  - c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
  - d. Ends: Threaded.
  - e. Stem: Bronze.
  - f. Disc: PTFE or TFE.
  - g. Packing: Asbestos free.
  - h. Handwheel: Malleable iron, bronze, or aluminum.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.

## SECTION 220523 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves.

### 3.2 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.

### 3.3 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

### 3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:
  - 1. Shutoff Service: Ball, or gate, or plug valves.
  - 2. Butterfly Valve Dead-End Service: Single-flange (lug) type.
  - 3. Throttling Service: Globe or ball valves.
- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.
- C. Select valves, except wafer types, with the following end connections:
  - 1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
  - 2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
  - 3. For Copper Tubing, NPS 5 and Larger: Flanged ends.

### 3.5 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE

- A. Pipe NPS 2 and Smaller:
  - 1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
  - 2. Ball Valves: One piece, regular port, bronze with bronze trim.
  - 3. Bronze Gate Valves: Class 150.

## SECTION 220523 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

4. Bronze Globe Valves: Class 150, bronze, nonmetallic disc.
- B. Pipe NPS 2-1/2 and Larger:
1. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
  2. Iron Ball Valves: Class 150.
  3. Iron, Single-Flange Butterfly Valves: 200 CWP, EPDM seat, stainless-steel disc.
  4. Iron Gate Valves: Class 250.
  5. Iron Globe Valves: Class 250.

END OF SECTION 220523

## SECTION 220529 - HANGERS AND SUPPORTS 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.

#### 1.2 SUMMARY

##### A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Thermal-hanger shield inserts.
4. Fastener systems.
5. Pipe stands.
6. Equipment supports.

##### B. Related Sections:

1. Section 055000 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Section 220516 "Expansion Fittings and Loops for Plumbing Piping" for pipe guides and anchors.
3. Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment" for vibration isolation devices.

#### 1.3 DEFINITIONS

- A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

#### 1.4 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
  1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
  2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.



## SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

### 1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer. 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. Fiberglass strut systems.
  - 4. Pipe stands.
  - 5. Equipment supports.
- C. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
  - 1. Detail fabrication and assembly of trapeze hangers.
  - 2. Design Calculations: Calculate requirements for designing trapeze hangers.

### 1.6 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

### 1.7 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.

## PART 2 - PRODUCTS

### 2.1 METAL PIPE HANGERS AND SUPPORTS

- A. Carbon-Steel Pipe Hangers and Supports:
  - 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
  - 2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
  - 3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
  - 4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
  - 5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
- B. Copper Pipe Hangers:

## SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel.

### 2.2 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

### 2.3 METAL FRAMING SYSTEMS

- A. MFMA Manufacturer Metal Framing Systems:
  1. Manufacturers:
    - a. Allied Tube & Conduit.
    - b. Cooper B-Line, Inc.
    - c. Flex-Strut Inc.
    - d. GS Metals Corp.
    - e. Thomas & Betts Corporation.
    - f. Unistrut Corporation; Tyco International, Ltd.
    - g. Wesanco, Inc.
  2. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.
  3. Standard: MFMA-4.
  4. Channels: Continuous slotted steel channel with inturned lips.
  5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
  6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
  7. Metallic Coating: Hot-dipped galvanized.
  8. Plastic Coating: PVC.

### 2.4 THERMAL-HANGER SHIELD INSERTS

- A. Manufacturers:
  1. Carpenter & Paterson, Inc.
  2. Clement Support Services.
  3. ERICO International Corporation.
  4. National Pipe Hanger Corporation.
  5. PHS Industries, Inc.
  6. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.
  7. Piping Technology & Products, Inc.
  8. Rilco Manufacturing Co., Inc.
  9. Value Engineered Products, Inc.

## SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

- B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig minimum compressive strength and vapor barrier.
- C. Insulation-Insert Material for Hot Piping: ASTM C 552, Type II cellular glass with 100-psig minimum compressive strength.
- D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

### 2.5 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- B. Mechanical-Expansion Anchors: Insert-wedge-type, stainless- steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

### 2.6 PIPE STANDS

- A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.
- B. Compact Pipe Stand: One-piece plastic unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.
- C. Low-Type, Single-Pipe Stand: One-piece plastic base unit with plastic roller, for roof installation without membrane penetration.
- D. High-Type, Single-Pipe Stand:
  - 1. Description: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
  - 2. Base: Plastic.
  - 3. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
  - 4. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.
- E. High-Type, Multiple-Pipe Stand:
  - 1. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
  - 2. Bases: One or more; plastic.
  - 3. Vertical Members: Two or more protective-coated-steel channels.

## SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

4. Horizontal Member: Protective-coated-steel channel.
  5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.
- F. Curb-Mounting-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

### 2.7 PIPE POSITIONING SYSTEMS

- A. Description: IAPMO PS 42, positioning system of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

### 2.8 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

### 2.9 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
1. Properties: Nonstaining, noncorrosive, and nongaseous.
  2. Design Mix: 5000-psi, 28-day compressive strength.

## PART 3 - EXECUTION

### 3.1 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
  2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

## SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

- C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.
- D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- E. Fastener System Installation:
  - 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
  - 2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- F. Pipe Stand Installation:
  - 1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
  - 2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Section 077200 "Roof Accessories" for curbs.
- G. Pipe Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.
- H. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- I. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- J. 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.
- K. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- L. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- M. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- N. Insulated Piping:
  - 1. Attach clamps and spacers to piping.
    - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.

## SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

- 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.
  - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 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.
  - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 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: 12 inches long and 0.048 inch thick.
  - b. NPS 4: 12 inches long and 0.06 inch thick.
  - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
  - d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
  - e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
5. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

### 3.2 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

### 3.3 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:

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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. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

### 3.4 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

### 3.5 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
  1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Section 099113 "Exterior Painting." Section 099123 "Interior Painting." Section 099600 "High-Performance Coatings."
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

### 3.6 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel pipe hangers and supports metal trapeze pipe hangers and metal framing systems and attachments for general service applications.
- F. Use stainless-steel pipe hangers and attachments for hostile environment applications.
- G. Use copper-plated pipe hangers and copper attachments for copper piping and tubing.

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- H. Use padded hangers for piping that is subject to scratching.
- I. Use thermal-hanger shield inserts for insulated piping and tubing.
- J. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
  - 2. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
  - 3. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction might occur.
  - 4. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
  - 5. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
  - 6. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.
- K. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  - 1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
  - 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.
- L. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  - 1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
  - 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
  - 3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
  - 4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
  - 5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
- M. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  - 1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
  - 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joint construction, to attach to top flange of structural shape.



## SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
  4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
  5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
  6. C-Clamps (MSS Type 23): For structural shapes.
  7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
  8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
  9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
  10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
  11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
  12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
    - a. Light (MSS Type 31): 750 lb.
    - b. Medium (MSS Type 32): 1500 lb.
    - c. Heavy (MSS Type 33): 3000 lb.
  13. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- N. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
  2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
  3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- O. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- P. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
- Q. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.
- R. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION 220529

## SECTION 220548.13 - 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.

#### 1.2 SUMMARY

- A. Section Includes:

1. Elastomeric isolation pads.
2. Elastomeric isolation mounts.
3. Restrained elastomeric isolation mounts.
4. Elastomeric hangers.
5. Spring hangers.

- B. Related Requirements:

1. Section 210548.13 "Vibration Controls for Fire-Suppression Piping and Equipment" for devices for fire-suppression equipment and systems.
2. Section 230548.13 "Vibration Controls for HVAC" for devices for HVAC equipment and systems.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of vibration isolation device type required.

- B. Shop Drawings:

1. Detail fabrication and assembly of equipment bases. Detail fabrication including anchorages and attachments to structure and to supported equipment.

- C. Delegated-Design Submittal: For each vibration isolation device.

1. Include design calculations for selecting vibration isolators.

## SECTION 220548.13 - VIBRATION CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

### 1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Show coordination of vibration isolation device installation for plumbing piping and equipment with other systems and equipment in the vicinity, including other supports and restraints, if any.
- B. Welding certificates.

### 1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

## PART 2 - PRODUCTS

### 2.1 VIBRATION ISOLATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Ace Mountings Co., Inc.
  - 2. Amber/Booth Company, Inc.
  - 3. California Dynamics Corporation.
  - 4. Isolation Technology, Inc.
  - 5. Kinetics Noise Control.
  - 6. Mason Industries.
  - 7. Vibration Eliminator Co., Inc.
  - 8. Vibration Isolation.
  - 9. Vibration Mountings & Controls, Inc.
- B. Elastomeric Isolation Pads:
  - 1. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.
  - 2. Size: Factory or field cut to match requirements of supported equipment.
  - 3. Pad Material: Oil and water resistant with elastomeric properties.
  - 4. Surface Pattern: Ribbed, Waffle, non-slip pattern.
  - 5. Infused nonwoven cotton or synthetic fibers.
  - 6. Load-bearing metal plates adhered to pads.
  - 7. Sandwich-Core Material: Resilient and elastomeric.
- C. Double-Deflection, Elastomeric Isolation Mounts:
  - 1. Mounting Plates:
    - a. Top Plate: Encapsulated steel load transfer top plates, factory drilled and threaded with threaded studs or bolts.
    - b. Baseplate: Encapsulated steel bottom plates with holes provided for anchoring to support structure.

## SECTION 220548.13 - VIBRATION CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

2. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.
- D. Restrained Elastomeric Isolation Mounts:
1. Description: All-directional isolator with restraints containing two separate and opposing elastomeric elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
    - a. Housing: Cast-ductile iron or welded steel.
    - b. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.
- E. Freestanding, Laterally Stable, Open-Spring Isolators:
1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
  2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
  3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
  4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
  5. Baseplates: Factory-drilled steel plate for bolting to structure with an elastomeric isolator pad attached to the underside. Baseplates shall limit floor load to 500 psig.
  6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.
- F. Freestanding, Laterally Stable, Open-Spring Isolators in Two-Part Telescoping Housing:
1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
  2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
  3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
  4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
  5. Two-Part Telescoping Housing: A steel top and bottom frame separated by an elastomeric material and enclosing the spring isolators.
    - a. Drilled base housing for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig.
    - b. Top housing with threaded mounting holes and internal leveling device, elastomeric pad.
- G. Elastomeric Mount in a Steel Frame with Upper and Lower Steel Hanger Rods:
1. Frame: Steel, fabricated with a connection for an upper threaded hanger rod and an opening on the underside to allow for a maximum of 30 degrees of angular lower hanger-rod misalignment without binding or reducing isolation efficiency.
  2. Dampening Element: Molded, oil-resistant rubber, neoprene, or other elastomeric material with a projecting bushing for the underside opening preventing steel to steel contact.
- H. Combination Coil-Spring and Elastomeric-Insert Hanger with Spring and Insert in Compression:

## SECTION 220548.13 - VIBRATION CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
7. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
8. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

### 2.2 FACTORY FINISHES

- A. Finish: Manufacturer's standard prime-coat finish ready for field painting.
- B. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.
  1. Powder coating on springs and housings.
  2. All hardware shall be galvanized. Hot-dip galvanize metal components for exterior use.
  3. Baked enamel or powder coat for metal components on isolators for interior use.
  4. Color-code or otherwise mark vibration isolation and seismic-control devices to indicate capacity range.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation 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 APPLICATIONS

- A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.
- B. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static within specified loading limits.

## SECTION 220548.13 - VIBRATION CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

### 3.3 VIBRATION CONTROL DEVICE 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.

END OF SECTION 220548.13

## SECTION 220553 - IDENTIFICATION 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.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Equipment labels.
  - 2. Warning signs and labels.
  - 3. Pipe labels.
  - 4. Stencils.
  - 5. Valve tags.
  - 6. Warning tags.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- D. Valve numbering scheme.
- E. Valve Schedules: For each piping system to include in maintenance manuals.

#### 1.4 COORDINATION

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

## SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

### PART 2 - PRODUCTS

#### 2.1 EQUIPMENT LABELS

##### A. Metal Labels for Equipment:

1. Material and Thickness: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
4. Fasteners: Stainless-steel rivets or self-tapping screws.
5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

##### B. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
2. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
3. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
4. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
5. Fasteners: Stainless-steel rivets or self-tapping screws.
6. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

##### C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.

##### D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number, and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

#### 2.2 WARNING SIGNS AND LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
- B. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- C. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.



## SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

- D. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
- E. Fasteners: Stainless-steel rivets or self-tapping screws.
- F. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- G. Label Content: Include caution and warning information plus emergency notification instructions.

### 2.3 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings; also include pipe size and an arrow indicating flow direction.
  - 1. Flow-Direction Arrows: Integral with piping-system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.
  - 2. Lettering Size: At least 1/2 inch.

### 2.4 STENCILS

- A. Stencils for Piping:
  - 1. Lettering Size: Size letters according to ASME A13.1 for piping.
  - 2. Stencil Paint: Exterior, gloss, alkyd enamel in colors complying with recommendations in ASME A13.1 unless otherwise indicated. Paint may be in pressurized spray-can form.
  - 3. Identification Paint: Exterior, alkyd enamel in colors according to ASME A13.1 unless otherwise indicated. Paint may be in pressurized spray-can form.

### 2.5 VALVE TAGS

- A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
  - 1. Tag Material: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
  - 2. Fasteners: Brass beaded chain.

## SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

- B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

- 1. Valve-tag schedule shall be included in operation and maintenance data.

### 2.6 WARNING TAGS

- A. Description: Preprinted or partially preprinted accident-prevention tags of plasticized card stock with matte finish suitable for writing.

- 1. Size: 3 by 5-1/4 inches minimum.
  - 2. Fasteners: Brass grommet and wire.
  - 3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
  - 4. Color: Safety yellow background with black lettering.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

### 3.2 GENERAL INSTALLATION REQUIREMENTS

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

### 3.3 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

### 3.4 PIPE LABEL INSTALLATION

- A. Piping Color Coding: Painting of piping is specified in Section 099123 "Interior Painting," and Section 099600 "High-Performance Coatings."

## SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

- B. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels, complying with ASME A13.1, with painted, color-coded bands or rectangles on each piping system.
  - 1. Identification Paint: Use for contrasting background.
  - 2. Stencil Paint: Use for pipe marking.
- C. Pipe Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
  - 1. Near each valve and control device.
  - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
  - 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
  - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
  - 5. Near major equipment items and other points of origination and termination.
  - 6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
  - 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- D. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.

### 3.5 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, shutoff valves, faucets, convenience and lawn-watering hose connections, and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:
  - 1. Valve-Tag Size and Shape:
    - a. Cold Water: 1-1/2 inches, round.
    - b. Hot Water: 1-1/2 inches, round.

### 3.6 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 220553

## SECTION 220719 - PLUMBING 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 insulating the following plumbing piping services:
  1. Domestic cold-water piping.
  2. Domestic hot-water piping.
  3. Domestic recirculating hot-water piping.
  4. Domestic chilled-water piping for drinking fountains.
  5. Storm water piping.
  6. Supplies and drains for handicap-accessible lavatories and sinks.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied, if any).
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
  1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
  2. Detail attachment and covering of heat tracing inside insulation.
  3. Detail insulation application at pipe expansion joints for each type of insulation.
  4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
  5. Detail removable insulation at piping specialties, equipment connections, and access panels.
  6. Detail application of field-applied jackets.
  7. Detail application at linkages of control devices.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.
- C. Field quality-control reports.

## SECTION 220719 - PLUMBING PIPING INSULATION

### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84 by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
  - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
  - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.
- C. Comply with the following applicable standards and other requirements specified for miscellaneous components:
  - 1. Supply and Drain Protective Shielding Guards: ICC A117.1.

### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

### 1.7 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heat tracing.

### 1.8 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.

## SECTION 220719 - PLUMBING PIPING INSULATION

### PART 2 - PRODUCTS

#### 2.1 INSULATION MATERIALS

- A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials shall be applied.
- 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. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.
  - 1. Products:
    - a. Armaflex
    - b. K-Flex
- G. Mineral-Fiber, Preformed Pipe Insulation:
  - 1. Products:
    - a. Johns Manville; Micro-Lok.
    - b. Knauf Insulation; 1000(Pipe Insulation.
    - c. Owens Corning; Fiberglas Pipe Insulation.
  - 2. Type I, 850 Deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

#### 2.2 INSULATING CEMENTS

- A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.
  - 1. Products:
    - a. Insulco, Division of MFS, Inc.; Triple I.
    - b. P. K. Insulation Mfg. Co., Inc.; Super-Stik.

#### 2.3 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.
- B. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
  - 1. Products:

## SECTION 220719 - PLUMBING PIPING INSULATION

- a. Foster Products Corporation, H. B. Fuller Company
  - b. Aeroflex
  - c. Armacell
  - d. K-Flex
2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  3. Adhesive 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."
- C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
1. Products:
    - a. Childers Products, Division of ITW; CP-82.
    - b. Foster Products Corporation, H. B. Fuller Company; 85-20.
    - c. ITW TACC, Division of Illinois Tool Works; S-90/80.
    - d. Marathon Industries, Inc.; 225.
    - e. Mon-Eco Industries, Inc.; 22-25.
  2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  3. Adhesive 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."
- D. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
1. Products:
    - a. Childers Products, Division of ITW; CP-82.
    - b. Foster Products Corporation, H. B. Fuller Company; 85-20.
    - c. ITW TACC, Division of Illinois Tool Works; S-90/80.
    - d. Marathon Industries, Inc.; 225.
    - e. Mon-Eco Industries, Inc.; 22-25.
  2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  3. Adhesive 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."

### 2.4 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.
1. Products:
    - a. Childers Products, Division of ITW; CP-35.
    - b. Foster Products Corporation, H. B. Fuller Company; 30-90.
    - c. ITW TACC, Division of Illinois Tool Works; CB-50.
    - d. Marathon Industries, Inc.; 590.

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- e. Mon-Eco Industries, Inc.; 55-40.
- f. Vimasco Corporation; 749.
2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
5. Color: White.

### 2.5 SEALANTS

#### A. Joint Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Permanently flexible, elastomeric sealant.
3. Service Temperature Range: Minus 100 to plus 300 deg F.
4. Color: White or gray.
5. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
6. Sealants 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. FSK and Metal Jacket Flashing Sealants:

1. Products:
  - a. Childers Products, Division of ITW; CP-76-8.
  - b. Foster Products Corporation, H. B. Fuller Company; 95-44.
  - c. Marathon Industries, Inc.; 405.
  - d. Mon-Eco Industries, Inc.; 44-05.
  - e. Vimasco Corporation; 750.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: Aluminum.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealants 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."

#### C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Products:
  - a. Childers Products, Division of ITW; CP-76.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: White.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealants 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."



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### 2.6 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
  - 1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.

### 2.7 FIELD-APPLIED FABRIC-REINFORCING MESH

- A. Woven Glass-Fiber Fabric: Approximately 2 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in. for covering pipe and pipe fittings.

### 2.8 FIELD-APPLIED CLOTHS

- A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd..

### 2.9 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. Metal Jacket:
  - 1. Products:
    - a. Childers Products, Division of ITW; Metal Jacketing Systems.
    - b. PABCO Metals Corporation; Surefit.
    - c. RPR Products, Inc.; Insul-Mate.
  - 2. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.
    - a. Sheet and roll stock ready for shop or field sizing.
    - b. Finish and thickness are indicated in field-applied jacket schedules.
    - c. Moisture Barrier for Indoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper
    - d. Moisture Barrier for Outdoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.
    - e. Factory-Fabricated Fitting Covers:
      - 1) Same material, finish, and thickness as jacket.
      - 2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
      - 3) Tee covers.
      - 4) Flange and union covers.
      - 5) End caps.
      - 6) Beveled collars.
      - 7) Valve covers.
      - 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

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- C. Underground Direct-Buried Jacket: 125-mil-thick vapor barrier and waterproofing membrane consisting of a rubberized bituminous resin reinforced with a woven-glass fiber or polyester scrim and laminated aluminum foil.

### 2.10 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
  - 1. Products:
    - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835.
    - b. Compac Corp.; 104 and 105.
    - c. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.
    - d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
  - 2. Width: 3 inches.
  - 3. Thickness: 11.5 mils.
  - 4. Adhesion: 90 ounces force/inch in width.
  - 5. Elongation: 2 percent.
  - 6. Tensile Strength: 40 lbf/inch in width.
  - 7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
  - 1. Products:
    - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
    - b. Compac Corp.; 110 and 111.
    - c. Ideal Tape Co., Inc., an American Biltrite Company; 491 AWF FSK.
    - d. Venture Tape; 1525 CW, 1528 CW, and 1528 CW/SQ.
  - 2. Width: 3 inches.
  - 3. Thickness: 6.5 mils.
  - 4. Adhesion: 90 ounces force/inch in width.
  - 5. Elongation: 2 percent.
  - 6. Tensile Strength: 40 lbf/inch in width.
  - 7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

### 2.11 SECUREMENTS

- A. Bands:
  - 1. Products:
    - a. Childers Products; Bands.
    - b. PABCO Metals Corporation; Bands.
    - c. RPR Products, Inc.; Bands.
  - 2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 316; 0.015 inch thick, 3/4 inch wide.
- B. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.
- C. Wire: 0.080-inch nickel-copper alloy.

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See Editing Instruction No. 1 in the Evaluations for cautions about naming manufacturers. Retain subparagraph and list of manufacturers below. See Section 016000 "Product Requirements."

1. Manufacturers:
  - a. C & F Wire.
  - b. Childers Products.
  - c. PABCO Metals Corporation.
  - d. RPR Products, Inc.

### 2.12 PROTECTIVE SHIELDING GUARDS

- A. Protective Shielding Pipe Covers:
  1. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.
- B. Protective Shielding Piping Enclosures:
  1. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
  1. Verify that systems to be insulated have been tested and are free of defects.
  2. Verify that surfaces to be insulated are clean and dry.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:
  1. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
- B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

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### 3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
  - 1. Install insulation continuously through hangers and around anchor attachments.
  - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
  - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
  - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
  - 1. Draw jacket tight and smooth.
  - 2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
  - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install 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. For below-ambient services, apply vapor-barrier mastic over staples.

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4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
  5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- P. For above-ambient services, do not install insulation to the following:
1. Vibration-control devices.
  2. Testing agency labels and stamps.
  3. Nameplates and data plates.
  4. Cleanouts.

### 3.4 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
1. Seal penetrations with flashing sealant.
  2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
  4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
1. Seal penetrations with flashing sealant.
  2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
  4. Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

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- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
  - 1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.
- F. Insulation Installation at Floor Penetrations:
  - 1. Pipe: Install insulation continuously through floor penetrations.
  - 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

### 3.5 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
  - 1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
  - 2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
  - 3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
  - 4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
  - 5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
  - 6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
  - 7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
  - 8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and

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- unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
  2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
  3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
  4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
  5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

### 3.6 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- B. Insulation Installation on Pipe Flanges:
1. Install pipe insulation to outer diameter of pipe flange.
  2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
  3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
  4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- C. Insulation Installation on Pipe Fittings and Elbows:
1. Install mitered sections of pipe insulation.
  2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

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- D. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed valve covers manufactured of same material as pipe insulation when available.
  2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
  3. Install insulation to flanges as specified for flange insulation application.
  4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

### 3.7 INSTALLATION OF MINERAL-FIBER INSULATION

- A. Insulation Installation on Straight Pipes and Tubes:
1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
  2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
  3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
  4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.
- B. Insulation Installation on Pipe Flanges:
1. Install preformed pipe insulation to outer diameter of pipe flange.
  2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
  3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
  4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.
- C. Insulation Installation on Pipe Fittings and Elbows:
1. Install preformed sections of same material as straight segments of pipe insulation when available.
  2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.
- D. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed sections of same material as straight segments of pipe insulation when available.
  2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
  3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
  4. Install insulation to flanges as specified for flange insulation application.



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### 3.8 FIELD-APPLIED JACKET INSTALLATION

- A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.
  - 1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
  - 2. Embed glass cloth between two 0.062-inch-thick coats of lagging adhesive.
  - 3. Completely encapsulate insulation with coating, leaving no exposed insulation.
- B. Where FSK jackets are indicated, install as follows:
  - 1. Draw jacket material smooth and tight.
  - 2. Install lap or joint strips with same material as jacket.
  - 3. Secure jacket to insulation with manufacturer's recommended adhesive.
  - 4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch-wide joint strips at end joints.
  - 5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.
- C. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

### 3.9 FINISHES

- A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
  - 1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
    - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless-steel jackets.

### 3.10 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
  - 1. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of

## SECTION 220719 - PLUMBING PIPING INSULATION

flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

- C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

### 3.11 EQUIPMENT INSULATION SCHEDULE

- A. Insulation materials and thicknesses are identified below. If more than one material is listed for a type of equipment, selection from materials listed is Contractor's option.
- B. Insulate indoor and outdoor equipment in paragraphs below that is not factory insulated.
- C. Domestic hot-water storage tank insulation shall be the following, of thickness to provide an R-value of 13: Mineral-fiber pipe and tank.

### 3.12 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
  - 1. Drainage piping located in crawl spaces.
  - 2. Underground piping.
  - 3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

### 3.13 INDOOR PIPING INSULATION SCHEDULE

- A. Domestic Cold Water Piping embedded in walls:
  - 1. All Pipe Sizes: Insulation shall be the following:
    - a. Flexible Elastomeric: 1 inch thick, with two coats of protective coating recommended by the insulation manufacturer.
- B. Domestic Hot and Recirculated Hot Water:
  - 1. Insulation shall be the following:
    - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick, with two coats of protective coating recommended by the insulation manufacturer.
- C. Condensate and Equipment Drain Water below 60 Deg F, and horizontal floor drain piping in ceiling plenums, receiving condensate:
  - 1. All Pipe Sizes: Insulation shall be the following:
    - a. Flexible Elastomeric: 3/4 inch thick, with two coats of protective coating recommended by the insulation manufacturer.
- D. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities:
  - 1. All Pipe Sizes: Insulation shall be the following:
    - a. Flexible Elastomeric: 1 inch thick.

## SECTION 220719 - PLUMBING PIPING INSULATION

- E. Floor Drains, Traps, and Sanitary Drain Piping within 10 Feet of Drain Receiving Condensate and Equipment Drain Water below 60 Deg F:
  - 1. All Pipe Sizes: Insulation shall be the following:
    - a. Flexible Elastomeric: 1 inch thick.
- F. Hot Service Drains:
  - 1. All Pipe Sizes: Insulation shall be the following:
    - a. Mineral-Fiber, Preformed Pipe, Type I or II: 1 inch thick.
- G. Hot Service Vents:
  - 1. All Pipe Sizes: Insulation shall be the following:
    - a. Mineral-Fiber, Preformed Pipe, Type I or II: 1 inch thick.
- H. Rainwater conductors, and roof drain bodies:
  - 1. All Pipe Sizes: Insulation shall be the following:
    - a. Flexible Elastomeric: 1 inch thick, with two coats of protective coating recommended by the insulation manufacturer.
- I. Vapor barrier on all piping, except on hot water piping.
- J. Insulation shall be painted where exposed to view. Coordinate with Architect.

### 3.14 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

- A. Domestic Water Piping:
  - 1. All Pipe Sizes: Insulation shall be the following:
    - a. Flexible Elastomeric: 1 inch thick.
    - b. Vapor barrier.

### 3.15 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. Piping, Exposed:
  - 1. Aluminum, Smooth: 0.020 inch thick.

### 3.16 UNDERGROUND, FIELD-INSTALLED INSULATION JACKET

- A. For underground direct-buried piping applications, install underground direct-buried jacket over insulation material.

END OF SECTION 220719

## SECTION 221116 - 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.

#### 1.2 SUMMARY

##### A. Section Includes:

1. Under-building-slab and aboveground domestic water pipes, tubes, and fittings inside buildings.
2. Encasement for piping.

##### B. Related Requirements:

1. Section 221113 "Facility Water Distribution Piping" for water-service piping and water meters outside the building from source to the point where water-service piping enters the building.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For transition fittings and dielectric fittings.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. System purging and disinfecting activities report.
- B. Field quality-control reports.

#### 1.5 FIELD CONDITIONS

- A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:
  1. Notify Architect no fewer than two days in advance of proposed interruption of water service.
  2. Do not interrupt water service without Architect's written permission.

## SECTION 221116 - DOMESTIC WATER PIPING

### PART 2 - PRODUCTS

#### 2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.
- B. Potable-water piping and components shall comply with NSF 14 and NSF 61 Annex G. Plastic piping components shall be marked with "NSF-pw."

#### 2.2 COPPER TUBE AND FITTINGS

- A. Hard Copper Tube: ASTM B 88, Type K water tube, drawn temper.
- B. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.
- C. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
- D. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
- E. Copper Unions:
  - 1. MSS SP-123.
  - 2. Cast-copper-alloy, hexagonal-stock body.
  - 3. Ball-and-socket, metal-to-metal seating surfaces.
  - 4. Solder-joint or threaded ends.
- F. Copper Pressure-Seal-Joint Fittings:
  - 1. Fittings for NPS 2 and Smaller: Wrought-copper fitting with EPDM-rubber, O-ring seal in each end.
  - 2. Fittings for NPS 2-1/2 to NPS 4: Cast-bronze or wrought-copper fitting with EPDM-rubber, O-ring seal in each end.
- G. Copper Push-on-Joint Fittings:
  - 1. Description:
    - a. Cast-copper fitting complying with ASME B16.18 or wrought-copper fitting complying with ASME B 16.22.
    - b. Stainless-steel teeth and EPDM-rubber, O-ring seal in each end instead of solder-joint ends.
- H. Copper-Tube, Extruded-Tee Connections:
  - 1. Description: Tee formed in copper tube according to ASTM F 2014.

#### 2.3 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials:

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1. AWWA C110/A21.10, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.
  2. Full-face or ring type unless otherwise indicated.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Solder Filler Metals: ASTM B 32, lead-free alloys.
- D. Flux: ASTM B 813, water flushable.
- E. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

### 2.4 ENCASUREMENT FOR PIPING

- A. Standard: ASTM A 674 or AWWA C105/A21.5.
- B. Form: tube.

### 2.5 TRANSITION FITTINGS

- A. General Requirements:
1. Same size as pipes to be joined.
  2. Pressure rating at least equal to pipes to be joined.
  3. End connections compatible with pipes to be joined.
- B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
- C. Sleeve-Type Transition Coupling: AWWA C219.
1. Manufacturers:
    - a. Cascade Waterworks Manufacturing.
    - b. Dresser, Inc.; Dresser Piping Specialties.
    - c. Ford Meter Box Company, Inc. (The).
    - d. JCM Industries.
    - e. Romac Industries, Inc.
    - f. Smith-Blair, Inc; a Sensus company.
    - g. Viking Johnson; c/o Mueller Co.
- D. Plastic-to-Metal Transition Unions:
1. Manufacturers:
    - a. Charlotte Pipe and Foundry Company.
    - b. Harvel Plastics, Inc.
    - c. Spears Manufacturing Company.
  2. Description:

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- a. PVC four-part union.
- b. Brass threaded end.
- c. Solvent-cement-joint plastic end.
- d. Rubber O-ring.
- e. Union nut.

### 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:

- a. Capitol Manufacturing Company.
- b. Central Plastics Company.
- c. EPCO Sales, Inc.
- d. Hart Industries International, Inc.
- e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- f. Zurn Plumbing Products Group; Wilkins Water Control Products.

2. Standard: ASSE 1079.

3. Pressure Rating: 150 psig.

4. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges:

1. Manufacturers:

- a. Capitol Manufacturing Company.
- b. Central Plastics Company.
- c. EPCO Sales, Inc.
- d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Standard: ASSE 1079.

3. Factory-fabricated, bolted, companion-flange assembly.

4. Pressure Rating: 150 psig.

5. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Insulating Kits:

1. Manufacturers:

- a. Advance Products & Systems, Inc.
- b. Calpico, Inc.
- c. Central Plastics Company.
- d. Pipeline Seal and Insulator, Inc.

2. Nonconducting materials for field assembly of companion flanges.

3. Pressure Rating: 150 psig.

4. Gasket: Neoprene or phenolic.

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5. Bolt Sleeves: Phenolic or polyethylene.
6. Washers: Phenolic with steel backing washers.

### E. Dielectric Nipples:

1. Manufacturers:
  - a. Perfection Corporation; a subsidiary of American Meter Company.
  - b. Precision Plumbing Products, Inc.
  - c. Victaulic Company.
2. Standard: IAPMO PS 66.
3. Electroplated steel nipple complying with ASTM F 1545.
4. Pressure Rating and Temperature: 300 psig at 225 deg F.
5. End Connections: Male threaded or grooved.
6. Lining: Inert and noncorrosive, propylene.

## 2.7 FLEXIBLE CONNECTORS

### A. Manufacturers:

1. Flex-Hose Co., Inc.
2. Flex Pression, Ltd.
3. Flex-Weld, Inc.
4. Hyspan Precision Products, Inc.
5. Metraflex, Inc.
6. Universal Metal Hose; a Hyspan company

### B. Stainless-Steel-Hose Flexible Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.

1. Working-Pressure Rating: Minimum **200 psig**
2. End Connections NPS 2 and Smaller: Threaded steel-pipe nipple.
3. End Connections NPS 2-1/2 and Larger: Flanged steel nipple.

## PART 3 - EXECUTION

### 3.1 EARTHWORK

- A. Comply with requirements in Section 312000 "Earth Moving" for excavating, trenching, and backfilling.

### 3.2 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.



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- B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."
- C. Install ductile-iron piping under building slab with restrained joints according to AWWA C600 and AWWA M41.
- D. Install underground copper tube in PE encasement according to ASTM A 674 or AWWA C105/A21.5.
- E. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve inside the building at each domestic water-service entrance. Comply with requirements for pressure gages in Section 220519 "Meters and Gages for Plumbing Piping" and with requirements for drain valves and strainers in Section 221119 "Domestic Water Piping Specialties."
- F. Install shutoff valve immediately upstream of each dielectric fitting.
- G. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements for pressure-reducing valves in Section 221119 "Domestic Water Piping Specialties."
- H. Install domestic water piping level with 0.25 percent slope downward toward drain and plumb.
- I. Rough-in domestic water piping for water-meter installation according to utility company's requirements.
- J. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- K. 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.
- L. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- M. Install piping to permit valve servicing.
- N. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.
- O. Install piping free of sags and bends.
- P. Install fittings for changes in direction and branch connections.
- Q. Install PEX piping with loop at each change of direction of more than 90 degrees.
- R. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- S. Install pressure gages on suction and discharge piping for each plumbing pump and packaged booster pump.
- T. Install thermostats in hot-water circulation piping.

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- U. Install thermometers on outlet piping from each water heater. Comply with requirements for thermometers in Section 220519 "Meters and Gages for Plumbing Piping."
- V. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- W. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- X. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

### 3.3 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 pipes, tubes, and fittings before assembly.
- C. 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.
  - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- D. Brazed Joints for Copper Tubing: Comply with CDA's "Copper Tube Handbook," "Braze Joints" chapter.
- E. Pressure-Sealed Joints for Copper Tubing: Join copper tube and pressure-seal fittings with tools recommended by fitting manufacturer.
- F. Extruded-Tee Connections: Form tee in copper tube according to ASTM F 2014. Use tool designed for copper tube; drill pilot hole, form collar for outlet, dimple tube to form seating stop, and braze branch tube into collar.
- G. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

### 3.4 VALVE INSTALLATION

- A. General-Duty Valves: Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for valve installations.
- B. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment, and on each water supply to plumbing fixtures that do not have supply stops. Use ball or gate valves for piping NPS 2 and smaller. Use butterfly or gate valves for piping NPS 2-1/2 and larger.

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- C. Install drain valves for equipment at base of each water riser, at low points in horizontal piping, and where required to drain water piping. Drain valves are specified in Division 22 Section "Domestic Water Piping Specialties."
  - 1. Hose-End Drain Valves: At low points in water mains, risers, and branches.
  - 2. Stop-and-Waste Drain Valves: Instead of hose-end drain valves where indicated.
- D. Install balancing valve in each hot-water circulation return branch and discharge side of each pump and circulator. Set balancing valves partly open to restrict but not stop flow. Use ball valves for piping NPS 2 and smaller and butterfly valves for piping NPS 2-1/2 and larger. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for balancing valves.
- E. Install calibrated balancing valves in each hot-water circulation return branch and discharge side of each pump and circulator. Set calibrated balancing valves partly open to restrict but not stop flow. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for calibrated balancing valves.

### 3.5 TRANSITION FITTING INSTALLATION

- A. Install transition couplings at joints of dissimilar piping.
- B. Transition Fittings in Underground Domestic Water Piping:
  - 1. Fittings for NPS 1-1/2 and Smaller: Fitting-type coupling.
  - 2. Fittings for NPS 2 and Larger: Sleeve-type coupling.
- C. Transition Fittings in Aboveground Domestic Water Piping NPS 2 and Smaller: Plastic-to-metal transition fittings or unions.

### 3.6 DIELECTRIC FITTING INSTALLATION

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

### 3.7 FLEXIBLE CONNECTOR INSTALLATION

- A. Install flexible connectors in suction and discharge piping connections to each domestic water pump and in suction and discharge manifold connections to each domestic water booster pump.
- B. Install bronze-hose flexible connectors in copper domestic water tubing.
- C. Install stainless-steel-hose flexible connectors in steel domestic water piping.

### 3.8 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for seismic-restraint devices in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

## SECTION 221116 - DOMESTIC WATER PIPING

- B. Comply with requirements for pipe hanger, support products, and installation in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
  - 1. Vertical Piping: MSS Type 8 or 42, clamps.
  - 2. Individual, Straight, Horizontal Piping Runs:
    - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
    - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
    - c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.
  - 3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
  - 4. Base of Vertical Piping: MSS Type 52, spring hangers.
- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.
- E. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
  - 1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
  - 2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
  - 3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
  - 4. NPS 2-1/2: 108 inches with 1/2-inch rod.
  - 5. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
  - 6. NPS 6: 10 feet with 5/8-inch rod.
  - 7. NPS 8: 10 feet with 3/4-inch rod.
- F. Install supports for vertical copper tubing every 10 feet.
- G. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

### 3.9 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.
- C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.
- D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
  - 1. Domestic Water Booster Pumps: Cold-water suction and discharge piping.
  - 2. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.

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3. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code.
4. Equipment: Cold- and hot-water-supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

### 3.10 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification materials and installation in Section 220553 "Identification for Plumbing Piping and Equipment."
- B. Label pressure piping with system operating pressure.

### 3.11 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
  1. Piping Inspections:
    - a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
    - b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
      - 1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after roughing in and before setting fixtures.
      - 2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.
    - c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
    - d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
  2. Piping Tests:
    - a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
    - b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
    - c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
    - d. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source

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and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.

- e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
- f. Prepare reports for tests and for corrective action required.

B. Domestic water piping will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

### 3.12 ADJUSTING

A. Perform the following adjustments before operation:

1. Close drain valves, hydrants, and hose bibbs.
2. Open shutoff valves to fully open position.
3. Open throttling valves to proper setting.
4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
  - a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide hot-water flow in each branch.
  - b. Adjust calibrated balancing valves to flows indicated.
5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
8. Check plumbing specialties and verify proper settings, adjustments, and operation.

### 3.13 CLEANING

A. Clean and disinfect domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
  - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
  - b. Fill and isolate system according to either of the following:
    - 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
    - 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.

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- c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
  - d. Repeat procedures if biological examination shows contamination.
  - e. Submit water samples in sterile bottles to authorities having jurisdiction.
- B. Clean non-potable domestic water piping as follows:
1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
  2. Use purging procedures prescribed by authorities having jurisdiction or; if methods are not prescribed, follow procedures described below:
    - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
    - b. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.
- C. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.
- D. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

### 3.14 PIPING SCHEDULE

- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
- B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.
- C. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.
- D. Under-building-slab, domestic water, building-service piping, up to NPS 8 and larger, shall be the following:
1. Soft copper tube, ASTM B 88, Type K; wrought-copper, solder-joint fittings; and brazed joints.
- E. Aboveground domestic water piping, NPS 2 and smaller, shall be the following:
1. Hard copper tube, ASTM B 88, Type K; copper, solder-joint fittings; and brazed joints.
  2. Hard copper tube, ASTM B 88, Type K; copper pressure-seal-joint fittings; and pressure-sealed joints.
- F. Aboveground domestic water piping, NPS 2-1/2 to NPS 4, shall be the following:
1. Hard copper tube, ASTM B 88, Type K; copper, solder-joint fittings; and brazed joints.
  2. Hard copper tube, ASTM B 88, Type K; copper pressure-seal-joint fittings; and pressure-sealed joints.
  3. Hard copper tube, ASTM B 88, Type K; grooved-joint, copper-tube appurtenances; and grooved joints.

## SECTION 221116 - DOMESTIC WATER PIPING

- G. Aboveground, combined domestic water-service and fire-service-main piping, NPS 6 to NPS 12, shall be the following:
  - 1. Plain-end, ductile-iron pipe; grooved-joint, ductile-iron-pipe appurtenances; and grooved joints.

### 3.15 VALVE SCHEDULE

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
  - 1. Shutoff Duty: Use ball or gate valves for piping NPS 2 and smaller. Use butterfly, ball, or gate valves with flanged ends for piping NPS 2-1/2 and larger.
  - 2. Throttling Duty: Use ball or globe valves for piping NPS 2 and smaller. Use butterfly or ball valves with flanged ends for piping NPS 2-1/2 and larger.
  - 3. Hot-Water Circulation Piping, Balancing Duty: Calibrated balancing valves.
  - 4. Drain Duty: Hose-end drain valves.
- B. Use check valves to maintain correct direction of domestic water flow to and from equipment.
- C. Iron grooved-end valves may be used with grooved-end piping.

END OF SECTION 221116



## SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES

### 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. Backflow preventers.
2. Outlet boxes.
3. Wall hydrants.
4. Water-hammer arresters.
5. Trap-seal primer valves.
6. Trap-seal primer systems.
7. Flexible connectors.

- B. Related Requirements:

1. Section 220519 "Meters and Gages for Plumbing Piping" for thermometers, pressure gages, and flow meters in domestic water piping.
2. Section 221116 "Domestic Water Piping" for water meters.
3. Section 223200 "Domestic Water Filtration Equipment" for water filters in domestic water piping.
4. Section 224300 "Medical Plumbing Fixtures" for thermostatic mixing valves for sitz baths, thermostatic mixing-valve assemblies for hydrotherapy equipment, and outlet boxes for dialysis equipment.
5. Section 224500 "Emergency Plumbing Fixtures" for water tempering equipment.
6. Section 224713 "Drinking Fountains" for water filters for water coolers.
7. Section 224716 "Pressure Water Coolers" for water filters for water coolers.
8. Section 224723 "Remote Water Coolers" for water filters for water coolers.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For domestic water piping specialties.
  1. Include diagrams for power, signal, and control wiring.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

## SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES

### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

## PART 2 - PRODUCTS

### 2.1 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

- A. Potable-water piping and components shall comply with NSF 61 Annex G [**and NSF 14**].**[Mark "NSF-pw" on plastic piping components.]**

### 2.2 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressure for Domestic Water Piping Specialties: [**125 psig (860 kPa)**] unless otherwise indicated.

### 2.3 BACKFLOW PREVENTERS

- A. Reduced-Pressure-Principle Backflow Preventers:
- B. Manufacturers:
  - 1. Zurn
  - 2. Wilkins
  - 3. Or Approved Equal.
- C. Description:
  - 1. Standard: ASSE 1013.
  - 2. Operation: Continuous-pressure applications.
  - 3. Pressure Loss: [**12 psig (83 kPa)**]
  - 4. Size: see drawings.
  - 5. Body: Bronze for **NPS 2 (DN 50)** and smaller
  - 6. End Connections: Threaded for **NPS 2 (DN 50)** and smaller.
  - 7. Configuration: Designed for [**horizontal, straight-through**] flow.
  - 8. Accessories:
    - a. Valves **NPS 2 (DN 50)** and Smaller: Ball type with threaded ends on inlet and outlet.
    - b. Valves **NPS 2-1/2 (DN 65)** and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.
    - c. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.

### 2.4 OUTLET BOXES

- A. Icemaker Outlet Boxes:

## SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES

1. Manufacturers:
  - a. Guy Gray
  - b. Zurn
  - c. Moen
2. Description: See schedule.

### 2.5 WALL HYDRANTS

1. Manufacturers:
  - a. Zurn
  - b. Woodford
  - c. Or Approved Equal
2. Description: See schedule.

### 2.6 WATER-HAMMER ARRESTERS

#### A. Water-Hammer Arresters:

1. Manufacturers:
  - a. Zurn.
  - b. Mifab.
  - c. Wade.
  - d. Or "Approved equal".
2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: [Stainless Steel **Metal bellows**].
4. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.

### 2.7 TRAP-SEAL PRIMER DEVICE

#### A. Supply-Type, Trap-Seal Primer Device:

1. Manufacturers:
  - a. PPP or Approved Equal
2. Standard: ASSE 1018.
3. Pressure Rating: **125 psig (860 kPa)** minimum.
4. Body: Bronze.
5. Inlet and Outlet Connections: **NPS 1/2 (DN 15)** threaded, union, or solder joint.
6. Gravity Drain Outlet Connection: **NPS 1/2 (DN 15)** threaded or solder joint.
7. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

## SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES

### 2.8 FLEXIBLE CONNECTORS

- A. Stainless-Steel-Hose Flexible Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.
  - 1. Working-Pressure Rating: Minimum [**200 psig (1380 kPa)**].
  - 2. End Connections **NPS 2 (DN 50)** and Smaller: Threaded steel-pipe nipple.
  - 3. End Connections **NPS 2-1/2 (DN 65)** and Larger: Flanged steel nipple.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
  - 1. Locate backflow preventers in same room as connected equipment or system.
  - 2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe-to-floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are unacceptable for this application.
  - 3. Do not install bypass piping around backflow preventers.
- B. Install outlet boxes recessed in wall or surface mounted on wall. Install **2-by-4-inch (38-by-89-mm)** fire-retardant-treated-wood blocking, wall reinforcement between studs. Comply with requirements for fire-retardant-treated-wood blocking in Section 061000 "Rough Carpentry."
- C. Install water-hammer arresters in water piping according to PDI-WH 201.
- D. Install supply-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.

### 3.2 CONNECTIONS

- A. Comply with requirements for ground equipment in Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Fire-retardant-treated-wood blocking is specified in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for electrical connections.

### 3.3 LABELING AND IDENTIFYING

- A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
  - 1. Reduced-pressure-principle backflow preventers.
  - 2. Outlet boxes.

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3. Supply-type, trap-seal primer valves.
  - B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

### 3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
  1. Test each [~~reduced-pressure-principle backflow preventer~~] [~~double-check, backflow-prevention assembly~~] [~~and~~] [~~double-check, detector-assembly backflow preventer~~] according to authorities having jurisdiction and the device's reference standard.
- B. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

END OF SECTION 221119

## SECTION 221123.13 - DOMESTIC-WATER PACKAGED BOOSTER 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. Multiplex, constant-speed booster pumps.
  - 2. Multiplex, variable-speed booster pumps.
- B. Related Sections:
  - 1. Section 221123 "Domestic Water Pumps" for domestic-water circulation pumps.
  - 2. Section 221223 "Facility Indoor Potable-Water Storage Tanks" for separate hydropneumatic domestic-water tanks for multiplex booster pumps.

#### 1.3 DEFINITIONS

- A. VFC: Variable-frequency controller(s).

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, and dimensions of individual components and profiles. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: For booster pumps. Include plans, elevations, sections, details, and attachments to other work.
  - 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.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For booster pumps to include in emergency, operation, and maintenance manuals.

## SECTION 221123.13 - DOMESTIC-WATER PACKAGED BOOSTER PUMPS

### 1.6 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. ASME Compliance: Comply with ASME B31.9 for piping.
- C. UL Compliance for Packaged Pumping Systems:
  - 1. UL 508, "Industrial Control Equipment."
  - 2. UL 508A, "Industrial Control Panels."
  - 3. UL 778, "Motor-Operated Water Pumps."
  - 4. UL 1995, "Heating and Cooling Equipment."
- D. Booster pumps shall be listed and labeled as packaged pumping systems by testing agency acceptable to authorities having jurisdiction.

### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Retain protective coatings and flange's protective covers during storage.

### 1.8 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

## PART 2 - PRODUCTS

### 2.1 MULTIPLEX, VARIABLE-SPEED BOOSTER PUMPS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Armstrong Pumps, Inc.
  - 2. Bell & Gossett; a Xylem brand.
  - 3. Goulds Water Technology; a Xylem brand.
  - 4. Grundfos Pumps Corporation U.S.A.
  - 5. ITT Flowtronex.
- B. Description: Factory-assembled and -tested, fluid-handling system for domestic water, with pumps, piping, valves, specialties, and controls, and mounted on base.
- C. Pumps:
  - 1. Type: End suction as defined in HI 1.1-1.2 and HI 1.3 for end-suction, close-coupled, single-stage, overhung-impeller, centrifugal pump.
  - 2. Casing: Radially split; stainless steel.
  - 3. Impeller: Closed, stainless steel; statically and dynamically balanced and keyed to shaft.
  - 4. Shaft and Shaft Sleeve: Steel shaft, with copper-alloy shaft sleeve and deflector.

## SECTION 221123.13 - DOMESTIC-WATER PACKAGED BOOSTER PUMPS

5. Seal: Mechanical.
  6. Orientation: Mounted horizontally.
- D. Motors: Single speed, TEFC, ball-type bearings. Select motors that will not overload through full range of pump performance curve.
- E. Piping: Copper tube and copper fittings.
- F. Valves:
1. Shutoff Valves NPS 2 and Smaller: Gate valve or two-piece, full-port ball valve, in each pump's suction and discharge piping.
  2. Shutoff Valves NPS 2-1/2 and Larger: Gate valve, in each pump's suction and discharge piping and in inlet and outlet headers.
  3. Check Valves: Silent type in each pump's discharge piping.
  4. Thermal-Relief Valve: Temperature-and-pressure relief type in pump's discharge header piping.
- G. Dielectric Fittings: With insulating material isolating joined dissimilar metals.
- H. Control Panel: Factory installed and connected as an integral part of booster pump; automatic for multiple-pump, variable-speed operation, with load control and protection functions.
1. Control Logic: Solid-state system with transducers, programmable microprocessor, VFC, and other devices in controller. Install VFC for pump motors larger than 25 hp in separate panel; same type as motor control panel enclosure.
  2. Motor Controller: NEMA ICS 2, variable-frequency, solid-state type.
  3. Enclosure: NEMA 250, Type 1.
  4. Motor Overload Protection: Overload relay in each phase.
  5. Starting Devices: Hand-off-automatic selector switch for each pump in cover of control panel, plus pilot device for automatic control.
    - a. Duplex, Automatic, Alternating Starter: Switches lead pump to lag main pump and to two-pump operation.
  6. Pump Operation and Sequencing: The system shall start upon drop in system pressure and will regulate pump speed to maintain constant pressure under variable flow conditions. The system will stop upon detection of no-flow.
  7. VFC: Voltage-source, pulse-width, modulating-frequency converter for each pump.
  8. Manual Bypass: Magnetic contactor arranged to transfer to constant-speed operation upon VFC failure.
  9. Instrumentation: Suction and discharge pressure gages.
  10. Lights: Running light for each pump.
  11. Alarm Signal Device: Sounds alarm when backup pumps are operating.
  12. Thermal-bleed cutoff.
  13. Low-suction-pressure cutout.
  14. Low-discharge-pressure cutout.
- I. Base: Structural steel.



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- J. Capacities and Characteristics: See schedules

### 2.2 MOTORS

- A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors.
  - 1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
  - 2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in NFPA 70.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine roughing-in for booster pumps to verify actual locations of piping connections before booster-pump installation.

### 3.2 INSTALLATION

- A. Equipment Mounting:
  - 1. Install booster pumps on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
  - 2. Comply with requirements for vibration isolation and seismic control devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment"
  - 3. Comply with requirements for vibration isolation devices specified in Section 220548.13 "Vibration Controls for Plumbing Piping and Equipment."
- B. Support connected domestic-water piping so weight of piping is not supported by booster pumps.

### 3.3 CONNECTIONS

- A. Comply with requirements for piping specified in Section 221116 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect domestic-water piping to booster pumps. Install suction and discharge pipe equal to or greater than size of system suction and discharge headers.
  - 1. Install shutoff valves on piping connections to booster-pump suction and discharge headers. Install ball, butterfly, or gate valves same size as suction and discharge headers. Comply with requirements for general-duty valves specified in Section 220523.12 "Ball Valves for Plumbing Piping," Section 220523.13 "Butterfly Valves for Plumbing Piping," and Section 220523.15 "Gate Valves for Plumbing Piping."

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2. Install union, flanged, or grooved-joint connections on suction and discharge headers at connection to domestic-water piping. Comply with requirements for unions and flanges specified in Section 221116 "Domestic Water Piping."
3. Install valved bypass, same size as and between piping, at connections to booster-pump suction and discharge headers. Comply with requirements for domestic-water piping specified in Section 221116 "Domestic Water Piping."
4. Install flexible connectors, same size as piping, on piping connections to booster-pump suction and discharge headers. Comply with requirements for flexible connectors specified in Section 221116 "Domestic Water Piping."
5. Install piping adjacent to booster pumps to allow service and maintenance.

### 3.4 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

### 3.5 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. Tests and Inspections:
  1. Perform visual and mechanical inspection.
  2. Leak Test: After installation, charge booster pump and test for leaks. Repair leaks and retest until no leaks exist.
  3. Operational Test: After electrical circuitry has been energized, start booster pumps to confirm proper motor rotation and booster-pump operation.
  4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Pumps and controls will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

### 3.6 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
  1. Complete installation and startup checks according to manufacturer's written instructions.

### 3.7 ADJUSTING

- A. Adjust booster pumps to function smoothly, and lubricate as recommended by manufacturer.
- B. Adjust pressure set points.

## SECTION 221123.13 - DOMESTIC-WATER PACKAGED BOOSTER PUMPS

- C. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting booster pump to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

### 3.8 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain booster pumps.

END OF SECTION 221123.13

## SECTION 221316 - 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.

#### 1.2 SUMMARY

##### A. Section Includes:

1. Pipe, tube, and fittings.
2. Specialty pipe fittings.
3. Encasement for underground metal piping.

##### B. Related Sections:

1. Section 221313 "Facility Sanitary Sewers" for sanitary sewerage piping and structures outside the building.

#### 1.3 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:

1. Soil, Waste, and Vent Piping: 10-foot head of water.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For sovent drainage system. Include plans, elevations, sections, and details.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

#### 1.6 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF/ANSI 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping and "NSF-sewer" for plastic sewer piping.

## SECTION 221316 - SANITARY WASTE AND VENT PIPING

### 1.7 PROJECT CONDITIONS

- A. Interruption of Existing Sanitary Waste Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
  - 1. Notify Architect no fewer than two days in advance of proposed interruption of sanitary waste service.
  - 2. Do not proceed with interruption of sanitary waste service without Architect's written permission.

## PART 2 - PRODUCTS

### 2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

### 2.2 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 888 or CISPI 301.
- B. Sovent Stack Fittings: ASME B16.45 or ASSE 1043, hubless, cast-iron aerator and deaerator drainage fittings.
- C. Heavy-Duty, Hubless-Piping Couplings:
  - a. Manufacturers:
    - 1) ANACO.
    - 2) Clamp-All Corp.
    - 3) Ideal Div.; Stant Corp.
    - 4) Mission Rubber Co.
    - 5) Tyler Pipe; Soil Pipe Div.
  - 2. Standards: ASTM C 1277 and ASTM C 1540.
  - 3. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

### 2.3 PVC PIPE AND FITTINGS

- A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.
- B. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.
- C. Adhesive Primer: ASTM F 656.

## SECTION 221316 - SANITARY WASTE AND VENT PIPING

1. 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).
2. 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."

### D. Solvent Cement: ASTM D 2564.

1. 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).
2. Solvent cement 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."

## 2.4 SPECIALTY PIPE FITTINGS

### A. Transition Couplings:

1. General Requirements: Fitting or device for joining piping with small differences in OD's or of different materials. Include end connections same size as and compatible with pipes to be joined.
2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
3. Shielded, Nonpressure Transition Couplings:
  - a. Standard: ASTM C 1460.
  - b. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
4. Pressure Transition Couplings:
  - a. Standard: AWWA C219.
  - b. Description: Metal, sleeve-type same size as, with pressure rating at least equal to, and ends compatible with, pipes to be joined.
  - c. Center-Sleeve Material: Stainless steel.
  - d. Gasket Material: Natural or synthetic rubber.
  - e. Metal Component Finish: Corrosion-resistant coating or material.

### B. Dielectric Fittings:

1. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
2. Dielectric Unions:
  - a. Description:
    - 1) Standard: ASSE 1079.
    - 2) Pressure Rating: 150 psig.
    - 3) End Connections: Solder-joint copper alloy and threaded ferrous.

## SECTION 221316 - SANITARY WASTE AND VENT PIPING

3. Dielectric Flanges:
  - a. Description:
    - 1) Standard: ASSE 1079.
    - 2) Factory-fabricated, bolted, companion-flange assembly.
    - 3) Pressure Rating: 150 psig.
    - 4) End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
  
4. Dielectric-Flange Insulating Kits:
  - a. Description:
    - 1) Nonconducting materials for field assembly of companion flanges.
    - 2) Pressure Rating: 150 psig.
    - 3) Gasket: Neoprene or phenolic.
    - 4) Bolt Sleeves: Phenolic or polyethylene.
    - 5) Washers: Phenolic with steel backing washers.
  
5. Dielectric Nipples:
  - a. Description:
    - 1) Standard: IAPMO PS 66
    - 2) Electroplated steel nipple.
    - 3) Pressure Rating: 300 psig at 225 deg F.
    - 4) End Connections: Male threaded or grooved.
    - 5) Lining: Inert and noncorrosive, propylene.

### 2.5 ENCASMENT FOR UNDERGROUND METAL PIPING

- A. Standard: ASTM A 674 or AWWA C105/A 21.5.
- B. Material: high-density, cross-laminated polyethylene film of 0.004-inch minimum thickness.

## PART 3 - EXECUTION

### 3.1 EARTH MOVING

- A. Comply with requirements for excavating, trenching, and backfilling specified in Section 312000 "Earth Moving."

### 3.2 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

## SECTION 221316 - SANITARY WASTE AND VENT PIPING

- 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. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- K. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
- L. Install soil and waste drainage and vent piping at the following minimum slopes unless otherwise indicated:
  - 1. Building Sanitary Drain: 2 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
  - 2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.
  - 3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.
- M. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
  - 1. Install encasement on underground piping according to ASTM A 674 or AWWA C105/A 21.5.
- N. Install aboveground PVC piping according to ASTM D 2665.
- O. Install underground PVC piping according to ASTM D 2321.



## SECTION 221316 - SANITARY WASTE AND VENT PIPING

- P. Install engineered soil and waste drainage and vent piping systems as follows:
  - 1. Combination Waste and Vent: Comply with standards of authorities having jurisdiction.
  - 2. Solvent Drainage System: Comply with ASSE 1043 and solvent fitting manufacturer's written installation instructions.
  - 3. Reduced-Size Venting: Comply with standards of authorities having jurisdiction.
- Q. Plumbing Specialties:
  - 1. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary drainage gravity-flow piping. Install cleanout fitting with closure plug inside the building in sanitary drainage force-main piping. Comply with requirements for cleanouts specified in Section 221319 "Sanitary Waste Piping Specialties."
  - 2. Install drains in sanitary drainage gravity-flow piping. Comply with requirements for drains specified in Section 221319 "Sanitary Waste Piping Specialties."
- R. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- S. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- T. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- U. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

### 3.3 JOINT CONSTRUCTION

- A. Join hubless, cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.
- B. Plastic, Nonpressure-Piping, Solvent-Cement 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. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 Appendixes.

### 3.4 SPECIALTY PIPE FITTING INSTALLATION

- A. Transition Couplings:
  - 1. Install transition couplings at joints of piping with small differences in OD's.
  - 2. In Drainage Piping: Shielded, nonpressure transition couplings.
  - 3. In Aboveground Force Main Piping: Fitting-type transition couplings.
  - 4. In Underground Force Main Piping:

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- a. NPS 1-1/2 and Smaller: Fitting-type transition couplings.
- b. NPS 2 and Larger: Pressure transition couplings.

### B. Dielectric Fittings:

1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
2. Dielectric Fittings for NPS 2 and Smaller: Use dielectric unions.
3. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flange kits.
4. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

## 3.5 HANGER AND SUPPORT INSTALLATION

### A. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

1. Vertical Piping: MSS Type 8 or Type 42, clamps.
2. Install individual, straight, horizontal piping runs:
  - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
  - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
  - c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.
3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers.

### B. Support horizontal piping and tubing within 12 inches of each fitting, valve, and coupling.

### C. Support vertical piping and tubing at base and at each floor.

### D. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.

### E. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
2. NPS 3: 60 inches with 1/2-inch rod.
3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
4. NPS 6 and NPS 8: 60 inches with 3/4-inch rod.
5. NPS 10 and NPS 12: 60 inches with 7/8-inch rod.
6. Spacing for 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.

### F. Install supports for vertical cast-iron soil piping every 15 feet.

### G. Install hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2: 48 inches with 3/8-inch rod.
2. NPS 3: 48 inches with 1/2-inch rod.
3. NPS 4 and NPS 5: 48 inches with 5/8-inch rod.

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4. NPS 6 and NPS 8: 48 inches with 3/4-inch rod.
5. NPS 10 and NPS 12: 48 inches with 7/8-inch rod.

- H. Install supports for vertical PVC piping every 48 inches.
- I. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

### 3.6 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect drainage and vent piping to the following:
  1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
  2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
  3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
  4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
  5. Comply with requirements for cleanouts and drains specified in Section 221319 "Sanitary Waste Piping Specialties."
  6. Equipment: Connect drainage piping as indicated. Provide shutoff valve if indicated and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 and larger.
- D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.
- E. Make connections according to the following unless otherwise indicated:
  1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
  2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

### 3.7 IDENTIFICATION

- A. Identify exposed sanitary waste and vent piping. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

## SECTION 221316 - SANITARY WASTE AND VENT PIPING

### 3.8 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
  - 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
  - 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
  - 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
  - 2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
  - 3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping except outside leaders on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
  - 4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
  - 5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
  - 6. Prepare reports for tests and required corrective action.

### 3.9 CLEANING AND PROTECTION

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.

## SECTION 221316 - SANITARY WASTE AND VENT PIPING

- D. Exposed PVC Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.

### 3.10 PIPING SCHEDULE

- A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.
- A. Underground and above ground (unless noted otherwise), soil, waste, and vent piping shall be the following:
  - 1. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
  - 2. Dissimilar Pipe-Material Couplings: Shielded, nonpressure pipe couplings for joining dissimilar pipe materials with small difference in OD.
- B. In Return Air Plenum: Soil, waste, and vent piping shall be the following:
  - 1. Hubless cast-iron soil pipe and fittings; heavy-duty shielded, stainless-steel couplings; and hubless-coupling joints.

END OF SECTION 221316

## SECTION 221319 - SANITARY WASTE PIPING SPECIALTIES

### 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. Cleanouts.
  - 2. Floor drains.
  - 3. Roof flashing assemblies.
  - 4. Through-penetration firestop assemblies.
  - 5. Miscellaneous sanitary drainage piping specialties.
  - 6. Flashing materials.
  - 7. Oil interceptors.

#### 1.3 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. FOG: Fats, oils, and greases.
- C. FRP: Fiberglass-reinforced plastic.
- D. HDPE: High-density polyethylene plastic.
- E. PE: Polyethylene plastic.
- F. PP: Polypropylene plastic.
- G. PVC: Polyvinyl chloride plastic.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and accessories for the following:
  - 1. Oil interceptors.
- B. Shop Drawings: Show fabrication and installation details for frost-resistant vent terminals.
  - 1. Wiring Diagrams: Power, signal, and control wiring.

## SECTION 221319 - SANITARY WASTE PIPING SPECIALTIES

### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For drainage piping specialties to include in emergency, operation, and maintenance manuals.

### 1.6 QUALITY ASSURANCE

- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.
- B. 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.
- C. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic sanitary piping specialty components.

### 1.7 COORDINATION

- A. Coordinate size and location of roof penetrations.

## PART 2 - PRODUCTS

### 2.1 CLEANOUTS

#### A. Metal Floor Cleanouts:

1. ASME A112.36.2M, Cast-Iron Cleanouts: see detail on plans.
2. Standard: ASME A112.36.2M for [**cast-iron soil pipe with cast-iron ferrule**]  
[**threaded, adjustable housing**] cleanout.
3. Size: Same as connected branch.
4. Type: [**Threaded, adjustable housing**].
5. Body or Ferrule: [**Cast iron**].
6. Clamping Device: [**Required**].
7. Outlet Connection: [**Threaded**].
8. Closure: [**Cast-iron plug**].
9. Adjustable Housing Material: [**Cast iron**] with [**threads**].
10. Frame and Cover Material and Finish: [**Nickel-bronze, copper alloy**].
11. Frame and Cover Shape: [**Round**].
12. Top Loading Classification: [**Medium**] Duty.

#### B. Plastic Wall Cleanouts:

1. See detail on plans.
2. Size: Same as connected branch.
3. Body: PVC.

## SECTION 221319 - SANITARY WASTE PIPING SPECIALTIES

4. Closure Plug: Stainless Steel.
5. Riser: Drainage pipe fitting and riser to cleanout of same material as drainage piping.

### 2.2 FLOOR DRAINS

#### A. Manufacturers:

1. Zurn.
2. Mifab.
3. Josam.
4. Wade.
5. Watts.

#### B. Description: See schedules.

### 2.3 ROOF FLASHING ASSEMBLIES

#### A. Roof Flashing Assemblies:

1. Description: Manufactured assembly made of [6.0-lb/sq. ft. (30-kg/sq. m), 0.0938-inch-(2.4-mm-)] thick, lead flashing collar and skirt extending at least [6 inches (150 mm)] from pipe, with galvanized-steel boot reinforcement and counterflashing fitting.
  - a. Open-Top Vent Cap: Without cap.
  - b. Low-Silhouette Vent Cap: With vandal-proof vent cap.
  - c. Extended Vent Cap: With field-installed, vandal-proof vent cap.

### 2.4 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

#### A. Through-Penetration Firestop Assemblies:

1. Standard: UL 1479 assembly of sleeve and stack fitting with firestopping plug.
2. Size: Same as connected soil, waste, or vent stack.
3. Sleeve: Molded PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
4. Stack Fitting: ASTM A 48/A 48M, gray-iron, hubless-pattern, wye branch with neoprene O-ring at base and gray-iron plug in thermal-release harness. Include PVC protective cap for plug.
5. Special Coating: Corrosion resistant on interior of fittings.

### 2.5 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

#### A. Floor-Drain, Trap-Seal Primer Fittings:



## SECTION 221319 - SANITARY WASTE PIPING SPECIALTIES

1. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
2. Size: Same as floor drain outlet with **NPS 1/2 (DN 15)** side inlet.

### B. Air-Gap Fittings:

1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
2. Body: Bronze or cast iron.
3. Inlet: Opening in top of body.
4. Outlet: Larger than inlet.
5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

### C. Sleeve Flashing Device:

1. Description: Manufactured, cast-iron fitting, with clamping device, that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend [**1 inch (25 mm)**] [**2 inches (51 mm)**] **<Insert dimension>** above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
2. Size: As required for close fit to riser or stack piping.

### D. Stack Flashing Fittings:

1. Description: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
2. Size: Same as connected stack vent or vent stack.

## 2.6 FLASHING MATERIALS

### A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:

1. General Use: **4.0-lb/sq. ft. (20-kg/sq. m)**, **0.0625-inch (1.6-mm)** thickness.
2. Vent Pipe Flashing: **3.0-lb/sq. ft. (15-kg/sq. m)**, **0.0469-inch (1.2-mm)** thickness.
3. Burning: **6-lb/sq. ft. (30-kg/sq. m)**, **0.0938-inch (2.4-mm)** thickness.

### B. Copper Sheet: ASTM B 152/B 152M, of the following minimum weights and thicknesses, unless otherwise indicated:

1. General Applications: **12 oz./sq. ft. (3.7 kg/sq. m or 0.41-mm thickness)**.
2. Vent Pipe Flashing: **8 oz./sq. ft. (2.5 kg/sq. m or 0.27-mm thickness)**.

### C. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and **0.04-inch (1.01-mm)** minimum thickness, unless otherwise indicated. Include **G90 (Z275)** hot-dip galvanized, mill-phosphatized finish for painting if indicated.

### D. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, **40-mil (1.01-mm)** minimum thickness.

## SECTION 221319 - SANITARY WASTE PIPING SPECIALTIES

- E. Fasteners: Metal compatible with material and substrate being fastened.
- F. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.
- G. Solder: ASTM B 32, lead-free alloy.
- H. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

### 2.7 OIL INTERCEPTORS

- A. Oil Interceptors:
  - 1. Description: See Schedule.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
  - 1. Size same as drainage piping up to **NPS 4 (DN 100)**. Use **NPS 4 (DN 100)** for larger drainage piping unless larger cleanout is indicated.
  - 2. Locate at each change in direction of piping greater than 45 degrees.
  - 3. Locate at minimum intervals of **50 feet (15 m)** for piping **NPS 4 (DN 100)** and smaller and **100 feet (30 m)** for larger piping.
  - 4. Locate at base of each vertical soil and waste stack.
- B. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- C. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- D. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
  - 1. Position floor drains for easy access and maintenance.
  - 2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:
    - a. Coordinate with Structural Drawings prior installation.
    - b. Radius, **30 Inches (750 mm)** or Less: Equivalent to 1 percent slope, but not less than **1/4-inch (6.35-mm)** total depression.
    - c. Radius, **30 to 60 Inches (750 to 1500 mm)**: Equivalent to 1 percent slope.
    - d. Radius, **60 Inches (1500 mm)** or Larger: Equivalent to 1 percent slope, but not greater than **1-inch (25-mm)** total depression.

## SECTION 221319 - SANITARY WASTE PIPING SPECIALTIES

3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
  4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.
- E. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.
- F. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.
- G. Install through-penetration firestop assemblies in plastic [**conductors**] [**and**] [**stacks**] at floor penetrations.
- H. Assemble open drain fittings and install with top of hub [**1 inch (25 mm)**] [**2 inches (51 mm)**] above floor.
- I. Install deep-seal traps on floor drains and other waste outlets, if indicated.
- J. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.
1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
  2. Size: Same as floor drain inlet.
- K. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.
- L. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.
- M. Install vent caps on each vent pipe passing through roof.
- N. Install oil interceptors, including trapping, venting, and flow-control fitting, according to authorities having jurisdiction and with clear space for servicing.
- O. Install wood-blocking reinforcement for wall-mounting-type specialties.
- P. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

### 3.2 CONNECTIONS

- A. Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.
- C. Oil Interceptors: Connect inlet, outlet, vent, and gravity drawoff piping to unit; flow-control fitting and vent to unit inlet piping; and gravity drawoff and suction piping to oil storage tank.

## SECTION 221319 - SANITARY WASTE PIPING SPECIALTIES

- D. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- E. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

### 3.3 FLASHING INSTALLATION

- A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:
  - 1. Lead Sheets: Burn joints of lead sheets **6.0-lb/sq. ft. (30-kg/sq. m)**, **0.0938-inch (2.4-mm)** thickness or thicker. Solder joints of lead sheets **4.0-lb/sq. ft. (20-kg/sq. m)**, **0.0625-inch (1.6-mm)** thickness or thinner.
  - 2. Copper Sheets: Solder joints of copper sheets.
- B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
  - 1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of **10 inches (250 mm)**, and skirt or flange extending at least **8 inches (200 mm)** around pipe.
  - 2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least **8 inches (200 mm)** around sleeve.
  - 3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least **8 inches (200 mm)** around specialty.
- C. Set flashing on floors and roofs in solid coating of bituminous cement.
- D. Secure flashing into sleeve and specialty clamping ring or device.
- E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Section 076200 "Sheet Metal Flashing and Trim."
- F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.
- G. Fabricate and install flashing and pans, sumps, and other drainage shapes.

### 3.4 LABELING AND IDENTIFYING

- A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
  - 1. Oil interceptors.
- B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

## SECTION 221319 - SANITARY WASTE PIPING SPECIALTIES

### 3.5 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
  - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled **[Oil Separator]** and its installation, including piping and electrical connections, and to assist in testing.
- B. Tests and Inspections:
  - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
  - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

### 3.6 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

### 3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain **[Oil Separator]**. Refer to Section 017900 "Demonstration and Training."

END OF SECTION 221319

## SECTION 221323 - SANITARY WASTE INTERCEPTORS

### 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. Grease interceptors.
  - 2. Oil interceptors.

#### 1.3 DEFINITIONS

- A. FRP: Fiberglass-reinforced plastic.
- B. PP: Polypropylene plastic.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of interceptor indicated. Include materials of fabrication, dimensions, rated capacities, retention capacities, operating characteristics, size and location of each pipe connection, furnished specialties, and accessories.
- B. Shop Drawings: For each type and size of precast-concrete interceptor indicated.
  - 1. Include materials of construction, dimensions, rated capacities, retention capacities, location and size of each pipe connection, furnished specialties, and accessories.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Interceptors, 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. Interceptors.
  - 2. Piping connections. Include size, location, and elevation of each.
  - 3. Interface with underground structures and utility services.

### PART 2 - PRODUCTS

#### 2.1 GREASE INTERCEPTORS

- A. Grease Interceptors: Precast concrete complying with ASTM C 913.

## SECTION 221323 - SANITARY WASTE INTERCEPTORS

1. Include rubber-gasketed joints, vent connections, manholes, compartments or baffles, and piping or openings to retain grease and to permit wastewater flow.
2. Structural Design Loads:
  - a. Heavy-Traffic Load: Comply with ASTM C 890, A-16 (ASSHTO HS20-44).
3. Resilient Pipe Connectors: ASTM C 923, cast or fitted into interceptor walls, for each pipe connection.
4. Steps: ASTM A 615/A 615M, deformed, 1/2-inch steel reinforcing rods encased in ASTM D 4101, PP, wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12- to 16-inch intervals. Omit steps if total depth from floor of interceptor to finished grade is less than 60 inches.
5. Grade Rings: Reinforced-concrete rings, 6- to 9-inch total thickness, to match diameter of manhole frame and cover.
6. Manhole Frames and Covers: Ferrous; 24-inch ID by 7- to 9-inch riser with 4-inch-minimum width flange and 26-inch-diameter cover.
  - a. Ductile Iron: ASTM A 536, Grade 60-40-18, unless otherwise indicated.
  - b. Gray Iron: ASTM A 48, Class 35, unless otherwise indicated.
  - c. Include indented top design with lettering cast into cover, using wording equivalent to "GREASE INTERCEPTOR."

B. Capacities and Characteristics: See Drawing Schedules.

## 2.2 OIL INTERCEPTORS

- A. Oil Interceptors: Precast concrete comply with ASTM C 913.
1. Include rubber-gasketed joints, vent connections, manholes, compartments or baffles, and piping or openings to retain grease and to permit wastewater flow.
  2. Structural Design Loads:
    - a. Medium-Traffic Load: Comply with ASTM C 890, A-12 (ASSHTO HS15-44).
  3. Resilient Pipe Connectors: ASTM C 923, cast or fitted into interceptor walls, for each pipe connection.
  4. Steps: ASTM A 615/A 615M, deformed, 1/2-inch steel reinforcing rods encased in ASTM D 4101, PP, wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12- to 16-inch intervals. Omit steps if total depth from floor of interceptor to finished grade is less than 60 inches.
  5. Grade Rings: Reinforced-concrete rings, 6- to 9-inch total thickness, to match diameter of manhole frame and cover.
  6. Manhole Frames and Covers: Ferrous; 24-inch ID by 7- to 9-inch riser with 4-inch-minimum width flange and 26-inch-diameter cover.
    - a. Ductile Iron: ASTM A 536, Grade 60-40-18, unless otherwise indicated.
    - b. Gray Iron: ASTM A 48, Class 35, unless otherwise indicated.
    - c. Include indented top design with lettering cast into cover, using wording equivalent to "OIL INTERCEPTOR."

B. Capacities and Characteristics: See Drawing Schedules.

## SECTION 221323 - SANITARY WASTE INTERCEPTORS

### PART 3 - EXECUTION

#### 3.1 EARTHWORK

- A. Excavating, trenching, and backfilling are specified in Section 312000 "Earth Moving."

#### 3.2 INSTALLATION

- A. Install precast-concrete interceptors according to ASTM C 891. Set level and plumb.
- B. Install manhole risers from top of underground concrete interceptors to manholes and gratings at finished grade.
- C. Set tops of manhole frames and covers flush with finished surface in pavements. Set tops 3 inches above finish surface elsewhere, unless otherwise indicated.
- D. Set tops of grating frames and grates flush with finished surface.
- E. Set interceptors level and plumb.

#### 3.3 CONNECTIONS

- A. Piping installation requirements are specified in Section 221316 "Sanitary Waste and Vent Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Make piping connections between interceptors and piping systems.

#### 3.4 IDENTIFICATION

- A. Identification materials and installation are specified in Section 312000 "Earth Moving." Arrange for installation of green warning tapes directly over piping and at outside edges of underground interceptors.
  - 1. Use warning tapes or detectable warning tape over ferrous piping.
  - 2. Use detectable warning tape over nonferrous piping and over edges of underground structures.

END OF SECTION 221323



## SECTION 221413 – FACILITY STORM DRAINAGE 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 the following storm drainage piping inside the building:
  - 1. Pipe, tube, and fittings.
  - 2. Special pipe fittings.
  - 3. Encasement for underground metal piping.

#### 1.3 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working-pressure, unless otherwise indicated:
  - 1. Storm Drainage Piping: **20-foot head of water**

#### 1.4 SUBMITTALS

- A. Product Data: For pipe, tube, fittings, and couplings.
- B. Field quality-control inspection and test reports.

#### 1.5 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-drain" for plastic drain piping and "NSF-sewer" for plastic sewer piping.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

## SECTION 221413 – FACILITY STORM DRAINAGE PIPING

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

### 2.2 PIPING MATERIALS

- A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

### 2.3 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 888 or CISPI 301.
- B. Shielded Couplings: ASTM C 1277 assembly of metal shield or housing, corrosion-resistant fasteners, and rubber sleeve with integral, center pipe stop.
  1. Heavy-Duty, Shielded, Stainless-Steel Couplings: With stainless-steel shield, stainless-steel bands and tightening devices, and ASTM C 564, rubber sleeve.
    - a. Manufacturers:
      - 1) ANACO.
      - 2) Clamp-All Corp.
      - 3) Ideal Div.; Stant Corp.
      - 4) Mission Rubber Co.
      - 5) Tyler Pipe; Soil Pipe Div.

### 2.4 PVC PIPE AND FITTINGS

- A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.
  1. PVC Socket Fittings: ASTM D 2665, socket type, made to ASTM D 3311, drain, waste, and vent patterns.

### 2.5 SPECIAL PIPE FITTINGS

- A. Flexible, Nonpressure Pipe Couplings: Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition pattern. Include shear ring, ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.
  1. Sleeve Materials:
    - a. For Cast-Iron Soil Pipes: ASTM C 564, rubber.
- B. Shielded Nonpressure Pipe Couplings: ASTM C 1460, elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

## SECTION 221413 – FACILITY STORM DRAINAGE PIPING

- C. Rigid, Unshielded, Nonpressure Pipe Couplings: ASTM C 1461, sleeve-type reducing- or transition-type mechanical coupling molded from ASTM C 1440, TPE material with corrosion-resistant-metal tension band and tightening mechanism on each end.
- D. Flexible Ball Joints: Ductile-iron fitting with combination of flanged and mechanical-joint ends complying with AWWA C110 or AWWA C153. Include gasketed ball-joint section and ductile-iron gland, rubber gasket, and steel bolts.
- E. Expansion Joints: Two or three-piece, ductile-iron assembly consisting of telescoping sleeve(s) with gaskets and restrained-type, ductile-iron, bell-and-spigot end sections complying with AWWA C110 or AWWA C153. Select and assemble components for expansion indicated. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.

### 2.6 ENCASUREMENT FOR UNDERGROUND METAL PIPING

- A. Description: ASTM A 674 or AWWA C105, **high-density, crosslaminated PE film of 0.004-inch** minimum thickness.

## PART 3 - EXECUTION

### 3.1 EXCAVATION

- A. Refer to Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

### 3.2 PIPING APPLICATIONS

- A. Flanges and unions may be used on aboveground pressure piping, unless otherwise indicated.
- B. Underground and above ground storm drainage piping **NPS 8 and smaller (UNO)** shall be the following:
  - 1. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
  - 2. Dissimilar Pipe-Material Couplings: Shielded, nonpressure pipe couplings for joining dissimilar pipe materials with small difference in OD.
- C. In Return Air Plenum: Storm drainage piping **NPS 8 and smaller** shall be the following:
  - 1. Hubless cast-iron soil pipe and fittings; **heavy-duty** shielded, stainless-steel couplings; and coupled joints.

### 3.3 PIPING INSTALLATION

- A. Storm sewer and drainage piping outside the building are specified in Division 33 Section "Storm Utility Drainage Piping."
- B. Basic piping installation requirements are specified in Division 22 Section "Common Work Results for Plumbing."

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- C. Install cleanouts at grade and extend to where building storm drains connect to building storm sewers. Cleanouts are specified in Division 22 Section "Storm Drainage Piping Specialties."
- D. Install cleanout fitting with closure plug inside the building in storm drainage force-main piping.
- E. Install underground, steel, force-main piping. **Install encasement on piping according to ASTM A 674 or AWWA C105.**
- F. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
  - 1. Install encasement on underground piping according to ASTM A 674 or AWWA C105.
- G. Install PVC soil and waste drainage and vent piping according to ASTM D 2665.
- H. Install underground PVC soil and waste drainage piping according to ASTM D 2321.
- I. Make changes in direction for storm drainage piping using appropriate branches, bends, and long-sweep bends. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- J. Lay buried building storm drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
- K. Install storm drainage piping at the following minimum slopes, unless otherwise indicated:
  - 1. Building Storm Drain: 1 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
  - 2. Horizontal Storm-Drainage Piping: 2 percent downward in direction of flow.
- L. Install force mains at elevations indicated.
- M. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.
- N. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- O. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 22 Section "Sleeves and Sleeve Seals for Plumbing Piping."
- P. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 22 Section "Sleeves and Sleeve Seals for Plumbing Piping."

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- Q. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 22 Section "Escutcheons for Plumbing Piping."

### 3.4 JOINT CONSTRUCTION

- A. Basic piping joint construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."
- B. Hubless Cast-Iron Soil Piping Coupled Joints: Join according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.
- C. PVC Nonpressure Piping Joints: Join piping according to ASTM D 2665.

### 3.5 HANGER AND SUPPORT INSTALLATION

- A. Pipe hangers and supports are specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment." Install the following:
  - 1. Vertical Piping: MSS Type 8 or Type 42, clamps.
  - 2. Individual, Straight, Horizontal Piping Runs: According to the following:
    - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
    - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
    - c. Longer Than 100 Feet, if Indicated: MSS Type 49, spring cushion rolls.
  - 3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
  - 4. Base of Vertical Piping: MSS Type 52, spring hangers.
- B. Install supports according to Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."
- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.
- E. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
  - 1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
  - 2. NPS 3: 60 inches with 1/2-inch rod.
  - 3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
  - 4. NPS 6: 60 inches with 3/4-inch rod.
  - 5. NPS 8 to NPS 12: 60 inches with 7/8-inch rod.
  - 6. Spacing for 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.
- F. Install supports for vertical cast-iron soil piping every 15 feet.

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- G. Install hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:
  - 1. NPS 1-1/2 and NPS 2: 48 inches with 3/8-inch rod.
  - 2. NPS 3: 48 inches with 1/2-inch rod.
  - 3. NPS 4 and NPS 5: 48 inches with 5/8-inch rod.
  - 4. NPS 6: 48 inches with 3/4-inch rod.
- H. Install supports for vertical PVC piping every 48 inches.
- I. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

### 3.6 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect interior storm drainage piping to exterior storm drainage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect storm drainage piping to roof drains and storm drainage specialties.

### 3.7 INSULATION

- A. Refer to Plumbing Insulation Specification Section 220719.
- B. Service: Rainwater conductors, and roof drain bodies.
  - 1. Operating Temperature: 32 to 100 deg F
  - 2. Insulation Material: Flexible elastomeric.
  - 3. Insulation Thickness: 1" thick.
  - 4. Vapor Retarder Required: Yes.
  - 5. Finish: Painted, where exposed to view (Coordinate with Architect).

### 3.8 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
  - 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in.
  - 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

## SECTION 221413 – FACILITY STORM DRAINAGE PIPING

- D. Test storm drainage piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
  - 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
  - 2. Leave uncovered and unconcealed new, altered, extended, or replaced storm drainage piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
  - 3. Test Procedure: Test storm drainage piping, **except outside leaders**, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
  - 4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
  - 5. Prepare reports for tests and required corrective action.

### 3.9 CLEANING

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.

### 3.10 PROTECTION

- A. Exposed **PVC** Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.

END OF SECTION 221413

## SECTION 221423 - STORM DRAINAGE PIPING SPECIALTIES

### 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. Miscellaneous storm drainage piping specialties.
  - 2. Cleanouts.
  - 3. Flashing materials.

#### 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.

#### 1.4 QUALITY ASSURANCE

- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

### PART 2 - PRODUCTS

#### 2.1 ROOF DRAINS

- A. See schedules:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Josam Company.
    - b. MIFAB, Inc.
    - c. Zurn Plumbing Products Group; Specification Drainage Operation.

#### 2.2 CLEANOUTS

- A. Floor Cleanouts: See schedules
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Josam Company; Josam Div.
    - b. MIFAB, Inc.
    - c. Zurn Plumbing Products Group; Light Commercial Operation.



## SECTION 221423 - STORM DRAINAGE PIPING SPECIALTIES

### B. Test Tees:

1. Manufacturers:
  - a. Josam Company.
  - b. MIFAB, Inc.
  - c. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.36.2M and ASTM A 74, ASTM A 888, or CISPI 301, for cleanout test tees.
3. Size: Same as connected drainage piping.
4. Body Material: Hub-and-spigot, cast-iron soil-pipe T-branch or hubless, cast-iron soil-pipe test tee as required to match connected piping.
5. Closure Plug: **Countersunk brass**.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

### C. Wall Cleanouts:

1. Manufacturers:
  - a. Josam Company.
  - b. MIFAB, Inc.
  - c. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.36.2M, for cleanouts. Include wall access.
3. Size: Same as connected drainage piping.
4. Body Material: **Hubless, cast-iron soil-pipe test tee** as required to match connected piping.
5. Closure: **Countersunk, drilled-and-threaded, cast-iron** plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Wall Access: Round, **stainless-steel** cover plate with screw.

## 2.3 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

### A. Through-Penetration Firestop Assemblies:

1. Manufacturers:
  - a. ProSet Systems Inc.
2. Standard: ASTM E 814, for through-penetration firestop assemblies.
3. Certification and Listing: **Insert testing agency acceptable to authorities having jurisdiction** for through-penetration firestop assemblies.
4. Size: Same as connected pipe.
5. Sleeve: Molded PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
6. Stack Fitting: ASTM A 48/A 48M, gray-iron, hubless-pattern, wye branch with neoprene O-ring at base and gray-iron plug in thermal-release harness. Include PVC protective cap for plug.
7. Special Coating: Corrosion resistant on interior of fittings.

## 2.4 FLASHING MATERIALS

- A. Copper Sheet: ASTM B 152/B 152M, **12 oz./sq. ft.**

## SECTION 221423 - STORM DRAINAGE PIPING SPECIALTIES

- B. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and **0.04-inch** minimum thickness unless otherwise indicated. Include **G90** hot-dip galvanized, mill-phosphatized finish for painting if indicated.
- C. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, **40-mil** minimum thickness.
- D. Fasteners: Metal compatible with material and substrate being fastened.
- E. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.
- F. Solder: ASTM B 32, lead-free alloy.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Install roof drains at low points of roof areas according to roof membrane manufacturer's written installation instructions. Roofing materials are specified in Division 07 Sections.
  - 1. Install flashing collar or flange of roof drain to prevent leakage between drain and adjoining roofing. Maintain integrity of waterproof membranes where penetrated.
  - 2. Install expansion joints, if indicated, in roof drain outlets.
  - 3. Position roof drains for easy access and maintenance.
- B. Install downspout adapters on outlet of back-outlet parapet roof drains and connect to sheet metal downspouts.
- C. Install downspout boots at grade with top **12 inches** above grade. Secure to building wall.
- D. Install conductor nozzles at exposed bottom of conductors where they spill onto grade.
- E. Install cleanouts in aboveground piping and building drain piping according to the following instructions unless otherwise indicated:
  - 1. Use cleanouts the same size as drainage piping up to **NPS 4**. Use **NPS 4** for larger drainage piping unless larger cleanout is indicated.
  - 2. Locate cleanouts at each change in direction of piping greater than 45 degrees.
  - 3. Locate cleanouts at minimum intervals of **50 feet** for piping **NPS 4** and smaller and **100 feet** for larger piping.
  - 4. Locate cleanouts at base of each vertical soil and waste stack.
- F. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- G. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- H. Install test tees in vertical conductors and near floor.

## SECTION 221423 - STORM DRAINAGE PIPING SPECIALTIES

- I. Install wall cleanouts in vertical conductors. Install access door in wall if indicated.
- J. Install through-penetration firestop assemblies in plastic conductors at concrete floor penetrations.
- K. Install sleeve flashing device with each conductor passing through floors with waterproof membrane.

### 3.2 CONNECTIONS

- A. Comply with requirements for piping specified in Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

### 3.3 FLASHING INSTALLATION

- A. Fabricate flashing from single piece of metal unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:
  - 1. Copper Sheets: Solder joints of copper sheets.
- B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
  - 1. Pipe Flashing: Sleeve type, matching the pipe size, with a minimum length of **10 inches** and with skirt or flange extending at least **8 inches** around pipe.
  - 2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least **8 inches** around sleeve.
  - 3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least **8 inches** around specialty.
- C. Set flashing on floors and roofs in solid coating of bituminous cement.
- D. Secure flashing into sleeve and specialty clamping ring or device.
- E. Fabricate and install flashing and pans, sumps, and other drainage shapes.

### 3.4 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 221423

## SECTION 221513 - GENERAL-SERVICE COMPRESSED-AIR PIPING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. This Section includes piping and related specialties for general-service compressed-air systems operating at 200 psig or less.
- B. Related Sections include the following:
  - 1. Section 221519 "General-Service Packaged Air Compressors and Receivers" for general-service air compressors and accessories.

#### 1.3 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. CR: Chlorosulfonated polyethylene synthetic rubber.
- C. EPDM: Ethylene-propylene-diene terpolymer rubber.
- D. HDPE: High-density polyethylene plastic.
- E. NBR: Acrylonitrile-butadiene rubber.
- F. PE: Polyethylene plastic.
- G. PVC: Polyvinyl chloride plastic.
- H. High-Pressure Compressed-Air Piping: System of compressed-air piping and specialties operating at pressures between 150 and 200 psig.
- I. Low-Pressure Compressed-Air Piping: System of compressed-air piping and specialties operating at pressures of 150 psig or less.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For the following:
  - 1. Dielectric fittings.
  - 2. Flexible pipe connectors.
  - 3. Safety valves.
  - 4. Pressure regulators. Include rated capacities and operating characteristics.
  - 5. Automatic drain valves.

## SECTION 221513 - GENERAL-SERVICE COMPRESSED-AIR PIPING

6. Filters. Include rated capacities and operating characteristics.
7. Lubricators. Include rated capacities and operating characteristics.
8. Quick couplings.
9. Hose assemblies.

### 1.5 INFORMATIONAL SUBMITTALS

- A. Brazing and welding certificates.
- B. Qualification Data: For Installers.
- C. Field quality-control test reports.

### 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For general-service compressed-air piping specialties to include in emergency, operation, and maintenance manuals.

### 1.7 QUALITY ASSURANCE

- A. Installer Qualifications:
  1. Extruded-Tee Outlet Procedure: Qualify operators according to training provided by T-DRILL Industries Inc., for making branch outlets.
  2. Pressure-Seal Joining Procedure for Copper Tubing: Qualify operators according to training provided by Viega; Plumbing and Heating Systems.
  3. Pressure-Seal Joining Procedure for Steel Piping. Qualify operators according to training provided by Victaulic Company.
- B. Brazing: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications," or to AWS B2.2, "Standard for Brazing Procedure and Performance Qualification."
- C. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
- D. ASME Compliance:
  1. Comply with ASME B31.1, "Power Piping," for high-pressure compressed-air piping.
  2. Comply with ASME B31.9, "Building Services Piping," for low-pressure compressed-air piping.

## PART 2 - PRODUCTS

### 2.1 PIPES, TUBES, AND FITTINGS

- A. Copper Tube: ASTM B 88, Type K or L seamless, drawn-temper, water tube.
  1. Wrought-Copper Fittings: ASME B16.22, solder-joint pressure type or MSS SP-73, wrought copper with dimensions for brazed joints.

## SECTION 221513 - GENERAL-SERVICE COMPRESSED-AIR PIPING

2. Cast-Copper-Alloy Flanges: ASME B16.24, Class 150 or 300.
  3. Copper Unions: ASME B16.22 or MSS SP-123.
  4. Press-Type Fittings, NPS 2 and Smaller: Wrought-copper fitting with EPDM O-ring seal in each end.
  5. Press-Type Fittings, NPS 2-1/2 to NPS 4: Bronze fitting with stainless-steel grip ring and EPDM O-ring seal in each end.
  6. Extruded-Tee Outlets: Procedure for making branch outlets in copper tube according to ASTM F 2014.
  7. Grooved-End Fittings and Couplings:
    - a. Grooved-End Fittings: ASTM B 75, copper tube or ASTM B 584, bronze castings.
    - b. Couplings: Copper-tube dimensions and design similar to AWWA C606. Include ferrous housing sections, gasket suitable for compressed air, and bolts and nuts. Provide EDPM gasket for oil-free compressed air. Provide NBR gasket if compressed air contains oil or oil vapor.
- B. Transition Couplings for Metal Piping: Metal coupling or other manufactured fitting same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

### 2.2 JOINING MATERIALS

- A. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated.

### 2.3 VALVES

- A. General Requirements for Valves: Manufacturer cleaned, purged, and bagged according to CGA G-4.1 for oxygen service.
- B. Zone-Valve Box Assemblies: Box with gas valves, tube extensions, and gages.
1. Zone-Valve Boxes:
    - a. Steel Box with Stainless-Steel Cover:
    - b. Manufacturers:
      - 1) Allied Healthcare Products, Inc.; Chemetron Div.
      - 2) Allied Healthcare Products, Inc.; Oxequip Health Industries.
      - 3) Amico Corporation.
      - 4) Beacon Medical Products.
      - 5) Hill-Rom.
      - 6) Squire-Cogswell/Aeros Instruments.
      - 7) Tri-Tech Medical, Inc.
    - c. Description: Formed steel box with cover, anchors for recessed mounting, holes with grommets in box sides for tubing extension protection, and of size for single or multiple valves with pressure gages and in sizes required to permit manual operation of valves. Air and vacuum tubing, valves, and gages may be incorporated in zone valve boxes for gases.
      - 1) Interior Finish: Factory-applied white enamel.
      - 2) Cover Plate: stainless-steel with frangible or removable windows.

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- 3) Valve-Box Windows: Clear or tinted transparent plastic with labeling that includes rooms served, according to NFPA 99.

### C. Ball Valves:

1. Manufacturers:
  - a. Allied Healthcare Products, Inc.; Chemetron Div.
  - b. Allied Healthcare Products, Inc.; Oxequip Health Industries.
  - c. Beacon Medical Products.
  - d. EMSE Corporation.
  - e. Hill-Rom.
  - f. Milwaukee Valve Company.
  - g. NIBCO INC.
  - h. Squire-Cogswell/Aeros Instruments.
2. Standard: MSS SP-110.
3. Description: Three-piece body, brass or bronze.
4. Pressure Rating: 300 psig minimum.
5. Ball: Full-port, chrome-plated brass.
6. Seats: PTFE or TFE.
7. Handle: Lever type with locking device.
8. Stem: Blowout proof with PTFE or TFE seal.
9. Ends: Manufacturer-installed ASTM B 819, copper-tube extensions.

### D. Check Valves:

1. Manufacturers: Same as for ball valves.
2. Description: In-line pattern, bronze.
3. Pressure Rating: 300 psig minimum.
4. Operation: Spring loaded.
5. Ends: Manufacturer-installed ASTM B 819, copper-tube extensions.

## 2.4 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. Description:
  - a. Standard: ASSE 1079.
  - b. Pressure Rating: 150 psig.
  - c. End Connections: Solder-joint copper alloy and threaded ferrous.

### C. Dielectric Flanges:

1. Description:
  - a. Standard: ASSE 1079.
  - b. Factory-fabricated, bolted, companion-flange assembly.
  - c. Pressure Rating: 150 psig.

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- d. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
- D. Dielectric-Flange Insulating Kits:
- 1. Description:
    - a. Nonconducting 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.

### 2.5 FLEXIBLE PIPE CONNECTORS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Bronze-Hose Flexible Pipe Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.
  - 1. Working-Pressure Rating: 200 psig minimum.
  - 2. End Connections, NPS 2 and Smaller: Threaded copper pipe or plain-end copper tube.
  - 3. End Connections, NPS 2-1/2 and Larger: Flanged copper alloy.
- C. Stainless-Steel-Hose Flexible Pipe Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.
  - 1. Working-Pressure Rating: 200 psig minimum.
  - 2. End Connections, NPS 2 and Smaller: Threaded steel pipe nipple.
  - 3. End Connections, NPS 2-1/2 and Larger: Flanged steel nipple.

### 2.6 SPECIALTIES

- A. Safety Valves: ASME Boiler and Pressure Vessel Code: Section VIII, "Pressure Vessels," construction; National Board certified, labeled, and factory sealed; constructed of bronze body with poppet-type safety valve for compressed-air service.
  - 1. Pressure Settings: Higher than discharge pressure and same or lower than receiver pressure rating.
- B. Air-Line Pressure Regulators: Diaphragm operated, bronze body, direct acting, spring-loaded manual pressure-setting adjustment, and rated for 200-psig minimum inlet pressure, unless otherwise indicated.
- C. Automatic Drain Valves: Stainless-steel body and internal parts, rated for 200-psig minimum working pressure, capable of automatic discharge of collected condensate. Include mounting bracket if wall mounting is indicated.
- D. Coalescing Filters: Coalescing type with activated carbon capable of removing water and oil aerosols; with color-change dye to indicate when carbon is saturated and warning light to indicate when selected maximum pressure drop has been exceeded. Include mounting bracket if wall mounting is indicated.



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- E. Mechanical Filters: Two-stage, mechanical-separation-type, air-line filters. Equip with deflector plates, resin-impregnated-ribbon-type filters with edge filtration, and drain cock. Include mounting bracket if wall mounting is indicated.
- F. Air-Line Lubricators: With drip chamber and sight dome for observing oil drop entering air stream; with oil-feed adjustment screw and quick-release collar for easy bowl removal. Include mounting bracket if wall mounting is indicated.
  - 1. Provide with automatic feed device for supplying oil to lubricator.

### 2.7 QUICK COUPLINGS

- A. General Requirements for Quick Couplings: Assembly with locking-mechanism feature for quick connection and disconnection of compressed-air hose.
- B. Automatic-Shutoff Quick Couplings: Straight-through brass body with O-ring or gasket seal and stainless-steel or nickel-plated-steel operating parts.
  - 1. Socket End: With one-way valve and threaded inlet for connection to piping or threaded hose fitting.
  - 2. Plug End: Flow-sensor-bleeder, check-valve type with barbed outlet for attaching hose.
- C. Valveless Quick Couplings: Straight-through brass body with stainless-steel or nickel-plated-steel operating parts.
  - 1. Socket End: With O-ring or gasket seal, without valve, and with barbed inlet for attaching hose.
  - 2. Plug End: With barbed outlet for attaching hose.

### 2.8 HOSE ASSEMBLIES

- A. Description: Compatible hose, clamps, couplings, and splicers suitable for compressed-air service, of nominal diameter indicated, and rated for 300-psig minimum working pressure, unless otherwise indicated.
  - 1. Hose: Reinforced double-wire-braid, CR-covered hose for compressed-air service.
  - 2. Hose Clamps: Stainless-steel clamps or bands.
  - 3. Hose Couplings: Two-piece, straight-through, threaded brass or stainless-steel O-ring or gasket-seal swivel coupling with barbed ends for connecting two sections of hose.
  - 4. Hose Splicers: One-piece, straight-through brass or stainless-steel fitting with barbed ends for connecting two sections of hose.

## PART 3 - EXECUTION

### 3.1 PIPING APPLICATIONS

- A. Compressed-Air Piping: Use one of the following piping materials for each size range:
  - 1. Type K or L, copper tube; wrought-copper fittings; and brazed joints.
  - 2. Type K or L, copper tube; press-type fittings; and pressure-sealed joints.
- B. Drain Piping: Use the following piping materials:

## SECTION 221513 - GENERAL-SERVICE COMPRESSED-AIR PIPING

1. NPS 2 and Smaller: Type M copper tube; wrought-copper fittings; and brazed or soldered joints.

### 3.2 VALVE APPLICATIONS

- A. Metal General-Duty Valves: Comply with requirements and use valve types specified according to the following:
  1. Low-Pressure Compressed Air: Valve types specified for low-pressure compressed air.
  2. High-Pressure Compressed Air: Valve types specified for medium-pressure compressed air.
  3. Equipment Isolation NPS 2 and Smaller: Safety-exhaust, copper-alloy ball valve with exhaust vent and pressure rating at least as great as piping system operating pressure.
  4. Grooved-end valves may be used with grooved-end piping and grooved joints.

### 3.3 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of compressed-air piping. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, air-compressor sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- B. Install piping concealed from view and protected from physical contact by building occupants, 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 otherwise indicated.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal and to coordinate with other services occupying that space.
- E. Install piping adjacent to equipment and machines to allow service and maintenance.
- F. Install air and drain piping with 1 percent slope downward in direction of flow.
- G. Install nipples, flanges, unions, transition and special fittings, and valves with pressure ratings same as or higher than system pressure rating, unless otherwise indicated.
- H. Equipment and Specialty Flanged Connections:
  1. Use steel companion flange with gasket for connection to steel pipe.
  2. Use cast-copper-alloy companion flange with gasket and brazed joint for connection to copper tube. Do not use soldered joints for connection to air compressors or to equipment or machines producing shock or vibration.
- I. Flanged joints may be used instead of specified joint for any piping or tubing system.
- J. Extended-tee outlets with brazed branch connection may be used for copper tubing, within extruded-tee connection diameter to run tube diameter ratio for tube type, according to Extruded Tee Connections Sizes and Wall Thickness for Copper Tube (Inches) Table in ASTM F 2104.

## SECTION 221513 - GENERAL-SERVICE COMPRESSED-AIR PIPING

- K. Install eccentric reducers where compressed-air piping is reduced in direction of flow, with bottoms of both pipes and reducer fitting flush.
- L. Install branch connections to compressed-air mains from top of main. Provide drain leg and drain trap at end of each main and branch and at low points.
- M. Install thermometer and pressure gage on discharge piping from each air compressor and on each receiver. Comply with requirements in Section 220519 "Meters and Gages for Plumbing Piping."
- N. Install piping to permit valve servicing.
- O. Install piping free of sags and bends.
- P. Install fittings for changes in direction and branch connections.
- Q. Install seismic restraints on piping. Seismic-restraint devices are specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- R. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- S. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- T. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

### 3.4 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. 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.
- D. Brazed Joints for Copper Tubing: Join according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter.
- E. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Join according to ASTM B 828 or CDA's "Copper Tube Handbook."

## SECTION 221513 - GENERAL-SERVICE COMPRESSED-AIR PIPING

- F. Extruded-Tee Outlets for Copper Tubing: Form branches according to ASTM F 2104, with tools recommended by procedure manufacturer, and using operators qualified according to Part 1 "Quality Assurance" Article.
- G. Flanged Joints: Use asbestos-free, nonmetallic gasket suitable for compressed air. Join flanges with gasket and bolts according to ASME B31.9 for bolting procedure.
- H. Grooved Joints: Assemble couplings with housing, gasket, lubricant, and bolts. Join according to AWWA C606 for grooved joints. Do not apply lubricant to prelubricated gaskets.
- I. Pressure-Sealed Joints: Join with tools recommended by fitting manufacturer, using operators qualified according to Part 1 "Quality Assurance" Article.
- J. Dissimilar Metal Piping Material Joints: Use dielectric fittings.

### 3.5 VALVE INSTALLATION

- A. General-Duty Valves: Comply with requirements Valves for Plumbing Piping.
- B. Install shutoff valves and unions or flanged joints at compressed-air piping to air compressors.
- C. Install shutoff valve at inlet to each automatic drain valve, filter, lubricator, and pressure regulator.
- D. Install check valves to maintain correct direction of compressed-air flow to and from compressed-air piping specialties and equipment.

### 3.6 DIELECTRIC FITTING INSTALLATION

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. NPS 2 and Smaller: Use dielectric unions.
- C. NPS 2-1/2 to NPS 4: Use dielectric flanges.

### 3.7 FLEXIBLE PIPE CONNECTOR INSTALLATION

- A. Install flexible pipe connectors in discharge piping and in inlet air piping from remote air-inlet filter of each air compressor.
- B. Install bronze-hose flexible pipe connectors in copper compressed-air tubing.
- C. Install stainless-steel-hose flexible pipe connectors in steel compressed-air piping.

### 3.8 SPECIALTY INSTALLATION

- A. Install safety valves on receivers in quantity and size to relieve at least the capacity of connected air compressors.

## SECTION 221513 - GENERAL-SERVICE COMPRESSED-AIR PIPING

- B. Install air-main pressure regulators in compressed-air piping at or near air compressors.
- C. Install air-line pressure regulators in branch piping to equipment and tools.
- D. Install automatic drain valves on aftercoolers, receivers, and dryers. Discharge condensate onto nearest floor drain.
- E. Install coalescing filters in compressed-air piping at or near air compressors and upstream from mechanical filters. Mount on wall at locations indicated.
- F. Install mechanical filters in compressed-air piping at or near air compressors and downstream from coalescing filters. Mount on wall at locations indicated.
- G. Install air-line lubricators in branch piping to machine tools. Mount on wall at locations indicated.
- H. Install quick couplings at piping terminals for hose connections.
- I. Install hose assemblies at hose connections.

### 3.9 CONNECTIONS

- A. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment and machine.
- B. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment and machine.

### 3.10 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment" for seismic-restraint devices.
- B. Comply with requirements in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support devices.
- C. Vertical Piping: MSS Type 8 or 42, clamps.
- D. Individual, Straight, Horizontal Piping Runs:
  - 1. 100 Feet or Less: MSS Type 1, adjustable, steel clevis hangers.
  - 2. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
- E. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
- F. Base of Vertical Piping: MSS Type 52, spring hangers.
- G. Support horizontal piping within 12 inches of each fitting and coupling.
- H. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.

## SECTION 221513 - GENERAL-SERVICE COMPRESSED-AIR PIPING

- I. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
  - 1. NPS 1/4: 60 inches with 3/8-inch rod.
  - 2. NPS 3/8 and NPS 1/2: 72 inches with 3/8-inch rod.
  - 3. NPS 3/4: 84 inches with 3/8-inch rod.
  - 4. NPS 1: 96 inches with 3/8-inch rod.
  - 5. NPS 1-1/4: 108 inches with 3/8-inch rod.
  - 6. NPS 1-1/2: 10 feet with 3/8-inch rod.
  - 7. NPS 2: 11 feet with 3/8-inch rod.
  - 8. NPS 2-1/2: 13 feet with 1/2-inch rod.
  - 9. NPS 3: 14 feet with 1/2-inch rod.
  - 10. NPS 3-1/2: 15 feet with 1/2-inch rod.
  - 11. NPS 4: 16 feet with 1/2-inch rod.
  
- J. Install supports for vertical copper tubing every 10 feet.

### 3.11 LABELING AND IDENTIFICATION

- A. Install identifying labels and devices for general-service compressed-air piping, valves, and specialties. Comply with requirements in Section 220553 "Identification for Plumbing Piping and Equipment."

### 3.12 FIELD QUALITY CONTROL

- A. Perform field tests and inspections.
  
- B. Tests and Inspections:
  - 1. Piping Leak Tests for Metal Compressed-Air Piping: Test new and modified parts of existing piping. Cap and fill general-service compressed-air piping with oil-free dry air or gaseous nitrogen to pressure of 50 psig above system operating pressure, but not less than 150 psig. Isolate test source and let stand for four hours to equalize temperature. Refill system, if required, to test pressure; hold for two hours with no drop in pressure.
  - 2. Repair leaks and retest until no leaks exist.
  - 3. Inspect filters lubricators and pressure regulators for proper operation.
  
- C. Prepare test reports.

END OF SECTION 221513

## SECTION 221519 - GENERAL-SERVICE PACKAGED AIR COMPRESSORS AND RECEIVERS

### 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. Scroll air compressors.
  - 2. Inlet-air filters.
  - 3. Compressed-air filter assemblies.

#### 1.3 DEFINITIONS

- A. Actual Air: Air delivered from air compressors. Flow rate is delivered compressed air measured in acfm.
- B. Standard Air: Free air at 68 deg F and 1 atmosphere before compression or expansion and measured in scfm.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings:
  - 1. Include diagrams for power, signal, and control wiring.
- C. Delegated-Design Submittal: For compressed-air equipment mounting.
  - 1. Detail fabrication and assembly of supports.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For compressed-air equipment to include in emergency, operation, and maintenance manuals.

## SECTION 221519 - GENERAL-SERVICE PACKAGED AIR COMPRESSORS AND RECEIVERS

### 1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Air-Compressor, Inlet-Air-Filter Elements: Equal to 10 percent of amount installed, but no fewer than 2 units.
  - 2. Belts: One for each belt-driven compressor.

### 1.7 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

## PART 2 - PRODUCTS

### 2.1 SYSTEM DESCRIPTION

- 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. ASME Compliance: Fabricate and label receivers to comply with ASME Boiler and Pressure Vessel Code.

### 2.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design compressed-air equipment mounting.

### 2.3 GENERAL REQUIREMENTS FOR PACKAGED AIR COMPRESSORS AND RECEIVERS

- A. General Description: Factory-assembled, -wired, -piped, and -tested; electric-motor-driven; air-cooled; continuous-duty air compressors and receivers that deliver air of quality equal to intake air.
- B. Control Panels: Automatic control station with load control and protection functions. Comply with NEMA ICS 2 and UL 508.
  - 1. Enclosure: NEMA ICS 6, Type 12 control panel unless otherwise indicated.
  - 2. Motor Controllers: Full-voltage, combination magnetic type with undervoltage release feature and motor-circuit-protector-type disconnecting means and short-circuit protective device.
  - 3. Control Voltage: 120-V ac or less, using integral control power transformer.
  - 4. Motor Overload Protection: Overload relay in each phase.
  - 5. Starting Devices: Hand-off-automatic selector switch in cover of control panel, plus pilot device for automatic control.
  - 6. Automatic control switches to alternate lead-lag compressors for duplex air compressors.



## SECTION 221519 - GENERAL-SERVICE PACKAGED AIR COMPRESSORS AND RECEIVERS

7. Instrumentation: Include discharge-air pressure gage, air-filter maintenance indicator, hour meter, compressor discharge-air and coolant temperature gages, and control transformer.
  8. Alarm Signal Device: For connection to alarm system to indicate when backup air compressor is operating.
- C. Receivers: Steel tank constructed according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
1. Pressure Rating: At least as high as highest discharge pressure of connected compressors, and bearing appropriate code symbols.
  2. Interior Finish: Corrosion-resistant coating.
  3. Accessories: Include safety valve, pressure gage, drain, and pressure-reducing valve.
- D. Mounting Frame: Fabricate mounting and attachment to pressure vessel with reinforcement strong enough to resist packaged equipment movement during a seismic event when base is anchored to building structure.

### 2.4 INLET-AIR FILTERS

- A. Description: Combination inlet-air filter-silencer, suitable for remote installation, for each air compressor.
1. Construction: Weatherproof housing for replaceable, dry-type filter element, with silencer tubes or other method of sound reduction.
  2. Capacity: Match capacity of air compressor, with filter having collection efficiency of 99 percent retention of particles larger than 10 micrometers.

### 2.5 COMPUTER INTERFACE CABINET

- A. Description:
1. Wall mounting.
  2. Welded steel with white enamel finish.
  3. Gasketed door.
  4. Grounding device.
  5. Factory-installed, signal circuit boards.
  6. Power transformer.
  7. Circuit breaker.
  8. Wiring terminal board.
  9. Internal wiring capable of interfacing 20 alarm signals.

### 2.6 MOTORS

- A. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 220513 "Common Motor Requirements for Plumbing Equipment."

## SECTION 221519 - GENERAL-SERVICE PACKAGED AIR COMPRESSORS AND RECEIVERS

1. Enclosure: Totally enclosed, fan cooled.
2. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load does not require motor to operate in service factor range above 1.0.

### PART 3 - EXECUTION

#### 3.1 EQUIPMENT INSTALLATION

##### A. Equipment Mounting:

1. Install air compressors, aftercoolers, and air dryers on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 033053 "Miscellaneous Cast-in-Place Concrete."
2. Comply with requirements for vibration isolation devices specified in Section 220548.13 "Vibration Controls for Plumbing Piping and Equipment."

##### B. Install compressed-air equipment anchored to substrate.

##### C. Arrange equipment so controls and devices are accessible for servicing.

##### D. Maintain manufacturer's recommended clearances for service and maintenance.

##### E. Install the following devices on compressed-air equipment:

1. Thermometer, Pressure Gage, and Safety Valve: Install on each compressed-air receiver.
2. Pressure Regulators: Install downstream from air compressors and dryers.
3. Automatic Drain Valves: Install on aftercoolers, receivers, and dryers. Discharge condensate over nearest floor drain.

#### 3.2 CONNECTIONS

##### A. Comply with requirements for piping specified in Section 221513 "General-Service Compressed-Air Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

##### B. Where installing piping adjacent to machine, allow space for service and maintenance.

#### 3.3 IDENTIFICATION

##### A. Identify general-service air compressors and components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

#### 3.4 STARTUP SERVICE

##### A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

## SECTION 221519 - GENERAL-SERVICE PACKAGED AIR COMPRESSORS AND RECEIVERS

2. Check for lubricating oil in lubricated-type equipment.
3. Check belt drives for proper tension.
4. Verify that air-compressor inlet filters and piping are clear.
5. Check for equipment vibration-control supports and flexible pipe connectors, and verify that equipment is properly attached to substrate.
6. Check safety valves for correct settings. Ensure that settings are higher than air-compressor discharge pressure, but not higher than rating of system components.
7. Check for proper seismic restraints.
8. Drain receiver tanks.
9. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
10. Test and adjust controls and safeties.

### 3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air compressors, aftercoolers and air dryers.

END OF SECTION 221519

## SECTION 223100 - DOMESTIC WATER SOFTENERS

### 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. Commercial water softeners for whole building facility
  - 2. Reverse osmosis (RO) and deionization (DI) systems
  - 3. For specifications, capacity, sizing, dimensions, etc., contact Juan Miranda, Culligan Water of The Rio Grande Valley, Phone: 956-399-1780.
  - 4. Chemicals.
  - 5. Water-testing sets.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for water softeners.
  - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
  - 3. Wiring Diagrams: For power, signal, and control wiring.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Source quality-control reports.
- B. Field quality-control reports.
- C. Warranty: Sample of special warranty.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For water softeners to include in emergency, operation, and maintenance manuals.

#### 1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

## SECTION 223100 - DOMESTIC WATER SOFTENERS

1. Salt for Brine Tanks: Furnish in same form as and at least 4 times original load, but not less than 400 lb. Deliver Food-Grade Pellet Salt: In 40-packages.
2. Store salt on raised platform where directed by Owner. Do not store in contact with concrete floor.

### 1.7 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 application.
- B. ASME Compliance for FRP Tanks: Fabricate and label mineral tanks to comply with ASME Boiler and Pressure Vessel Code: Section X, where indicated.
- C. UL Compliance: Fabricate and label water softeners to comply with UL 979, "Water Treatment Appliances."

### 1.8 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

### 1.9 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of water softeners that fail in materials or workmanship within specified warranty period.
  1. Failures include, but are not limited to, the following:
    - a. Structural failures of mineral and brine tanks.
    - b. Faulty operation of controls.
    - c. Deterioration of metals, metal finishes, and other materials beyond normal use.
    - d. Attrition loss of resin exceeding 3 percent per year.
    - e. Mineral washed out of system during service run or backwashing period.
    - f. Effluent turbidity greater and color darker than incoming water.
    - g. Fouling of underdrain system, gravel, and resin with turbidity or by dirt, rust, or scale from water softener or soft water, while operating according to manufacturer's written operating instructions.
  2. Commercial Water Softeners, Warranty Period: From date of Substantial Completion.
    - a. Mineral Tanks: 5 years.
    - b. Brine Tanks: 10 years.
    - c. Control Valve: One year(s).

## SECTION 223100 - DOMESTIC WATER SOFTENERS

### 1.10 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Beginning at Substantial Completion, provide 12 months' full maintenance by skilled employees of water softener Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, cleaning, and adjusting as required for proper water softener operation at rated capacity. Provide parts and supplies the same as those used in the manufacture and installation of original equipment.
- B. Continuing Maintenance Proposal: From Installer to Owner, in the form of a standard yearly (or other period) maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.

## PART 2 - PRODUCTS

### 2.1 COMMERCIAL WATER SOFTENERS

- A. Culligan, or pre-approved equal, with an office within 30 miles.
- B. Description: Factory-assembled, pressure-type water softener.
  - 1. Standard: Comply with NSF 61 Annex, "Drinking Water System Components - Health Effects."
  - 2. Configuration: Twin unit with two mineral tanks and one brine tank.
  - 3. Mounting: On skids.
  - 4. Wetted Components: Suitable for water temperatures from 40 to at least 100 deg F
  - 5. Mineral Tanks: FRP, pressure-vessel quality.
    - a. Construction: Fabricated and stamped to comply with ASME Boiler and Pressure Vessel Code: Section X, "Fiber-Reinforced Plastic Pressure Vessels."
    - b. Pressure Rating: 125 psig minimum.
    - c. Freeboard: 50 percent minimum for backwash expansion above normal resin bed level.
    - d. Support Legs or Skirt: Constructed of structural steel, welded to tank before testing and labeling.
    - e. Upper Distribution System: Single, point type, fabricated from galvanized-steel pipe and fittings.
    - f. Lower Distribution System: Hub and radial-arm or header-lateral type; fabricated from nonmetallic pipe and fittings with individual, fine-slotted, nonclogging plastic strainers, and arranged for even flow distribution through resin bed.
    - g. Liner: PE, ABS, or other material suitable for potable water.
  - 6. Controls: Fully automatic; factory wired and factory mounted on unit.
    - a. Adjustable duration of various regeneration steps.
    - b. Push-button start and complete manual operation.
    - c. Electric time clock and switch for fully automatic operation, adjustable to initiate regeneration at any hour of day and any day of week or at fixed intervals.
    - d. Sequence of Operation: Multiport pilot-control valve automatically pressure-actuates main operating valve through steps of regeneration and return to service.

## SECTION 223100 - DOMESTIC WATER SOFTENERS

- e. Pointer on pilot-control valve shall indicate cycle of operation.
  - f. Includes means of manual operation of pilot-control valve if power fails.
7. Main Operating Valves: Industrial, automatic, multiport, diaphragm type with the following features:
- a. Slow opening and closing, nonslam operation.
  - b. Diaphragm guiding on full perimeter from fully open to fully closed.
  - c. Isolated, dissimilar metals within valve.
  - d. Self-adjusting, internal, automatic brine injector that draws brine and rinses at constant rate independent of pressure.
  - e. Sampling cocks for soft water.
  - f. Special tools are not required for service.
8. Flow Control: Automatic, to control backwash and flush rates over wide variations in operating pressure; does not require field adjustments.
- a. Meter Control: Each mineral tank is equipped with signal-register-head water meter that produces electrical signal indicating need for regeneration on reaching hand-set total in gallons. Signal will continue until reset.
  - b. Demand-Initiated Control: Each multiple mineral-tank unit is equipped with automatic-reset-head water meter, in common outlet header, that electrically activates cycle controller to automatically regenerate one mineral tank at preset total in gallons and divert flow to other tanks. Automatically repeats with other tanks. Electrical lockout prevents simultaneous regeneration of more than one tank.
9. Brine Tank: Combination measuring and wet-salt storing system.
- a. Tank and Cover Material: Fiberglass, 3/16 inch thick; or molded PE, 3/8 inch thick.
  - b. Brine Valve: Float operated and plastic fitted for automatic control of brine withdrawal and freshwater refill.
  - c. Size: Large enough for at least four regenerations at full salting.
10. Factory-Installed Accessories:
- a. Piping, valves, tubing, and drains.
  - b. Sampling cocks.
  - c. Main-operating-valve position indicators.
  - d. Water meters.
- C. Capacities and Characteristics: See drawings

## 2.2 CHEMICALS

- A. Mineral: High-capacity, sulfonated-polystyrene, ion-exchange resin that is stable over entire pH range with good resistance to bead fracture from attrition or shock.
- 1. Exchange Capacity: [30,000 grains/cu. ft.] <Insert capacity> of calcium carbonate of resin when regenerated with 15 lb of salt.

## SECTION 223100 - DOMESTIC WATER SOFTENERS

- B. Salt for Brine Tanks: High-purity sodium chloride, free of dirt and foreign material. Rock and granulated forms are unacceptable.
  - 1. Form: Processed, food-grade salt pellets.

### 2.3 WATER-TESTING SETS

- A. Description: Manufacturer's standard water-hardness testing apparatus and chemicals with testing procedure instructions. Include metal container suitable for wall mounting.

### 2.4 SOURCE QUALITY CONTROL

- A. Hydrostatically test mineral tanks before shipment to a minimum of one and one-half times the pressure rating.
- B. Prepare test and inspection reports.

## PART 3 - EXECUTION

### 3.1 WATER SOFTENER INSTALLATION

- A. Equipment Mounting:
  - 1. Install water softeners on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
  - 2. Comply with requirements for vibration isolation devices specified in Section 220548.13 "Vibration Controls for Plumbing Piping and Equipment."
- B. Install brine lines and fittings furnished by equipment manufacturer but not specified to be factory installed.
- C. Prepare mineral-tank distribution system and underbed for minerals and place specified mineral into mineral tanks.
- D. Install water-testing sets mounted on wall, unless otherwise indicated, and near water softeners.

### 3.2 CONNECTIONS

- A. Comply with requirements for piping specified in Section 221116 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where piping is installed adjacent to equipment, allow space for service and maintenance of equipment.
- C. Install shutoff valves on raw-water inlet and soft-water outlet piping of each mineral tank, and on inlet and outlet headers.
  - 1. Exception: Water softeners with factory-installed shutoff valves at locations indicated.



## SECTION 223100 - DOMESTIC WATER SOFTENERS

- D. Install pressure gages on raw-water inlet and soft-water outlet piping of each mineral tank. Pressure gages are specified in Section 220519 "Meters and Gages for Plumbing Piping."
  - 1. Exception: Water softeners with factory-installed pressure gages at locations indicated.
- E. Install valved bypass in water piping around water softeners.
- F. Install drains as indirect wastes to spill into open drains or over floor drains.

### 3.3 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

### 3.4 FIELD QUALITY CONTROL

- A. Tests and Inspections:
  - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
  - 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation.
  - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Water softeners will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

### 3.5 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
  - 1. Complete installation and startup checks according to manufacturer's written instructions.
- B. Add water to brine tanks and fill with the following form of salt:
  - 1. Commercial Water Softeners: Processed, food grade salt pellets.
- C. Sample water softener effluent after startup and at three consecutive seven-day intervals (total of four samples), and prepare certified test reports for required water performance characteristics. Comply with the following:
  - 1. ASTM D 859, "Test Method for Silica in Water."
  - 2. ASTM D 1067, "Test Methods for Acidity or Alkalinity of Water."
  - 3. ASTM D 1068, "Test Methods for Iron in Water."
  - 4. ASTM D 1126, "Test Method for Hardness in Water."
  - 5. ASTM D 1129, "Terminology Relating to Water."
  - 6. ASTM D 3370, "Practices for Sampling Water from Closed Conduits."

SECTION 223100 - DOMESTIC WATER SOFTENERS

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain water softeners.

END OF SECTION 223100

## SECTION 223300 - ELECTRIC, DOMESTIC-WATER 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. Commercial, electric, storage, domestic-water heaters.
  - 2. Flow-control, electric, tankless, domestic-water heaters.
  - 3. Domestic-water heater accessories.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type and size of domestic-water heater indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings:
  - 1. Wiring Diagrams: For power, signal, and control wiring.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of commercial and tankless, electric, domestic-water heater, from manufacturer.
- B. Domestic-Water Heater Labeling: Certified and labeled by testing agency acceptable to authorities having jurisdiction.
- C. Source quality-control reports.
- D. Field quality-control reports.
- E. Warranty: Sample of special warranty.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For electric, domestic-water heaters to include in emergency, operation, and maintenance manuals.

## SECTION 223300 - ELECTRIC, DOMESTIC-WATER HEATERS

### 1.6 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. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1.
- C. ASME Compliance: Where ASME-code construction is indicated, fabricate and label commercial, domestic-water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
- D. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61 Annex G, "Drinking Water System Components - Health Effects."

### 1.7 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

### 1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of electric, domestic-water heaters that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Structural failures including storage tank and supports.
    - b. Faulty operation of controls.
    - c. Deterioration of metals, metal finishes, and other materials beyond normal use.
  - 2. Warranty Periods: From date of Substantial Completion.
    - a. Commercial, Electric, Domestic-Water Booster Heaters:
      - 1) Controls and Other Components: Five years.
    - b. Commercial, Electric, Storage, Domestic-Water Heaters:
      - 1) Storage Tank: Ten years.
      - 2) Controls and Other Components: Five years.
    - c. Electric, Tankless, Domestic-Water Heaters: Five year(s).
    - d. Compression Tanks: Ten years.

## SECTION 223300 - ELECTRIC, DOMESTIC-WATER HEATERS

### PART 2 - PRODUCTS

#### 2.1 COMMERCIAL, ELECTRIC, DOMESTIC-WATER HEATERS

##### A. Commercial, Electric, Domestic-Water Heaters:

1. Commercial, Storage, Electric Water Heaters:
  - a. Bradford White Co.
  - b. State Industries.
  - c. Rheem
  - d. A.O. Smith
2. Standard: UL 1453.
3. Tank Construction: ASME-code steel with 150-psig working-pressure rating..
  - a. Tappings: Factory fabricated of materials compatible with tank for piping connections, relief valve, pressure gage, thermometer, drain, anode rod, and controls as required. Attach tappings to tank before testing and labeling. ASME B1.20.1 pipe thread.
  - b. Interior Finish: Materials and thicknesses complying with NSF 61, barrier materials for potable-water tank linings. Extend finish into and through tank fittings and outlets.
  - c. Insulation: Comply with ASHRAE 90.1. Surround entire storage tank except connections and controls.
  - d. Jacket: Steel, with enameled finish.
4. Factory-Installed Tank Appurtenances:
  - a. Anode Rod: Replaceable magnesium.
  - b. Drain Valve: Corrosion-resistant metal complying with ASSE 1005.
  - c. Insulation: Comply with ASHRAE/IESNA 90.1.
  - d. Jacket: Steel with enameled finish.
  - e. Heating Elements: Electric, screw-in or bolt-on immersion type arranged in multiples of three.
  - f. Temperature Control: Adjustable thermostat.
  - g. Safety Controls: High-temperature-limit and low-water cutoff devices or systems.
  - h. Relief Valve: ASME rated and stamped for combination temperature-and-pressure relief valve. Include relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select relief valve with sensing element that extends into storage tank.
  - i. Gages: Combination temperature-and-pressure type or separate thermometer and pressure gage.
5. Special Requirements: NSF 5 construction.
6. Capacity and Characteristics: See Drawings

## SECTION 223300 - ELECTRIC, DOMESTIC-WATER HEATERS

### 2.2 ELECTRIC, TANKLESS, DOMESTIC-WATER HEATERS

#### A. Flow-Control, Electric, Tankless, Domestic-Water Heaters:

1. Manufacturers:
  - a. Controlled Energy Corporation.
  - b. Chronomite Laboratories, Inc.
  - c. Eemax.
2. Standard: UL 499 for electric, tankless, (domestic-water heater) heating appliance.
3. Construction: Copper piping or tubing complying with NSF 61 Annex G barrier materials for potable water, without storage capacity.
  - a. Connections: ASME B1.20.1 pipe thread.
  - b. Pressure Rating: 150 psig.
  - c. Heating Element: Resistance heating system.
  - d. Temperature Control: Flow-control fitting.
  - e. Safety Control: High-temperature-limit cutoff device or system.
  - f. Jacket: Aluminum or steel with enameled finish or plastic.
4. Support: Bracket for wall mounting.
5. Capacity and Characteristics: See drawings.

### 2.3 DOMESTIC-WATER HEATER ACCESSORIES

#### A. Domestic-Water Compression Tanks:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - a. AMTROL Inc.
  - b. Smith, A. O. Water Products Co.; a division of A. O. Smith Corporation.
  - c. State Industries.
  - d. Taco, Inc.
  - e. Rheem
2. Description: Steel pressure-rated tank constructed with welded joints and factory-installed butyl-rubber diaphragm. Include air precharge to minimum system-operating pressure at tank.
3. Construction:
  - a. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1 pipe thread.
  - b. Interior Finish: Comply with NSF 61 Annex G barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
  - c. Air-Charging Valve: Factory installed.
4. Capacity and Characteristics: See drawings.

- #### B. Drain Pans: Corrosion-resistant metal with raised edge. Comply with ANSI/CSA LC 3. Include dimensions not less than base of domestic-water heater, and include drain outlet not less than NPS 3/4 with ASME B1.20.1 pipe threads or with ASME B1.20.7 garden-hose threads.

## SECTION 223300 - ELECTRIC, DOMESTIC-WATER HEATERS

- C. Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE/IESNA 90.1.
- D. Heat-Trap Fittings: ASHRAE 90.2.
- E. Manifold Kits: Domestic-water heater manufacturer's factory-fabricated inlet and outlet piping for field installation, for multiple domestic-water heater installation. Include ball-, butterfly-, or gate-type shutoff valves to isolate each domestic-water heater and calibrated balancing valves to provide balanced flow through each domestic-water heater.
  - 1. Comply with requirements for ball-, butterfly-, or gate-type shutoff valves specified in Section 220523.12 "Ball Valves for Plumbing Piping," Section 220523.13 "Butterfly Valves for Plumbing Piping," and Section 220523.15 "Gate Valves for Plumbing Piping."
  - 2. Comply with requirements for balancing valves specified in Section 221119 "Domestic Water Piping Specialties."
- F. Pressure-Reducing Valves: ASSE 1003 for water. Set at 25-psig-maximum outlet pressure unless otherwise indicated.
- G. Combination Temperature-and-Pressure Relief Valves: ASME rated and stamped. Include relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select relief valves with sensing element that extends into storage tank.
- H. Pressure Relief Valves: ASME rated and stamped. Include pressure setting less than domestic-water heater working-pressure rating.
- I. Vacuum Relief Valves: ANSI Z21.22/CSA 4.4.
- J. Shock Absorbers: ASSE 1010 or PDI-WH 201, Size A water hammer arrester.
- K. Domestic-Water Heater Stands: Manufacturer's factory-fabricated steel stand for floor mounting, capable of supporting domestic-water heater and water. Include dimension that will support bottom of domestic-water heater a minimum of 18 inches above the floor.
- L. Domestic-Water Heater Mounting Brackets: Manufacturer's factory-fabricated steel bracket for wall mounting, capable of supporting domestic-water heater and water.

### 2.4 SOURCE QUALITY CONTROL

- A. Factory Tests: Test and inspect domestic-water heaters specified to be ASME-code construction, according to ASME Boiler and Pressure Vessel Code.
- B. Hydrostatically test domestic-water heaters to minimum of one and one-half times pressure rating before shipment.
- C. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in Section 014000 "Quality Requirements" for retesting and reinspecting requirements and Section 017300 "Execution" for requirements for correcting the Work.

## SECTION 223300 - ELECTRIC, DOMESTIC-WATER HEATERS

- D. Prepare test and inspection reports.

### PART 3 - EXECUTION

#### 3.1 DOMESTIC-WATER HEATER INSTALLATION

- A. Commercial, Electric, Domestic-Water Heater Mounting: Install commercial, electric, domestic-water heaters on concrete base. Comply with requirements for concrete bases specified in Section 033000 "Cast-in-Place Concrete." Section 033053 "Miscellaneous Cast-in-Place Concrete."
  - 1. Exception: Omit concrete bases for commercial, electric, domestic-water heaters if installation on stand, bracket, suspended platform, or directly on floor is indicated.
  - 2. Maintain manufacturer's recommended clearances.
  - 3. Arrange units so controls and devices that require servicing are accessible.
  - 4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
  - 5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
  - 6. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 7. Install anchor bolts to elevations required for proper attachment to supported equipment.
  - 8. Anchor domestic-water heaters to substrate.
- B. Electric, Tankless, Domestic-Water Heater Mounting: Install electric, tankless, domestic-water heaters at least 18 inches above floor on wall bracket.
  - 1. Maintain manufacturer's recommended clearances.
  - 2. Arrange units so controls and devices that require servicing are accessible.
  - 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 4. Install anchor bolts to elevations required for proper attachment to supported equipment.
  - 5. Anchor domestic-water heaters to substrate.
- C. Install electric, domestic-water heaters level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.
  - 1. Install shutoff valves on domestic-water-supply piping to domestic-water heaters and on domestic-hot-water outlet piping. Comply with requirements for shutoff valves specified in Section 220523.12 "Ball Valves for Plumbing Piping," Section 220523.13 "Butterfly Valves for Plumbing Piping," and Section 220523.15 "Gate Valves for Plumbing Piping."
- D. Install combination temperature-and-pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend commercial-water-heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.



## SECTION 223300 - ELECTRIC, DOMESTIC-WATER HEATERS

- E. Install combination temperature-and-pressure relief valves in water piping for electric, domestic-water heaters without storage. Extend commercial-water-heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.
- F. Install water-heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for electric, domestic-water heaters that do not have tank drains. Comply with requirements for hose-end drain valves specified in Section 221119 "Domestic Water Piping Specialties."
- G. Install thermometers on outlet piping of electric, domestic-water heaters. Comply with requirements for thermometers.
- H. Assemble and install inlet and outlet piping manifold kits for multiple electric, domestic-water heaters. Fabricate, modify, or arrange manifolds for balanced water flow through each electric, domestic-water heater. Include shutoff valve and thermometer in each domestic-water heater inlet and outlet, and throttling valve in each electric, domestic-water heater outlet. Comply with requirements for valves and thermometers.
- I. Install pressure-reducing valve with integral bypass relief valve in electric, domestic-water booster-heater inlet piping and water hammer arrester in booster-heater outlet piping. Set pressure-reducing valve for outlet pressure of 25 psig. Comply with requirements for pressure-reducing valves and water hammer arresters specified in Section 221119 "Domestic Water Piping Specialties."
- J. Install piping-type heat traps on inlet and outlet piping of electric, domestic-water heater storage tanks without integral or fitting-type heat traps.
- K. Fill electric, domestic-water heaters with water.
- L. Charge domestic-water compression tanks with air.

### 3.2 CONNECTIONS

- A. Comply with requirements for piping specified in Section 221116 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to electric, domestic-water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of domestic-water heaters.
- C. Connect hot- and cold-water piping with shutoff valves and unions.
- D. Make connections with dielectric fittings where piping is made of dissimilar metal.
- E. Electrical Connections: Power wiring and disconnect switches are specified in Division 16 Sections. Arrange wiring to allow unit service.
- F. Ground equipment.

## SECTION 223300 - ELECTRIC, DOMESTIC-WATER HEATERS

1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

### 3.3 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

### 3.4 FIELD QUALITY CONTROL

- A. 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.
  2. Leak Test: After installation, charge system 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 operation.
  4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in Section 014000 "Quality Requirements" for retesting and reinspecting requirements and Section 017300 "Execution" for requirements for correcting the Work.
- C. Prepare test and inspection reports.

### 3.5 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain commercial and tankless, electric, domestic-water heaters.

END OF SECTION 223300

## SECTION 224000 - 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.

#### 1.2 SUMMARY

- A. This Section includes the following conventional plumbing fixtures and related components:

1. Faucets for lavatories and sinks.
2. Flushometers.
3. Toilet seats.
4. Protective shielding guards.
5. Fixture supports.
6. Water closets.
7. Urinals
8. Lavatories.
9. Kitchen sinks.
10. Service basins.

- B. Related Sections include the following:

1. Division 10 Section "Toilet, Bath, and Laundry Accessories."
2. Division 22 Section "Domestic Water Piping Specialties" for backflow preventers, floor drains, and specialty fixtures not included in this Section.
3. Division 22 Section "Drinking Fountains and Water Coolers."
4. Division 31 Section "Facility Water Distribution Piping" for exterior plumbing fixtures and hydrants.

#### 1.3 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.
- C. Cast Polymer: Cast-filled-polymer-plastic material. This material includes cultured-marble and solid-surface materials.
- D. Cultured Marble: Cast-filled-polymer-plastic material with surface coating.
- E. Fitting: Device that controls the flow of water into or out of the plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, shower heads and tub spouts, drains and tailpieces, and traps and waste pipes. Piping and general-duty valves are included where indicated.

## SECTION 224000 - PLUMBING FIXTURES

- F. FRP: Fiberglass-reinforced plastic.
- G. PMMA: Polymethyl methacrylate (acrylic) plastic.
- H. PVC: Polyvinyl chloride plastic.
- I. Solid Surface: Nonporous, homogeneous, cast-polymer-plastic material with heat-, impact-, scratch-, and stain-resistance qualities.

### 1.4 SUBMITTALS

- A. Product Data: For each type of plumbing fixture indicated. Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports. Indicate materials and finishes, dimensions, construction details, and flow-control rates.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Operation and Maintenance Data: For plumbing fixtures to include in emergency, operation, and maintenance manuals.
- D. Warranty: Special warranty specified in this Section.

### 1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer.
  - 1. Exception: If fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.
- B. 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.
- C. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; for plumbing fixtures for people with disabilities.
- D. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.
- E. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.
- F. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.

## SECTION 224000 - PLUMBING FIXTURES

- G. Comply with the following applicable standards and other requirements specified for plumbing fixtures:
1. Enameled, Cast-Iron Fixtures: ASME A112.19.1M.
  2. Porcelain-Enameled, Formed-Steel Fixtures: ASME A112.19.4M.
  3. Stainless-Steel Commercial, Handwash Sinks: NSF 2 construction.
  4. Vitreous-China Fixtures: ASME A112.19.2M.
  5. Water-Closet, Flush Valve, Tank Trim: ASME A112.19.5.
  6. Water-Closet, Flushometer Tank Trim: ASSE 1037.
- H. Comply with the following applicable standards and other requirements specified for lavatory and sink faucets:
1. Backflow Protection Devices for Faucets with Side Spray: ASME A112.18.3M.
  2. Backflow Protection Devices for Faucets with Hose-Thread Outlet: ASME A112.18.3M.
  3. Diverter Valves for Faucets with Hose Spray: ASSE 1025.
  4. Faucets: ASME A112.18.1.
  5. Hose-Connection Vacuum Breakers: ASSE 1011.
  6. Hose-Coupling Threads: ASME B1.20.7.
  7. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
  8. NSF Potable-Water Materials: NSF 61.
  9. Pipe Threads: ASME B1.20.1.
  10. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
  11. Supply Fittings: ASME A112.18.1.
  12. Brass Waste Fittings: ASME A112.18.2.
- I. Comply with the following applicable standards and other requirements specified for miscellaneous fittings:
1. Atmospheric Vacuum Breakers: ASSE 1001.
  2. Brass and Copper Supplies: ASME A112.18.1.
  3. Dishwasher Air-Gap Fittings: ASSE 1021.
  4. Plastic Tubular Fittings: ASTM F 409.
  5. Sensor-Operation Flushometers: ASSE 1037 and UL 1951.
- J. Comply with the following applicable standards and other requirements specified for miscellaneous components:
1. Flexible Water Connectors: ASME A112.18.6.
  2. Floor Drains: ASME A112.6.3.
  3. Grab Bars: ASTM F 446.
  4. Hose-Coupling Threads: ASME B1.20.7.
  5. Off-Floor Fixture Supports: ASME A112.6.1M.
  6. Pipe Threads: ASME B1.20.1.
  7. Plastic Toilet Seats: ANSI Z124.5.
  8. Supply and Drain Protective Shielding Guards: ICC A117.1.

## SECTION 224000 - PLUMBING FIXTURES

### 1.6 WARRANTY

- A. Special Warranties: Manufacturer's standard form in which manufacturer agrees to repair or replace components of whirlpools that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Structural failures of unit shell.
    - b. Faulty operation of controls, blowers, pumps, heaters, and timers.
    - c. Deterioration of metals, metal finishes, and other materials beyond normal use.

## PART 2 - PRODUCTS

### 2.1 LAVATORY FAUCETS

- A. Lavatory Faucets:
  - 1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include the following:
    - a. Chicago Faucets.
    - b. Elkay Manufacturing Co.
    - c. Moen, Inc.
  - 2. Description: See plumbing schedule.

### 2.2 SINK FAUCETS

- A. Sink Faucets:
  - 1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include the following:
    - a. Chicago Faucets.
    - b. Elkay Manufacturing Co.
    - c. Moen, Inc.
  - 2. Description: See plumbing schedule.

### 2.3 FLUSHOMETERS

- A. Flushometers:
  - 1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include the following:

## SECTION 224000 - PLUMBING FIXTURES

- a. Sloan Valve Company.
  - b. Zurn
2. Description: See plumbing schedule.

### 2.4 TOILET SEATS

#### A. Toilet Seats:

1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include the following:
  - a. American Standard Companies, Inc.
  - b. Bemis Manufacturing Company.
  - c. Kohler Co.
2. Description: See plumbing schedule.

### 2.5 PROTECTIVE SHIELDING GUARDS

#### A. Protective Shielding Pipe Covers:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. TRUEBRO, Inc.
2. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

### 2.6 FIXTURE SUPPORTS

#### A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. MIFAB Manufacturing Inc.
2. Zurn Plumbing Products Group; Specification Drainage Operation.
3. Watts Drainage.

#### B. Water-Closet Supports:

1. Description: See plumbing schedule.

#### C. Urinals Supports:

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1. Description: See plumbing schedule.

### D. Lavatory Supports:

1. Description: See plumbing schedule.

### E. Sink Supports:

1. Description: See plumbing schedule.

## 2.7 WATER CLOSETS

### A. Water Closets:

1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include the following:

- a. Crane Plumbing, L.L.C./Fiat Products.
- b. American Standard Companies, Inc.
- c. Zurn
- d. Kohler
- e. Toto USA.

2. Description: See plumbing schedule.

### B. Urinals:

1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include the following:

- a. Crane Plumbing, L.L.C./Fiat Products.
- b. American Standard Companies, Inc.
- c. Zurn
- d. Kohler
- e. Toto USA.

2. Description: See plumbing schedule.

## 2.8 LAVATORIES

### A. Lavatories:

1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include the following:

- a. American Standard Companies, Inc.
- b. Toto USA
- c. Crane Plumbing, L.L.C./Fiat Products.

2. Description: See plumbing schedule.



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### 2.9 KITCHEN SINKS

#### A. Kitchen Sinks:

1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include the following:
  - a. Elkay USA
  - b. Acorn
  - c. Willoughby
2. Description: See plumbing schedule.

### 2.10 SERVICE BASINS

#### A. Mop Service Basim:

1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include the following:
  - a. American Standard Companies, Inc.
  - b. Toto USA
  - c. Crane Plumbing, L.L.C./Fiat Products.
2. Description: See plumbing schedule.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before plumbing fixture installation.
- B. Examine cabinets, counters, floors, and walls for suitable conditions where fixtures will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.
- B. Install off-floor supports, affixed to building substrate, for wall-mounting fixtures.

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1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
  2. Use carrier supports without waste fitting for fixtures with tubular waste piping.
  3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.
- C. Install back-outlet, wall-mounting fixtures onto waste fitting seals and attach to supports.
- D. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.
- E. Install wall-mounting fixtures with tubular waste piping attached to supports.
- F. Install floor-mounting, back-outlet water closets attached to building floor substrate and wall bracket and onto waste fitting seals.
- G. Install counter-mounting fixtures in and attached to casework.
- H. Install fixtures level and plumb according to roughing-in drawings.
- I. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.
1. Exception: Use ball, gate, or globe valves if supply stops are not specified with fixture. Valves are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."
- J. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.
- K. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.
- L. Install flushometer valves for accessible water closets with handle mounted on wide side of compartment. Install other actuators in locations that are easy for people with disabilities to reach.
- M. Install tanks for accessible, tank-type water closets with lever handle mounted on wide side of compartment.
- N. Install toilet seats on water closets.
- O. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
- P. Install water-supply flow-control fittings with specified flow rates in fixture supplies at stop valves.
- Q. Install faucet flow-control fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
- R. Install traps on fixture outlets.
1. Exception: Omit trap on fixtures with integral traps.

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2. Exception: Omit trap on indirect wastes, unless otherwise indicated.
- S. Install escutcheons at piping wall ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Escutcheons are specified in Division 22 Section "Escutcheons for Plumbing Piping."
- T. Set service basins in leveling bed of cement grout. Grout is specified in Division 22 Section "Common Work Results for Plumbing."
- U. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 07 Section "Joint Sealants."

### 3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

### 3.4 FIELD QUALITY CONTROL

- A. Verify that installed plumbing fixtures are categories and types specified for locations where installed.
- B. Check that plumbing fixtures are complete with trim, faucets, fittings, and other specified components.
- C. Inspect installed plumbing fixtures for damage. Replace damaged fixtures and components.
- D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.
- E. Install fresh batteries in sensor-operated mechanisms.

### 3.5 ADJUSTING

- A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.
- B. Operate and adjust controls. Replace damaged and malfunctioning units and controls.

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- C. Adjust water pressure at faucets and flushometer valves to produce proper flow and stream.
- D. Replace washers and seals of leaking and dripping faucets and stops.
- E. Install fresh batteries in sensor-operated mechanisms.

### 3.6 CLEANING

- A. Clean fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Do the following:
  - 1. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts.
  - 2. Remove sediment and debris from drains.
- B. After completing installation of exposed, factory-finished fixtures, faucets, and fittings, inspect exposed finishes and repair damaged finishes.

### 3.7 PROTECTION

- A. Provide protective covering for installed fixtures and fittings.
- B. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 224000

## SECTION 224500 - EMERGENCY 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.

#### 1.2 SUMMARY

- A. Section Includes: Combination units.

#### 1.3 DEFINITIONS

- A. Accessible Fixture: Emergency plumbing fixture that can be approached, entered, and used by people with disabilities.
- B. Plumbed Emergency Plumbing Fixture: Fixture with fixed, potable-water supply.
- C. Self-Contained Emergency Plumbing Fixture: Fixture with flushing-fluid-solution supply.
- D. Tepid: Moderately warm.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include flow rates and capacities, furnished specialties, and accessories.
- B. Shop Drawings: Diagram power, signal, and control wiring.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Product Certificates: Submit certificates of performance testing specified in "Source Quality Control" Article.
- B. Field quality-control test reports.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For emergency plumbing fixtures to include in operation and maintenance manuals.

## SECTION 224500 - EMERGENCY PLUMBING FIXTURES

### 1.7 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. ANSI Standard: Comply with ANSI Z358.1, "Emergency Eyewash and Shower Equipment."
- C. NSF Standard: Comply with NSF 61 Annex G, "Drinking Water System Components - Health Effects," for fixture materials that will be in contact with potable water.
- D. Regulatory Requirements: Comply with requirements in ICC/ANSI A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; for plumbing fixtures for people with disabilities.

### 1.8 COORDINATION

- A. Coordinate roughing-in and final plumbing fixture locations, and verify that fixtures can be installed to comply with original design and referenced standards.

## PART 2 - PRODUCTS

### 2.1 COMBINATION UNITS

- A. Plumbed Emergency Shower with Eyewash Combination Units, see schedules:
  - 1. Products:
    - a. Bradley Corporation
    - b. Chicago Faucet Co
    - c. Encon Safety Products
    - d. Guardian Equipment Co
    - e. Haws Corporation
    - f. Lab Safety Supply, Inc
    - g. Murdock, Inc
    - h. Sellstrom Manufacturing Co
    - i. Speakman Co
    - j. WaterSaver Faucet Co
    - k. Western Emergency Equipment
  - 2. Piping:
    - a. Material: Chrome-plated brass or stainless steel.
    - b. Unit Supply: NPS 1-1/4 minimum.
    - c. Unit Drain: Outlet at back or side near bottom.
  - 3. Shower:
    - a. Capacity: Not less than 20 gpm for at least 15 minutes.
    - b. Supply Piping: NPS 1 with flow regulator and stay-open control valve.
    - c. Control-Valve Actuator: See schedule.

## SECTION 224500 - EMERGENCY PLUMBING FIXTURES

- d. Shower Head: 8-inch-minimum diameter, chrome-plated brass or stainless steel.
  - e. Mounting: Pedestal.
4. Eye/Facewash Unit:
- a. Capacity: Not less than 3 gpm for at least 15 minutes.
  - b. Supply Piping: NPS 1/2 with flow regulator and stay-open control valve.
  - c. Control-Valve Actuator: Paddle.
  - d. Spray-Head Assembly: Two or four receptor-mounted spray heads.
  - e. Receptor: Chrome-plated brass or stainless-steel bowl.
  - f. Mounting: Attached shower pedestal.

### 2.2 WATER-TEMPERING EQUIPMENT

- A. Hot- and Cold-Water, Water-Tempering Equipment, if required by authorities having jurisdiction:
  - 1. Description: Factory-fabricated equipment with thermostatic mixing valve.
    - a. Thermostatic Mixing Valve: Designed to provide 85 deg F tepid, potable water at emergency plumbing fixtures, to maintain temperature at plus or minus 5 deg F throughout required 15-minute test period, and in case of unit failure to continue cold-water flow, with union connections, controls, metal piping, and corrosion-resistant enclosure.
    - b. Supply Connections: For hot and cold water.
- B. SOURCE QUALITY CONTROL
- C. Certify performance of emergency plumbing fixtures by independent testing organization acceptable to authorities having jurisdiction.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine roughing-in for water and waste piping systems to verify actual locations of piping connections before plumbed emergency plumbing fixture installation.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 EMERGENCY PLUMBING FIXTURE INSTALLATION

- A. Assemble emergency plumbing fixture piping, fittings, control valves, and other components.
- B. Install fixtures level and plumb.
- C. Fasten fixtures to substrate.

## SECTION 224500 - EMERGENCY PLUMBING FIXTURES

- D. Install shutoff valves in water-supply piping to fixtures. Use ball or gate valve if specific type valve is not indicated. Install valves chained or locked in open position if permitted. Install valves in locations where they can easily be reached for operation. Comply with requirements for valves specified in Division 22 Sections.
  - 1. Exception: Omit shutoff valve on supply to group of plumbing fixtures that includes emergency equipment.
  - 2. Exception: Omit shutoff valve on supply to emergency equipment if prohibited by authorities having jurisdiction.
- E. Install dielectric fitting in supply piping to emergency equipment if piping and equipment connections are made of different metals. Comply with requirements for dielectric fittings specified in Section 221116 "Domestic Water Piping."
- F. Install thermometers in supply and outlet piping connections to water-tempering equipment.
- G. Install trap and waste piping on drain outlet of emergency equipment receptors that are indicated to be directly connected to drainage system. Comply with requirements for waste piping specified in Section 221316 "Sanitary Waste and Vent Piping."
- H. Install indirect waste piping on drain outlet of emergency equipment receptors that are indicated to be indirectly connected to drainage system. Comply with requirements for waste piping specified in Section 221316 "Sanitary Waste and Vent Piping."
- I. Install escutcheons on piping wall and ceiling penetrations in exposed, finished locations. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

### 3.3 CONNECTIONS

- A. Connect cold-water-supply piping to plumbed emergency plumbing fixtures not having water-tempering equipment. Comply with requirements for cold-water piping specified in Section 221116 "Domestic Water Piping."
- B. Connect emergency plumbing fixture receptors with trapped drain outlet to sanitary waste and vent piping. Comply with requirements for waste piping specified in Section 221316 "Sanitary Waste and Vent Piping."
- C. Where installing piping adjacent to emergency plumbing fixtures, allow space for service and maintenance of fixtures.

### 3.4 IDENTIFICATION

- A. Install equipment nameplates or equipment markers on emergency plumbing fixtures and equipment and equipment signs on water-tempering equipment. Comply with requirements for identification materials specified in Section 220553 "Identification for Plumbing Piping and Equipment."



## SECTION 224500 - EMERGENCY PLUMBING FIXTURES

### 3.5 FIELD QUALITY CONTROL

- A. Mechanical-Component Testing: After plumbing connections have been made, test for compliance with requirements. Verify ability to achieve indicated capacities.
- B. Tests and Inspections:
  - 1. Perform each visual and mechanical inspection.
  - 2. Leak Test: After installation, charge system 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 unit operation.
  - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Emergency plumbing fixtures will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

### 3.6 ADJUSTING

- A. Adjust or replace fixture flow regulators for proper flow.
- B. Adjust equipment temperature settings.

END OF SECTION 224500

## SECTION 224713 - DRINKING FOUNTAINS

### 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 drinking fountains and related components.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of drinking fountain.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
  - 2. Include operating characteristics, and furnished specialties and accessories.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For drinking fountains to include in maintenance manuals.

#### 1.5 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. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities" for fixtures for people with disabilities.
- C. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.
- D. ARI Standard: Comply with ARI's "Directory of Certified Drinking Water Coolers" for style classifications.
- E. ARI Standard: Comply with ARI 1010, "Self-Contained, Mechanically Refrigerated Drinking-Water Coolers," for water coolers and with ARI's "Directory of Certified Drinking Water Coolers" for type and style classifications.
- F. ASHRAE Standard: Comply with ASHRAE 34, "Designation and Safety Classification of Refrigerants," for water coolers. Provide HFC 134a refrigerant, unless otherwise indicated.

## SECTION 224713 - DRINKING FOUNTAINS

### 1.6 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Filter Cartridges: Equal to 10 percent of amount installed for each type and size indicated, but no fewer than 3 of each.

## PART 2 - PRODUCTS

### 2.1 DRINKING FOUNTAINS

- A. Drinking Fountains: See Drawings for schedules and description.
  - 1. Manufacturers:
    - a. Elkay Manufacturing Co.
    - b. Oasis.
    - c. Halsey Taylor
    - d. Acorn Engineering Co.

### 2.2 FIXTURE SUPPORTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Josam Co.
  - 2. MIFAB Manufacturing, Inc.
  - 3. Zurn Plumbing Products Group; Specification Drainage Operation.
- B. Description: ASME A112.6.1M, water cooler carriers. Include vertical, steel uprights with feet and tie rods and bearing plates with mounting studs matching fixture to be supported.
  - 1. Type I: Hanger-type carrier with two vertical uprights.
  - 2. Type II: Bilevel, hanger-type carrier with three vertical uprights.
  - 3. Supports for Accessible Fixtures: Include rectangular, vertical, steel uprights instead of steel pipe uprights.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine roughing-in for water-supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before fixture installation.
- B. Examine walls and floors for suitable conditions where fixtures will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

## SECTION 224713 - DRINKING FOUNTAINS

### 3.2 INSTALLATION

- A. Install fixtures level and plumb according to roughing-in drawings. For fixtures indicated for children, install at height required by authorities having jurisdiction.
- B. Set pedestal drinking fountains on floor.
- C. Install recessed drinking fountains secured to wood blocking in wall construction.
- D. Install off-the-floor carrier supports, affixed to building substrate, for wall-mounted fixtures.
- E. Install water-supply piping with shutoff valve on supply to each fixture to be connected to domestic-water distribution piping. Use ball or gate valve. Install valves in locations where they can be easily reached for operation.
- F. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.
- G. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons where required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."
- H. Seal joints between fixtures and walls using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

### 3.3 CONNECTIONS

- A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."
- C. Install ball or gate shutoff valve on water supply to each fixture. Comply with valve requirements.
- D. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

### 3.4 ADJUSTING

- A. Adjust fixture flow regulators for proper flow and stream height.
- B. Adjust water cooler temperature settings.

### 3.5 FIELD QUALITY CONTROL

- A. Water Cooler Testing: After electrical circuitry has been energized, test for compliance with requirements. Test and adjust controls and safeties.

## SECTION 224713 - DRINKING FOUNTAINS

1. Remove and replace malfunctioning units and retest as specified above.
2. Report test results in writing.

### 3.6 CLEANING

- A. After installing fixtures, inspect unit. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.
- B. Clean fixtures, on completion of installation, according to manufacturer's written instructions.
- C. Provide protective covering for installed fixtures.
- D. Do not allow use of fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 224713

## SECTION 226600 - CHEMICAL-WASTE SYSTEMS FOR LABORATORY

### 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: Chemical-waste and vent, gravity-flow, non-pressure piping and specialties system designated "chemical waste."

#### 1.3 DEFINITIONS

- A. CR: Chlorosulfonated polyethylene synthetic rubber.
- B. FPM: Vinylidene fluoride-hexafluoro propylene copolymer rubber.

#### 1.4 PERFORMANCE REQUIREMENTS

- A. Single-Wall Piping Pressure Rating: 10 feet head of water.

#### 1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For neutralization system and leak-detection system. Include plans, elevations, sections, details, and attachments to other work.
  - 1. Detail neutralization-system assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 2. Detail leak-detection-system assemblies and indicate required clearances, method of field assembly, components, and location and size of each field connection.
  - 3. Wiring Diagrams: For power, signal, and control wiring.

#### 1.6 INFORMATIONAL SUBMITTALS

- A. Profile Drawings for Outdoor Underground Piping: Show system piping in elevation. Draw profiles at horizontal scale of not less than 1 inch equals 50 feet and vertical scale of not less than 1 inch equals 5 feet. Indicate underground structures and pipes. Show types, sizes, materials, and elevations of other utilities crossing system piping.

## SECTION 226600 - CHEMICAL-WASTE SYSTEMS FOR LABORATORY

- B. Coordination Drawings: Show pipe sizes, locations, and elevations. Show other piping in same trench and clearances from sewerage system piping. Indicate interface and spatial relationship between piping and proximate structures.
- C. Field quality-control test reports.

### 1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For chemical-waste specialties and neutralization tanks, to include in emergency, operation, and maintenance manuals.

### 1.8 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Neutralization-Tank Limestone: Equal to 200 percent of amount required for each tank sump initial charge. Furnish limestone in 50-lb bags.

### 1.9 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 70, "National Electrical Code."

### 1.10 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store piping and specialties with sealing plugs in ends or with end protection.
- B. Do not store plastic pipe or fittings in direct sunlight.
- C. Protect pipe, fittings, and seals from dirt and damage.

### 1.11 PROJECT CONDITIONS

- A. Interruption of Existing Chemical-Waste Service: Do not interrupt chemical-waste service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary chemical-waste service according to requirements indicated:
  - 1. Notify Architect no fewer than 7 days in advance of proposed interruption of chemical-waste service.
  - 2. Do not proceed with interruption of chemical-waste service without Architect's written permission.

## SECTION 226600 - CHEMICAL-WASTE SYSTEMS FOR LABORATORY

### 1.12 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Section 033000 "Cast-in-Place Concrete."

## PART 2 - PRODUCTS

### 2.1 SINGLE-WALL PIPE AND FITTINGS

- A. PP Drainage Pipe and Fittings: ASTM F 1412, pipe extruded and drainage-pattern fittings molded, with Schedule 40 dimensions, from PP resin with fire-retardant additive complying with ASTM D 4101; with fusion- and mechanical-joint ends.
  - 1. Exception: Pipe and fittings made from PP resin without fire-retardant additive may be used for underground installation.
  - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Georg Fischer Inc.
    - b. IPEX USA LLC.
    - c. Orion Fittings; a Watts Water Technologies company.
    - d. Town & Country Plastics, Inc.
    - e. Watts; a Watts Water Technologies company.
    - f. Zurn Industries, LLC.
- B. CPVC Drainage Pipe and Fittings: ASTM F2618, pipe extruded and drainage pattern fittings molded, from CPVC resin Cell Classification 23447. CPVC Drainage system conforms to ULC S 102.2 M88 rating for flame spread and smoke development. Rated for chemical waste piping application.
- C. Adapters and Transition Fittings: Assemblies with combination of clamps, couplings, adapters, and gaskets; compatible with piping and system liquid; made for joining different piping materials.

### 2.2 JOINING MATERIALS

- A. Couplings: Assemblies with combination of clamps, gaskets, sleeves, and threaded or flanged parts; compatible with piping and system liquid; and made by piping manufacturer for joining system piping.
- B. Adapters and Transition Fittings: Assemblies with combination of clamps, couplings, adapters, gaskets, and threaded or flanged parts; compatible with piping and system liquid; and made for joining different piping materials.
- C. Flanges: Assemblies of companion flanges and gaskets complying with ASME B16.21 and compatible with system liquid, and bolts and nuts.



## SECTION 226600 - CHEMICAL-WASTE SYSTEMS FOR LABORATORY

### 2.3 PIPING SPECIALTIES

#### A. Plastic Dilution Traps:

1. Manufacturers:
  - a. Enfield Industrial Corp.
  - b. Nalge Nunc International; Nalge Process Technologies.
  - c. Orion Fittings, Inc.
  - d. Sloane, George Fischer, Inc.
  - e. Town & Country Plastics, Inc.
  - f. **Spears Manufacturing Company**
2. Material: Corrosion-resistant PP, with removable base.
3. End Connections: Mechanical joint.
4. Dilution Tanks: 1-gal. capacity, with clear base unless colored base is indicated; with two NPS 1-1/2 top inlets and one NPS 1-1/2 side outlet.
5. Large Dilution Jars: 1-quart capacity; with NPS 1-1/2 top inlet and NPS 1-1/2 side outlet.

#### B. PP Floor Drains :

1. Manufacturers:
  - a. Enfield Industrial Corp.
  - b. Nalge Nunc International; Nalge Process Technologies.
  - c. Orion Fittings, Inc.
  - d. Schier Products Co.
  - e. Sloane, George Fischer, Inc.
  - f. Town & Country Plastics, Inc.
2. Body: With 7- to 9-inch top diameter, with flashing flange and weep holes; and with flashing clamp, basket strainer, funnel attachment and trap-primer connection.
3. Outlet: Bottom, to match connecting pipe, with NPS 2, NPS 3, NPS 4, or NPS 6 outlet as indicated.

#### C. Stainless-Steel Cleanouts:

1. Standard: ASME A112.3.1, ASTM A 666, Type 316L, stainless steel.
2. Aboveground Piping: Cleanout tee of size matching piping.
3. Underground and Underslab Piping: Floor access cleanout of size matching piping.

#### D. PP Sink Outlets:

1. Description: NPS 1-1/2, with clamping device, stopper, and 7-inch-high overflow fitting.

### 2.4 NEUTRALIZATION TANKS

#### A. Plastic Neutralization Tanks:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Chem-Tainer Industries.

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- b. [Georg Fischer Inc.](#)
  - c. [IPEX USA LLC.](#)
  - d. [Orion Fittings; a Watts Water Technologies company.](#)
  - e. [Schier Products Company.](#)
  - f. [Town & Country Plastics, Inc.](#)
  - g. [Watts; a Watts Water Technologies company.](#)
  - h. [Zurn Industries, LLC.](#)
2. Description: Corrosion-resistant plastic materials; with removable, gastight cover; interior, sidewall, dip-tube inlet; outlet; vent; and threaded or flanged, sidewall pipe connections.
- a. Material: ASTM D 4101, PP.
  - b. Dip Tube: On outlet pipe instead of inlet pipe.
  - c. Extension: PP.
  - d. Traffic Cover: Heavy-duty pedestrian or light-duty vehicular, steel plate over plastic, bolted.
  - e. Limestone: Chips or lumps, with more than 90 percent calcium carbonate content and 1- to 3-inch diameter.

### 2.5 NEUTRALIZATION SYSTEMS

#### A. Plastic-Tank Neutralization Systems:

1. [Manufacturers](#): Subject to compliance with requirements, provide products by one of the following:
  - a. [Orion Fittings; a Watts Water Technologies company.](#)
  - b. [Town & Country Plastics, Inc.](#)
2. Description: Automatic system for neutralizing chemical waste.
  - a. Controls: Factory-wired and -tested, 120-V ac, to operate probes, control valves, and metering pumps and to monitor pH of effluent; with wiring and electrical-power terminals.
  - b. Panel: NEMA 250, Type 4X enclosure, unless otherwise indicated; with manufacturer's standard features, control devices, and indicators, but not less than the following:
    - 1) Power light and on/off switch.
    - 2) pH analyzer with meter and high- and low-pH indicators.
    - 3) Low caustic- and acid-solution level indicators.
    - 4) Alarm horn with silencer and reset switch.
    - 5) Agitator running light with on/off switch.
    - 6) Running lights with on/off switches for caustic- and acid-solution pumps.
  - c. Strip chart recorder with capacity for 30-day record.
  - d. Piping between Tanks: Same material as chemical-waste piping system unless otherwise indicated.

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- e. Interceptor Tank: Same material as mixing tank; with removable, gastight cover; and sidewall inlet and outlet piping connections.
- f. Neutralization Tank: Same material as mixing tank; with removable, gastight cover; sidewall inlet and outlet piping connections; and vent connection in sidewall or top.
  - 1) Limestone: Chips or lumps, with more than 90 percent calcium carbonate content and 1- to 3-inch diameter.
- g. Mixing Tank: With removable, gastight cover; sidewall inlet and outlet piping connections; vent connection in sidewall or top; neutralizing-solution piping connections; and openings in top for probe and agitator.
  - 1) Material: ASTM D 4101, PP.
  - 2) pH Probe: Type and length suitable for mixing-tank size.
  - 3) Agitator: Electric, with stainless-steel shaft and propeller.
- h. Caustic-Solution Storage Tank: PP.
  - 1) Caustic Chemical: Sodium hydroxide solution.
- i. Acid Storage Tank: PP.
  - 1) Acid Chemical: Sulfuric acid solution.
- j. Metering Pumps: Types suitable for neutralizing solutions.
- k. Sampling Tank: Same material as mixing tank; with removable, gastight cover; sidewall inlet and outlet piping connections; and opening in top for probe.
  - 1) pH probe: Type and length suitable for sampling-tank size.

### 2.6 EXECUTION

### 2.7 EARTHWORK

- A. Comply with requirements in Section 312000 "Earth Moving" for excavating, trenching, and backfilling.

### 2.8 CONCRETE BASES

- A. Anchor neutralization system tanks to concrete bases.
  - 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 19-inch centers around full perimeter of base.
  - 2. For installed equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
  - 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be imbedded.
  - 4. Install anchor bolts to elevations required for proper attachment to supported equipment.

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5. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
6. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Section 033000 "Cast-in-Place Concrete."

### 2.9 PIPING INSTALLATION

#### A. Chemical-Waste Sewerage Outside the Building:

1. Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground chemical-waste sewerage piping. Location and arrangement of piping layout take design considerations into account. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.
2. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for using lubricants, cements, and other installation requirements.
3. Install manholes for changes in direction, unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.
4. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.
5. Tunneling: Install pipe under streets or other obstructions that cannot be disturbed by tunneling, jacking, or combination of both.
6. Install drainage piping pitched down in direction of flow, at minimum slope of 2 percent, unless otherwise indicated.
7. Install drainage piping with 36-inch minimum cover.
8. Install drainage piping according to ASTM D 2321 and ASTM F 1668.
9. Clear interior of piping and structures of dirt and superfluous material as work progresses. Maintain swab or drag in piping, and pull past each joint as it is completed. Place plug in end of incomplete piping at end of day and when work stops.

#### B. Chemical-Waste Piping Inside the Building:

1. Install piping next to equipment, accessories, and specialties to allow service and maintenance.
2. Transition and special fittings with pressure ratings at least equal to piping pressure rating may be used unless otherwise indicated.
3. Flanges may be used on aboveground piping unless otherwise indicated.
4. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
5. 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.
6. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
7. Install piping at indicated slopes.
8. Install piping free of sags and bends.
9. Install fittings for changes in direction and branch connections.

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10. Verify final equipment locations for roughing-in.
11. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
12. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
13. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

### 2.10 PIPING SPECIALTY INSTALLATION

- A. Embed floor drains in 4-inch minimum depth of concrete around bottom and sides. Comply with requirements in Section 033000 "Cast-in-Place Concrete" for concrete.
- B. Fasten grates to drains if indicated.
- C. Set floor drains with tops flush with pavement surface.
- D. Install cleanouts and riser extension from sewer pipe to cleanout at grade. Use fittings of same material as sewer pipe at branches for cleanouts and riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in pipe.
  1. Set cleanout bodies in earth in cast-in-place concrete block, 18 by 18 by 12 inches deep. Set with tops 1 inch above surrounding grade. Set cleanout plugs in concrete pavement with tops flush with pavement surface. Comply with requirements in Section 033000 "Cast-in-Place Concrete" for formwork, reinforcement, and concrete requirements.
- E. Install backwater valves in horizontal position. Include riser to cleanout at grade.

### 2.11 JOINT CONSTRUCTION

- A. Chemical-Waste Piping and Sewerage :
  1. Plastic-Piping, Electrofusion Joints: Make polyolefin drainage-piping joints according to ASTM F 1290.
  2. Join dissimilar pipe materials with adapters compatible with pipe materials being joined.
  3. PVC Nonpressure Piping Joints: Join piping according to ASTM D 2665.
  4. CPVC Plastic Piping Solvent Cemented Joints: Make CPVC drainage-piping joints according to ASTM F493.

### 2.12 HANGER AND SUPPORT INSTALLATION

- A. Pipe sizes in this article refer to aboveground, single-wall piping.
- B. Comply with requirements in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support devices. Install the following:

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1. Vertical Piping: MSS Type 8 or MSS Type 42, riser clamps.
  2. Individual, Straight, Horizontal Piping Runs:
    - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
    - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
    - c. Longer Than 100 Feet, if Indicated: MSS Type 49, spring cushion rolls.
  3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
  4. Base of Vertical Piping: MSS Type 52, spring hangers.
- C. Comply with requirements in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment" for installation of supports.
- D. Support horizontal piping and tubing within 12 inches of each fitting and coupling.
- E. Support vertical piping and tubing at base and at each floor.
- F. Rod diameter may be reduced 1 size for double-rod hangers, to minimum of 3/8 inch.
- G. Install vinyl-coated hangers for PP piping with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 2: 33 inches with 3/8-inch rod.
  2. NPS 2-1/2 and NPS 3: 42 inches with 1/2-inch rod.
  3. NPS 4 and NPS 5: 48 inches with 5/8-inch rod.
  4. NPS 6: 48 inches with 3/4-inch rod.
  5. NPS 8: 48 inches with 7/8-inch rod.
- H. Install supports for vertical PP piping every 72 inches.
- I. Install vinyl-coated hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 1-1/4: 36 inches with 3/8-inch rod.
  2. NPS 1-1/2 and NPS 2: 42 inches with 3/8-inch rod.
  3. NPS 2-1/2 and NPS 3: 42 inches with 1/2-inch rod.
  4. NPS 4 and NPS 5: 48 inches with 5/8-inch rod.
  5. NPS 6: 48 inches with 3/4-inch rod.
  6. NPS 8 to NPS 12: 48 inches with 7/8-inch rod.
- J. Install supports for vertical PVC piping every 48 inches.
- K. Support piping and tubing not listed above according to MSS SP-69.
- ### 2.13 NEUTRALIZATION TANK INSTALLATION
- A. Install exterior collection and neutralization tanks, complete with appurtenances indicated.
1. Set tops of tank covers flush with finished surface where covers occur in pavements. Set covers 3 inches above finished surface elsewhere unless otherwise indicated.

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2. Include initial fill of limestone for neutralization tanks.

- B. Install interior neutralization tanks on smooth and level [**concrete base**] [**floor surface**]. Include full initial charge of limestone.

### 2.14 NEUTRALIZATION SYSTEM INSTALLATION

- A. Install neutralization systems on smooth and level concrete base. Include neutralizing solutions and full initial charge of limestone.

### 2.15 MANHOLE INSTALLATION

- A. General: Install manholes, complete with appurtenances and accessories indicated. Comply with requirements in Section 221313 "Facility Sanitary Sewers."
- B. Set tops of manhole frames and covers flush with finished surface where manholes occur in pavements. Set tops 3 inches above finished surface elsewhere unless otherwise indicated.

### 2.16 CONCRETE PLACEMENT

- A. Comply with requirements in Section 033000 "Cast-in-Place Concrete" for concrete supports.
- B. Place cast-in-place concrete according to ACI 318/318R.

### 2.17 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Make connections to existing piping so finished Work complies as nearly as practical with requirements specified for new Work.
- C. Use commercially manufactured wye fittings for sewerage piping branch connections. Remove section of existing pipe; install wye fitting into existing piping; and encase entire wye fitting plus 6-inch overlap, with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.
- D. Protect existing piping to prevent concrete or debris from entering while making connections. Remove debris or other extraneous material that may accumulate.
- E. Install piping adjacent to equipment to allow service and maintenance.

### 2.18 LABELING AND IDENTIFICATION

- A. Comply with requirements in Section 220553 "Identification for Plumbing Piping and Equipment" for labeling of equipment and piping.
1. Use detectable warning tape over piping and over edges of underground structures.

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### 2.19 FIELD QUALITY CONTROL

- A. Inspect interior of sewerage piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place and again at completion of Project.
  - 1. Defects requiring correction include the following:
    - a. Alignment: Less than full diameter of inside of pipe is visible between inspection points.
    - b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
    - c. Crushed, broken, cracked, or otherwise damaged piping.
    - d. Hydrostatic Tests for Drainage Piping:
      - 1) Allowable leakage is a maximum of 50 gal./inch of nominal pipe size per mile of pipe, during 24-hour period.
      - 2) Close openings in system and fill with water.
      - 3) Purge air and refill with water.
      - 4) Disconnect water supply.
      - 5) Test and inspect joints for leaks.
    - e. Air Tests for Drainage Piping: Comply with UNI-B-6.
  - 2. Leaks and loss in test pressure constitute defects that must be repaired.
  - 3. Submit separate reports for each test.
- B. Replace leaking sewerage piping using new materials, and repeat testing until leakage is within allowances specified.
- C. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- D. 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.
- E. Tests and Inspections:
  - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect assembled neutralization systems and their installation, including piping and electrical connections, and to assist in testing.
  - 2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
  - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- F. Chemical-waste piping will be considered defective if it does not pass tests and inspections.



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- G. Prepare test and inspection reports.

### 2.20 STARTUP SERVICE

- A. Perform startup service for neutralization systems.
  - 1. Complete installation and startup checks according to manufacturer's written instructions.
  - 2. Neutralization Systems:
    - a. Verify that neutralization system is installed and connected according to the Contract Documents.
    - b. Verify that electrical wiring installation complies with manufacturer's submittal.
    - c. Install neutralizing solutions and limestone.
    - d. Energize circuits.
    - e. Start and run systems through complete sequence of operations.
    - f. Adjust operating controls.

### 2.21 ADJUSTING

- A. Adjust neutralization-system set points.

### 2.22 CLEANING

- A. Use procedures prescribed by authorities having jurisdiction or, if not prescribed, use procedures described below:
  - 1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
  - 2. Clean piping by flushing with potable water.

### 2.23 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain neutralization systems.

### 2.24 PIPING SCHEDULE

- A. Transition and special fittings with pressure ratings at least equal to piping pressure rating may be used in applications below unless otherwise indicated.
- B. Single-Wall, Chemical-Waste Sewerage Piping: Use any of the following piping materials for each size range:
  - 1. NPS 1-1/2 to NPS 6: PP drainage pipe and fittings and electrofusion joints.
  - 2. NPS 1-1/2 to NPS 6: CPVC drainage pipe and fittings and solvent-cemented joints, rated for this service.

END OF SECTION 226600

## SECTION 226700 - PROCESSED WATER SYSTEMS FOR LABORATORY FACILITIES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section includes a skid mounted full building water softener, and skid mounted deionized-water and reverse-osmosis-water system and piping for the Labs. See Water Softener specification for more information.

#### 1.3 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressure Ratings:
  - 1. Deionized-Water Piping: 150 psig unless otherwise indicated.
  - 2. Reverse-Osmosis-Water Piping: 150 psig unless otherwise indicated.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Submittals:
  - 1. Product Data for Credit IEQ 4.1: For solvent cements and adhesive primers, documentation including printed statement of VOC content.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Field quality-control reports.

#### 1.6 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
- B. ASME Compliance: Comply with ASME B31.3, "Process Piping," for piping conveying fluid at a pressure of 15 psig or greater.

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### PART 2 - PRODUCTS

#### 2.1 PLASTIC PIPE AND FITTINGS

- A. PP Pipe and Fittings for Heat-Fusion Joints: Made from ASTM D 4101, PP resin.
  - 1. Schedule 40, Pipe and Fittings: Pipe made to ASTM D 2447, Schedule 40 or SDR 11 dimensions; with socket- or butt-fusion fittings matching pipe dimensions.
- B. PP Pipe and Fittings for Electro-Fusion Joints: Made from ASTM D 4101, PP resin.
  - 1. Schedule 80, Pipe and Fittings: Pipe made to ASTM D 2447, Schedule 80 dimensions; with socket fittings matching pipe dimensions.
  - 2. Electro-Fusion Fitting: Electrical-resistance heating coil for PP piping joints.
- C. PVDF Pipe and Fittings: Made from ASTM D 3222, PVDF resin.
  - 1. Schedule 40, Pipe and Fittings: Pipe made to ASTM D 2447, Schedule 40 or SDR 11 dimensions; with socket- or butt-fusion fittings matching pipe dimensions.

#### 2.2 TRANSITION FITTINGS

- A. Transition Fittings: Couplings, flanges, or other manufactured fittings; same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

#### 2.3 PP VALVES

- A. PP Ball Valves:
  - 1. Description:
    - a. Standard: MSS SP-122.
    - b. Pressure Rating: 150 psig at 73 deg F.
    - c. Body Material: ASTM D 4101, PP resin.
    - d. Body Design: Union type.
    - e. End Connections: Detachable, butt or socket.
    - f. Ball: ASTM D 4101, PP resin.
    - g. Port: Full.
    - h. Seats: PTFE.
    - i. Stem: ASTM D 4101, PP resin.
    - j. Stem Seals: FKM-rubber O-rings.
    - k. Handle: Tee shaped.
- B. PP Butterfly Valves:
  - 1. Description:
    - a. Pressure Rating: 150 psig at 73 deg F.
    - b. Body Material: ASTM D 4101, PP resin.
    - c. Body Design: Lug or wafer type.
    - d. Seat: FKM rubber.
    - e. Disc: ASTM D 4101, PP resin.
    - f. Stem: Stainless steel.

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- g. Stem Seals: FKM-rubber O-rings.
  - h. Handle: Lever type with locking device.
- C. PP Ball-Check Valves:
  - 1. Description:
    - a. Pressure Rating: 150 psig at 73 deg F.
    - b. Body Material: ASTM D 4101, PP resin.
    - c. Body Design: Union type.
    - d. End Connections: Detachable, socket.
    - e. Ball: ASTM D 4101, PP resin.
    - f. Seat and Seals: FKM-rubber O-rings.
- D. PP Swing-Check Valves:
  - 1. Description:
    - a. Pressure Rating: 150 psig at 73 deg F.
    - b. Body Material: ASTM D 4101, PP resin.
    - c. Body Design: Bolted-bonnet type.
    - d. End Connections: Flanged.
    - e. Shaft: ASTM D 4101, PP resin.
    - f. Disc and Arm: ASTM D 4101, PP resin.
    - g. Gasket and Seals: FKM rubber.
- E. PP Diaphragm Valves:
  - 1. Description:
    - a. Pressure Rating: 150 psig at 73 deg F.
    - b. Body Material: ASTM D 4101, PP resin.
    - c. Body Design: Bolted-bonnet type.
    - d. End Connections for NPS 2 and Smaller: Detachable, socket.
    - e. End Connections for NPS 2-1/2 and NPS 3: Flanged.
    - f. Diaphragm: FKM rubber.
    - g. Seals: FKM-rubber O-rings.
    - h. Handle: Wheel type.

## PART 3 - EXECUTION

### 3.1 PIPING INSTALLATION

- A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of water piping. Location and arrangement of piping layout take design considerations into account. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.
- B. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

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- C. Install piping indicated to be exposed and 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 removal of ceiling panel, and coordinate with other services occupying that space.
- E. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.
- F. Install piping to permit valve servicing.
- G. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than system pressure ratings unless otherwise indicated.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- K. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- L. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

### 3.2 JOINT CONSTRUCTION

- A. Where specific joint construction is not indicated, follow piping manufacturer's written instructions.
- B. PP Piping Electro-Fusion Joints: Make according to ASTM F 1290.
- C. PP Piping Heat-Fusion Joints: Make according to ASTM D 2657.
- D. Join dissimilar pipe materials with transition fittings compatible with pipe materials being joined.

### 3.3 VALVE INSTALLATION

- A. Install sectional valves close to mains on each branch and riser serving equipment.
- B. Install shutoff valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- C. Locate valves for easy access and provide separate support where necessary.

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- D. Install valves of same size as the pipe or tube in which they are installed unless otherwise indicated.
- E. Install plastic valves of the same material as the plastic pipe in which they are installed.
- F. Install valves in horizontal piping with stem at or above center of pipe.
- G. Install valves in position to allow full movement of stem and lever handle.
- H. Install ball-check valves in horizontal or vertical position so ball will unseat during normal flow.
- I. Install swing-check valves in horizontal position with the hinge pin level.

### 3.4 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
  - 1. Install pre-galvanized carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
  - 2. Install fiberglass pipe hangers for horizontal piping in corrosive environments.
  - 3. Install pre-galvanized carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
  - 4. Clamps for Vertical Piping: MSS Type 8 or Type 42.
  - 5. Individual, Straight, Horizontal Piping Runs:
    - a. 100 Feet and Less: MSS Type 1, adjustable clevis hangers.
    - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
    - c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.
  - 6. Multiple, Straight, Horizontal Piping Runs, 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
  - 7. Base of Vertical Piping: MSS Type 52, spring hangers.
- B. Support horizontal piping and tubing within 12 inches of each fitting, valve, and coupling.
- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced one size for double-rod hangers, to minimum 3/8 inch.
- E. Install padded hangers for PP piping with the following maximum horizontal spacing and minimum rod diameters:
  - 1. NPS 1 and Smaller: 32 inches with 3/8-inch rod.
  - 2. NPS 1-1/4 to NPS 2: 48 inches with 3/8-inch rod.
  - 3. NPS 2-1/2 and NPS 3: 48 inches with 1/2-inch rod.
- F. Install padded supports for vertical PP piping NPS 2-1/2 and larger every 120 inches and midstory for NPS 2 and smaller.

## SECTION 226700 - PROCESSED WATER SYSTEMS FOR LABORATORY FACILITIES

- G. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

### 3.5 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.
- C. Connect deionized-water, and reverse-osmosis-water piping to equipment and service outlets with unions or flanges.

### 3.6 IDENTIFICATION

- A. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

### 3.7 FIELD QUALITY CONTROL

- A. Test new piping, and parts of existing piping that have been altered, extended, or repaired, for leaks and defects.
  - 1. Schedule tests and their inspections with at least 24 hours' advance notice.
  - 2. Do not cover piping or put into service before inspection and approval.
  - 3. Test completed piping according to AHJ and Owner requirements. If AHJ or Owner does not have published procedures, perform tests as follows:
    - a. Hydrostatic Tests: Test piping at pressure not less than 1-1/2 times the maximum system operating pressure, but not less than 100 psig
      - 1) Exception: Do not subject glass piping to pressure above manufacturer's pressure rating for size.
  - 4. Replace leaking joints with new materials and retest until no leaks exist.
  - 5. Submit separate reports for each test.

### 3.8 CLEANING

- A. Use procedures prescribed by authorities having jurisdiction and Owner or, if not prescribed, use procedures described below:
  - 1. Before using, purge new piping and parts of existing piping that have been altered, extended, or repaired.
  - 2. Clean piping by flushing with distilled water.

## SECTION 226700 - PROCESSED WATER SYSTEMS FOR LABORATORY FACILITIES

### 3.9 PIPING SCHEDULE

- A. Transition and special fittings with pressure ratings at least equal to piping, and of same or compatible material, may be used in applications below.
- B. Deionized, Distilled, Reverse-Osmosis-Water Piping: Use the following piping materials for each pipe size range:
  - 1. NPS 3 and Smaller: PP SDR 11 or thicker, and PP fittings with electro-fusion joints.

### 3.10 VALVE SCHEDULE

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
  - 1. Shutoff Duty: Install ball valves in piping NPS 2 and smaller. Install butterfly or diaphragm valves for NPS 3 piping.
  - 2. Throttling Duty: Install ball valves in piping NPS 2 and smaller. Install diaphragm valves for NPS 3 piping.

END OF SECTION 226700



## SECTION 230010 – SUMMARY OF MECHANICAL WORK

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 23 Specification Sections, apply to this Section.

#### 1.2 WORK COVERED BY CONTRACT DOCUMENTS

- A. The following Summary of Work is intended as an aid to achieve an understanding of the various elements of work included in the project, and is not intended to be all-inclusive. Detailed descriptions of work and requirements are given in drawings and specifications.
- B. Mechanical Contract Documents were prepared for the Project by:
  - Ethos Engineering,
  - 1126 South Commerce
  - Harlingen, Texas 78550
  - Phone Number: (956) 230-3435
- C. Scope of Work: Refer to drawings for a detailed Scope of Work.
  - 1. Provide all materials and labor associated with new fully-operational mechanical and controls systems for the project “[UTRGV/ECISD Early College High School](#)”, including but not limited to the following:
    - a. Central Plant: High efficiency air-cooled chillers with integral dual primary pumps, secondary pumps, expansion tank, gauges, fittings, valves, hardware, and hydronic specialties, and chemical treatment for the systems.
    - b. Hydronic Distribution Systems: Insulated, underground piping per specifications. Painted, insulated and jacketed chilled water piping, pipe connections, valves, piping specialties, hot dipped and painted piping supports, as indicated on piping plans and schematics. Provide insulation on cold surfaces capable of generating condensation. Aluminum jacketing for all piping exposed outdoors and in the pump room.
    - c. Space conditioning Hydronic dual path central station air handling units.
    - d. Space conditioning units with direct-expansion cooling split systems.
    - e. Building exhaust fans and associated louvers.
    - f. Specialty exhaust fans, and material air handling systems.
    - g. Kitchen hood, kitchen ventilation system, associated grease duct and fire suppression system.
    - h. Ductwork, VAV boxes (air terminal units), diffusers, grilles, dynamic fire dampers, control dampers, zone dampers, OA intake louvers, and other accessories.
    - i. Testing, Adjusting, & Balancing (TAB) shall not be provided under the mechanical contract. General contractor to provide TAB. Coordinate work.
    - j. Building Automation System (BAS) for HVAC, plumbing and electrical equipment including all controls relays, contactors, power to DDC panels, valves, dampers, interface cards, and other controls equipment.

## SECTION 230010 – SUMMARY OF MECHANICAL WORK

- k. Shop drawing submittals for all mechanical systems including but not limited to equipment, ductwork and piping. These include coordination drawings for placing of mechanical systems in relation to work by other disciplines.
  - l. Contractor is responsible for providing [windstorm certification inspections and certifications](#) for exterior mounted equipment. Contractor must notify Inspector prior to installing equipment, and apprise inspector of work scheduling involving equipment requiring wind inspection / certification, so that inspections may be carried out at required stage(s) of construction. Cost for inspection shall be borne by the Contractor. Inspector shall be certified by the Texas Department of Insurance (see [www.tdi.state.tx.us](http://www.tdi.state.tx.us) for a list of certified Inspectors).
  - m. Coordinate electrical work with Div. 26 as required.
  - n. Coordinate fire alarm related work with Fire Alarm Contractor. Provide smoke detectors, wiring and controls for units, 2000 cfm and larger, where none exist.
2. Painting: See Division 9 specifications. Paint all exposed piping, ductwork, insulation, hangers, accessories in interior exposed areas. Paint exterior pipe supports. Coordinate paint type, color and scope of work with Architect.
  3. Commissioning: Provide assistance with commissioning services per specifications. This includes completing systems readiness checklists, performing functional testing, providing operator training, etc.

### 1.3 ALLOWANCES

- A. [Allowances are included in the Division 1 specifications.](#)

### 1.4 COORDINATION

- A. All mechanical work shall be done under sub-contract to a General Contractor. Mechanical Contractor shall coordinate all work through General Contractor, who is ultimately responsible for the entire project.
- B. Prior to bidding, Mechanical Contractor shall coordinate all work in Division-23 for integration with plumbing, electrical, controls work and general construction. A detailed list of inclusion and exclusions shall be provided to General Contractors at least three days prior to the end of the period set aside to request clarifications so that coordination of any missing items may be addressed and clarified by Architect/Engineer as needed.
- C. All electrical work required for operation of mechanical systems shall be coordinated through the General Contractor prior to bidding to ensure that all starters, disconnects, VFD's, conduit and wiring are provided as part of the project. All components needed for a full operational installation of systems shall be provided.
- D. All controls required for operation of mechanical systems shall be coordinated prior to bidding, to ensure that all equipment, materials, sensors, devices and labor are provided as part of the project. All components needed for a full operational installation of systems shall be provided. Mechanical Contractor shall coordinate and supervise installation of all controls systems.
- E. All questions, requests for information, submittals, and correspondence from the Div. 23 Contractor shall be submitted via the General Contractor, who will forward to the Architect, who will then forward to the Engineer.

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- F. Div. 23 Contractor shall not make any changes to design without written authorization from the Engineer. If changes are requested by the Owner, Architect, General Contractor, Suppliers, Manufacturers, or any others, Contractor should issue a written RFI for response by the Engineer.
- G. Div. 23 Contractor shall issue seven days written notice prior to any activities that require the presence of the Engineer at the job-site. This applies to all inspections required by specifications, and particularly to those where work will be covered.
- H. Cooperate fully with other contractors so that work under those contracts may be carried out smoothly, without interfering with or delaying work under this Contract. Ensure that systems are ready for controls and electrical connections when needed so as to not delay construction.
- I. Contractor shall coordinate with other divisions for power and control of mechanical systems. It is not the intent of this specification to dictate who will conduct work, only to state the requirements of conducting the work.
- J. Coordinate with Div. 1 for work sequence and optimization of construction schedule.
- K. Coordinate with Div. 21 for Fire Suppression System.
- L. Coordinate with Div. 22 for Plumbing System.
- M. Coordinate with Div. 26 electrical contractor for providing power to mechanical equipment, and for Fire Alarm Systems interface with mechanical systems.
- N. Coordinate commissioning activities with Commissioning Authority.
- O. Coordinate TAB activities with TAB Contractor.
- P. Issue written notification of the following tasks and allow five (5) days for Engineer to respond and schedule an inspection as required. Failure to issue written notification may result in work having to be redone to allow for proper inspection. It is contractor's responsibility to make sure Engineer receives notification.
  - 1. Upon completion of underground piping installation and prior to testing or covering up.
  - 2. Upon completion of all water piping installation and prior to insulation and/or testing.
  - 3. Upon completion of ductwork and prior to testing and insulating.
  - 4. Metal duct leakage testing.
  - 5. Above ceiling inspections prior to ceiling tile installation.
  - 6. When ready to request manufacturer's start-up of each piece of equipment.
  - 7. When ready for an inspection by TAB contractor prior to developing detailed TAB Plan.
  - 8. When ready to conduct complete Automation System software demonstration.
  - 9. When ready for Systems Readiness Checklists (Commissioning).
  - 10. When ready for Functional Performance testing (Commissioning).
  - 11. When ready for Substantial Completion Inspection.
  - 12. Training.
  - 13. When ready for Final Inspection.
- Q. General
  - 1. The Contractor shall execute all work hereinafter specified or indicated on accompanying Drawings. Contractor shall provide all equipment necessary and usually furnished in

## SECTION 230010 – SUMMARY OF MECHANICAL WORK

- connection with such work and systems whether or not mentioned specifically herein or on the Drawings.
2. The Contractor shall be responsible for fitting his material and apparatus into the building and shall carefully lay out his work at the site to conform to the structural conditions, to avoid all obstructions, to conform to the details of the installation and thereby to provide an integrated satisfactory operating installation.
  3. The Mechanical, Electrical, Plumbing, and associated Drawings are necessarily diagrammatic by their nature, and are not intended to show every connection in detail or every pipe or conduit in its exact location. These details are subject to the requirements of standards referenced elsewhere in these specifications, and 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 organized and 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. All exposed work shall be installed parallel or perpendicular to the lines of the building unless otherwise noted.
  4. When the mechanical, electrical and plumbing 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 proper grades for the functioning of the system involved. Piping, exposed conduit and the duct systems 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, control lines, pilot lines and other location details. Work shall be concealed in all finished areas.

### 1.5 WORK SEQUENCE

#### A. Locate Utilities:

1. Coordinate with power, water, sewer, telephone, communications, and other utilities as well as designated Owner's personnel to locate all utilities prior to digging in any area.
2. Obtain any approvals required from utilities to relocate utilities.
3. Cost of relocating or bypassing utilities indicated on drawings shall be included in Base Bid.
4. Where several new utilities must share a common area or path, coordinate with other trades so that the proper clearances are maintained and utilities may be installed in compliance with all requirements.
5. Refer to Civil Plans for coordination of connection points from site utilities to buildings.

#### B. Coordinate with Division 1 requirements to optimize construction schedule.

#### C. Provide equipment and material submittals, coordination drawings and shop drawings as required by specifications.

#### D. Submit detailed mechanical Schedule of Values with Submittals. Mechanical Submittals will not be accepted without a detailed Schedule of Values.

#### E. Sequence construction in coordination with work by other disciplines.

## SECTION 230010 – SUMMARY OF MECHANICAL WORK

### 1.6 CONTRACTOR USE OF PREMISES

- A. Use of the Site: Limit use of the premises to work in areas indicated. Confine operations to areas within contract limits indicated. Do not disturb portions of the site beyond the areas in which the Work is indicated.
  - 1. Driveways and Entrances: Keep driveways and entrances to construction site clear and available to other Contractors, Owner, and A/E personnel at all times. Do not use these areas for parking or storage of materials. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.
- B. Site Safety: Take every precaution to ensure the site does not present a threat to the safety of occupants and/or workers. Minimal safety requirements include, but are not limited to the following:
  - 1. Temporary fencing around construction areas.
  - 2. Yellow caution tape and construction barricades along open trenches during the day. Trenches shall be covered at night and warning lights provided on construction barricades.
  - 3. Temporary fencing around equipment while site work is in progress.

### 1.7 SUBMITTALS

- A. Manufacturer's standard dimensioned drawings, performance and product data shall be edited to delete reference to equipment, features, or information which is not applicable to the equipment being supplied for this project.
- B. Provide all mechanical submittals at the same time in one or multiple bound volumes. Include originals from manufacturer. [All submittals shall be in native pdf and searchable format.](#) Faxes and copies of faxes are not acceptable.
- C. Provide sufficient copies of approved data, with the engineer's approved stamp, for inclusion in the operations and maintenance manuals.
- D. Provide detailed coordination drawings showing how mechanical system components will be installed in coordination with work by others. Engineer's drawing files will be made available to Contractor for producing coordination and as-built drawings upon request.

### 1.8 SCHEDULE OF VALUES -Special Requirements

- A. Mechanical Contractor shall submit a Schedule of Values reflecting the total value of Mechanical Work in the Contract, and broken down into the following items as a minimum, with a line-item for Materials/Equipment and another for Labor:

#### MECHANICAL

- 1. HVAC equipment
- 2. HVAC materials (ductwork, piping, dampers)
- 3. HVAC labor
- 4. Controls equipment
- 5. Controls labor
- 6. Controls engineering and programming

## SECTION 230010 – SUMMARY OF MECHANICAL WORK

7. Controls commissioning and closeout (minimum 10% of total controls cost)
8. Controls training (minimum 5% of total controls cost)
9. TAB
10. Commissioning
11. Allowances
12. Miscellaneous
13. Administrative and project management

- B. Schedule of Values shall be included with bound submittals. Submittals without a Schedule of Values shall not be reviewed.

### 1.9 EQUIPMENT MANUFACTURERS

- A. Mechanical design is based on equipment and materials scheduled and specified. These are used as the basis for performance characteristics, quality, and physical dimensions/weight.
- B. Equipment and materials by other APPROVED manufacturers may be provided by Contractor. In doing so, Contractor assumes responsibility for the performance, quality, and physical dimensions of the proposed units.
- C. Any costs associated with modifications to the design due to submittal of equipment and/or materials other than those used as the basis of design are the Contractor's responsibility. This includes any design time, production of drawings, and time delays.
- D. Where use of equipment and/or materials other than those used as the basis of design impact other disciplines, Contractor shall assume responsibility for all costs associated with any APPROVED modifications. This may include resizing of electrical circuits, modifying openings in the structure, relocating floor drains, etc.

### 1.10 OPERATIONS AND MAINTENANCE MANUALS & TRAINING

- A. Submit Operations and Maintenance Manuals two weeks prior to Substantial Completion Inspection. Engineer will not conduct a Substantial Completion Inspection without having reviewed Operations and Maintenance Manuals.
- B. Use Operations and Maintenance Manuals as a guide for conducting training of Owner's personnel.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 230010

## SECTION 230513 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

#### 1.3 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
  - 1. Motor controllers.
  - 2. Torque, speed, and horsepower requirements of the load.
  - 3. Ratings and characteristics of supply circuit and required control sequence.
  - 4. Ambient and environmental conditions of installation location.

### PART 2 - PRODUCTS

#### 2.1 GENERAL MOTOR REQUIREMENTS

- A. Comply with requirements in this Section except when stricter requirements are specified in HVAC equipment schedules or Sections.
- B. Comply with NEMA MG 1 unless otherwise indicated.
- C. Comply with IEEE 841 for severe-duty motors.

#### 2.2 MOTOR CHARACTERISTICS

- A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.
- B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

## SECTION 230513 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

### 2.3 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.
- B. Efficiency: Energy efficient, as defined in NEMA MG 1.
- C. Service Factor: 1.15.
- D. Multispeed Motors: Variable torque. Unless otherwise noted, windings shall be:
  - 1. For motors with 2:1 speed ratio, consequent pole, single winding.
  - 2. For motors with other than 2:1 speed ratio, separate winding for each speed.
- E. Multispeed Motors: Separate winding for each speed.
- F. Rotor: Random-wound, squirrel cage.
- G. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
- H. Temperature Rise: Match insulation rating.
- I. Insulation: Class F.
- J. Code Letter Designation:
  - 1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
  - 2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.
- K. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

### 2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

- A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
- B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
  - 1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
  - 2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
  - 3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
  - 4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.
- C. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.



## SECTION 230513 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

### 2.5 SINGLE-PHASE MOTORS

- A. Motors larger than 1/20 HP shall be one of the following, to suit starting torque and requirements of specific motor application:
  - 1. Permanent-split capacitor.
  - 2. Split phase.
  - 3. Capacitor start, inductor run.
  - 4. Capacitor start, capacitor run.
- B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
- C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
- D. Motors 1/20 HP and Smaller: Shaded-pole type.
- E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 230513

## SECTION 230516 - EXPANSION FITTINGS AND LOOPS FOR HVAC PIPING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Flexible, ball-joint packed expansion joints.
  - 2. Rubber union connector packless expansion joints.
  - 3. Flexible-hose packless expansion joints.
  - 4. Metal-bellows packless expansion joints.
  - 5. Rubber packless expansion joints.
  - 6. Grooved-joint expansion joints.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For expansion joints to include in maintenance manuals.

#### 1.6 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe and Pressure-Vessel Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

## SECTION 230516 - EXPANSION FITTINGS AND LOOPS FOR HVAC PIPING

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Compatibility: Products shall be suitable for piping service fluids, materials, working pressures, and temperatures.
- B. Capability: Products to absorb 200 percent of maximum axial movement between anchors.

#### 2.2 PACKLESS EXPANSION JOINTS

##### A. Flexible-Hose Packless Expansion Joints:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Flex-Hose Co., Inc.
  - b. Mason Industries, Inc.
  - c. Metraflex Company (The).
2. Description: Manufactured assembly with inlet and outlet elbow fittings and two flexible-metal-hose legs joined by long-radius, 180-degree return bend or center section of flexible hose.
3. Flexible Hose: Corrugated-metal inner hoses and braided outer sheaths.
4. Expansion Joints for Copper Tubing NPS 2 and Smaller: Copper-alloy fittings with threaded end connections.
  - a. Bronze hoses and double-braid bronze sheaths with 700 psig at 70 deg F and 500 psig at 450 deg F ratings.
5. Expansion Joints for Copper Tubing NPS 2-1/2 to NPS 4: Copper-alloy fittings with threaded end connections.
  - a. Stainless-steel hoses and double-braid, stainless-steel sheaths with 420 psig at 70 deg F and 315 psig at 450 deg F ratings.
6. Expansion Joints for Steel Piping NPS 2 and Smaller: Carbon-steel fittings with threaded end connections.
  - a. Stainless-steel hoses and double-braid, stainless-steel sheaths with 700 psig at 70 deg F and 515 psig at 600 deg F ratings.
7. Expansion Joints for Steel Piping NPS 2-1/2 to NPS 6: Carbon-steel fittings with flanged end connections.
  - a. Stainless-steel hoses and double-braid, stainless-steel sheaths with 275 psig at 70 deg F and 200 psig at 600 deg F ratings.
8. Expansion Joints for Steel Piping NPS 8 to NPS 12: Carbon-steel fittings with flanged end connections.
  - a. Stainless-steel hoses and double-braid, stainless-steel sheaths with 165 psig at 70 deg F and 120 psig at 600 deg F ratings.

## SECTION 230516 - EXPANSION FITTINGS AND LOOPS FOR HVAC PIPING

### B. Metal-Bellows Packless Expansion Joints:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Flex-Hose Co., Inc.
  - b. Hyspan Precision Products, Inc.
  - c. Mason Industries, Inc.
  - d. Metraflex Company (The).
2. Standards: ASTM F 1120 and EJMA's "Standards of the Expansion Joint Manufacturers Association, Inc."
3. Type: Circular, corrugated bellows with external tie rods.
4. Minimum Pressure Rating: 150 psig, unless otherwise indicated.
5. Expansion Joints for Copper Tubing: multi- ply phosphor-bronze bellows, copper pipe ends, and brass shrouds.
  - a. End Connections for Copper Tubing NPS 2 and Smaller: threaded.
  - b. End Connections for Copper Tubing NPS 2-1/2 to NPS 4: threaded.
  - c. End Connections for Copper Tubing NPS 5 and Larger: Flanged.
6. Expansion Joints for Steel Piping: multi- ply stainless-steel bellows, steel pipe ends, and carbon-steel shroud.
  - a. End Connections for Steel Pipe NPS 2 and Smaller: Threaded.
  - b. End Connections for Steel Pipe NPS 2-1/2 and Larger: Welded.

## PART 3 - EXECUTION

### 3.1 EXPANSION JOINT INSTALLATION

- A. Install expansion joints of sizes matching sizes of piping in which they are installed.
- B. Install metal-bellows expansion joints according to EJMA's "Standards of the Expansion Joint Manufacturers Association, Inc."
- C. Install rubber packless expansion joints according to FSA-PSJ-703.
- D. Install grooved-joint expansion joints to grooved-end steel piping.

END OF SECTION 230516

## SECTION 230517 - SLEEVES AND SLEEVE SEALS 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. Sleeves.
  - 2. Stack-sleeve fittings.
  - 3. Sleeve-seal systems.
  - 4. Sleeve-seal fittings.
  - 5. Grout.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

### PART 2 - PRODUCTS

#### 2.1 SLEEVES

- A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.
- C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.
- D. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

#### 2.2 STACK-SLEEVE FITTINGS

- A. Manufacturers:
  - 1. Smith, Jay R. Mfg. Co.
  - 2. Zurn Specification Drainage Operation; Zurn Plumbing Products Group.

## SECTION 230517 - SLEEVES AND SLEEVE SEALS FOR HVAC PIPING

- B. Description: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring, bolts, and nuts for membrane flashing.
  - 1. Underdeck Clamp: Clamping ring with setscrews.

### 2.3 SLEEVE-SEAL SYSTEMS

- A. Manufacturers:
  - 1. Advance Products & Systems, Inc.
  - 2. CALPICO, Inc.
  - 3. Metraflex Company (The).
  - 4. Pipeline Seal and Insulator, Inc.
  - 5. Proco Products, Inc.
- B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
  - 1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
  - 2. Pressure Plates: Carbon steel.
  - 3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

### 2.4 SLEEVE-SEAL FITTINGS

- A. Manufacturers:
  - 1. Presealed Systems.
- B. Description: Manufactured plastic, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall. Unit has plastic or rubber waterstop collar with center opening to match piping OD.

### 2.5 GROUT

- A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Nonshrink; recommended for interior and exterior applications.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

## SECTION 230517 - SLEEVES AND SLEEVE SEALS FOR HVAC PIPING

### PART 3 - EXECUTION

#### 3.1 SLEEVE INSTALLATION

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.
- C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
  - 1. Cut sleeves to length for mounting flush with both surfaces.
    - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
  - 2. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.
- D. Install sleeves for pipes passing through interior partitions.
  - 1. Cut sleeves to length for mounting flush with both surfaces.
  - 2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
  - 3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Section 079200 "Joint Sealants."
- E. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

#### 3.2 STACK-SLEEVE-FITTING INSTALLATION

- A. Install stack-sleeve fittings in new slabs as slabs are constructed.
  - 1. Install fittings that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
  - 2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Section 076200 "Sheet Metal Flashing and Trim."
  - 3. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level.
  - 4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
  - 5. Using grout, seal the space around outside of stack-sleeve fittings.

## SECTION 230517 - SLEEVES AND SLEEVE SEALS FOR HVAC PIPING

- B. Fire-Barrier Penetrations: Maintain indicated fire rating of floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

### 3.3 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.
- B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

### 3.4 SLEEVE-SEAL-FITTING INSTALLATION

- A. Install sleeve-seal fittings in new walls and slabs as they are constructed.
- B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.
- C. Secure nailing flanges to concrete forms.
- D. Using grout, seal the space around outside of sleeve-seal fittings.

### 3.5 SLEEVE AND SLEEVE-SEAL SCHEDULE

- A. Use sleeves and sleeve seals for the following piping-penetration applications:
  1. Exterior Concrete Walls above Grade: Cast-iron wall sleeves.
  2. Exterior Concrete Walls below Grade: Cast-iron wall sleeves with sleeve-seal system. Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
  3. Concrete Slabs-on-Grade: Cast-iron wall sleeves with sleeve-seal system. Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
  4. Concrete Slabs above Grade: Galvanized-steel-pipe sleeves.
  5. Interior Partitions: Galvanized-steel-pipe sleeves.

END OF SECTION 230517



## SECTION 230518 - ESCUTCHEONS 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. Escutcheons.
  - 2. Floor plates.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

### PART 2 - PRODUCTS

#### 2.1 ESCUTCHEONS

- A. One-Piece, Cast-Brass Type: With polished, chrome-plated and rough-brass finish and setscrew fastener.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.
- C. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.
- D. Split-Casting Brass Type: With polished, chrome-plated and rough-brass finish and with concealed hinge and setscrew.

#### 2.2 FLOOR PLATES

- A. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.
- B. Split-Casting Floor Plates: Cast brass with concealed hinge.

## SECTION 230518 - ESCUTCHEONS FOR HVAC PIPING

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
- B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
  - 1. Escutcheons for New Piping:
    - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
    - b. Insulated Piping: One-piece, stamped-steel type.
    - c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
    - d. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
    - e. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with rough-brass finish.
    - f. Bare Piping in Equipment Rooms: One-piece, cast-brass type with rough-brass finish.
  - 2. Escutcheons for Existing Piping:
    - a. Insulated Piping: Split-plate, stamped-steel type with concealed hinge.
    - b. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-casting brass type with polished, chrome-plated finish.
    - c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge.
    - d. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting brass type with polished, chrome-plated finish.
    - e. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge.
    - f. Bare Piping in Unfinished Service Spaces: Split-casting brass type with rough-brass finish.
    - g. Bare Piping in Equipment Rooms: Split-casting brass type with rough-brass finish.
- C. Install floor plates for piping penetrations of equipment-room floors.
- D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
  - 1. New Piping: One-piece, floor-plate type.
  - 2. Existing Piping: Split-casting, floor-plate type.

#### 3.2 FIELD QUALITY CONTROL

- A. Replace broken and damaged escutcheons and floor plates using new materials.

END OF SECTION 230518

## SECTION 230519 - 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. Liquid-in-glass thermometers.
  - 2. Thermowells.
  - 3. Dial-type pressure gages.
  - 4. Gage attachments.
  - 5. Test plugs.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Wiring Diagrams: For power, signal, and control wiring.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of meter and gage, from manufacturer.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

### PART 2 - PRODUCTS

#### 2.1 LIQUID-IN-GLASS THERMOMETERS

- A. Metal-Case, Industrial-Style, Liquid-in-Glass Thermometers:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Terice, H. O. Co.
    - b. Weiss Instruments, Inc.
    - c. Weksler Glass Thermometer Corp.

## SECTION 230519 - METERS AND GAGES FOR HVAC PIPING

2. Standard: ASME B40.200.
3. Case: Cast aluminum; 9-inch nominal size unless otherwise indicated.
4. Case Form: Adjustable angle unless otherwise indicated.
5. Tube: Glass with magnifying lens and blue or red organic liquid.
6. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F.
7. Window: Glass.
8. Stem: Aluminum and of length to suit installation.
  - a. Design for Air-Duct Installation: With ventilated shroud.
  - b. Design for Thermowell Installation: Bare stem.
9. Connector: 1-1/4 inches, with ASME B1.1 screw threads.
10. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

### 2.2 DUCT-THERMOMETER MOUNTING BRACKETS

- A. Description: Flanged bracket with screw holes, for attachment to air duct and made to hold thermometer stem.

### 2.3 THERMOWELLS

- A. Manufacturers: Same as manufacturer of thermometer being used.
- B. Thermowells:
  1. Standard: ASME B40.200.
  2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
  3. Material for Use with Copper Tubing: brass.
  4. Material for Use with Steel Piping: stainless steel.
  5. Type: Stepped shank unless straight or tapered shank is indicated.
  6. Bore: Diameter required to match thermometer bulb or stem.
  7. Insertion Length: Length required to match thermometer bulb or stem.
  8. Lagging Extension: Include on thermowells for insulated piping and tubing.
  9. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.
- C. Heat-Transfer Medium: Mixture of graphite and glycerin.

### 2.4 PRESSURE GAGES

- A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:
  1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
    - a. **Treice, H. O. Co.**

## SECTION 230519 - METERS AND GAGES FOR HVAC PIPING

- b. [Weiss Instruments, Inc.](#)
  - c. [Weksler Glass Thermometer Corp.](#)
- 2. Standard: ASME B40.100.
  - 3. Case: Liquid-filled type(s); cast aluminum or drawn steel; 4-1/2-inch nominal diameter.
  - 4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
  - 5. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
  - 6. Movement: Mechanical, with link to pressure element and connection to pointer.
  - 7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.
  - 8. Pointer: Dark-colored metal.
  - 9. Window: Glass.
  - 10. Ring: Stainless steel.
  - 11. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

### 2.5 GAGE ATTACHMENTS

- A. Snubbers: ASME B40.100, brass; with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and surge-dampening device. Include extension for use on insulated piping.
- B. Siphons: Loop-shaped section of stainless-steel pipe with NPS 1/4 or NPS 1/2 pipe threads.
- C. Valves: Brass or stainless-steel needle, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads.

### 2.6 TEST PLUGS

- A. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
  - 1. [Trerice, H. O. Co.](#)
  - 2. [Weiss Instruments, Inc.](#)
  - 3. [Weksler Glass Thermometer Corp.](#)
- B. Description: Test-station fitting made for insertion into piping tee fitting.
- C. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.
- D. Thread Size: NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe thread.
- E. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.
- F. Core Inserts: Chlorosulfonated polyethylene synthetic and EPDM self-sealing rubber.

### 2.7 TEST-PLUG KITS

- A. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:

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1. [Trerice, H. O. Co.](#)
  2. [Weiss Instruments, Inc.](#)
- B. Furnish one test-plug kit(s) containing two thermometer(s), one pressure gage and adapter, and carrying case. Thermometer sensing elements, pressure gage, and adapter probes shall be of diameter to fit test plugs and of length to project into piping.
- C. Low-Range Thermometer: Small, bimetallic insertion type with 1- to 2-inch- diameter dial and tapered-end sensing element. Dial range shall be at least 25 to 125 deg F.
- D. High-Range Thermometer: Small, bimetallic insertion type with 1- to 2-inch- diameter dial and tapered-end sensing element. Dial range shall be at least 0 to 220 deg F.
- E. Pressure Gage: Small, Bourdon-tube insertion type with 2- to 3-inch- diameter dial and probe. Dial range shall be at least 0 to 200 psig.
- F. Carrying Case: Metal or plastic, with formed instrument padding.

### 2.8 SIGHT FLOW INDICATORS

- A. [Manufacturers:](#) Subject to compliance with requirements, provide products by one of the following:
1. [Dwyer Instruments, Inc.](#)
  2. [Emerson Process Management; Rosemount Division.](#)
  3. [KOBOLD Instruments, Inc. - USA.](#)
- B. Description: Piping inline-installation device for visual verification of flow.
- C. Construction: Bronze or stainless-steel body, with sight glass and ball, flapper, or paddle wheel indicator, and threaded or flanged ends.
- D. Minimum Pressure Rating: 150 psig.
- E. Minimum Temperature Rating: 200 deg F.
- F. End Connections for NPS 2 and Smaller: Threaded.
- G. End Connections for NPS 2-1/2 and Larger: Flanged.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install thermowells with socket extending one-third of pipe diameter and in vertical position in piping tees.
- B. Install thermowells with extension on insulated piping.

## SECTION 230519 - METERS AND GAGES FOR HVAC PIPING

- C. Fill thermowells with heat-transfer medium.
- D. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.
- E. Install duct-thermometer mounting brackets in walls of ducts. Attach to duct with screws.
- F. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.
- G. Install valve and snubber in piping for each pressure gage for fluids (except steam).
- H. Install test plugs in piping tees.
- I. Install flow indicators in piping systems in accessible positions for easy viewing.
- J. Install thermometers in the following locations:
  - 1. Inlet and outlet of each hydronic zone.
  - 2. Inlet and outlet of each hydronic boiler.
  - 3. Two inlets and two outlets of each chiller.
  - 4. Inlet and outlet of each hydronic coil in air-handling units.
  - 5. Two inlets and two outlets of each hydronic heat exchanger.
  - 6. Inlet and outlet of each thermal-storage tank.
  - 7. Outside-, return-, supply-, and mixed-air ducts.
- K. Install pressure gages in the following locations:
  - 1. Discharge of each pressure-reducing valve.
  - 2. Inlet and outlet of each chiller chilled-water and condenser-water connection.
  - 3. Suction and discharge of each pump.

### 3.2 CONNECTIONS

- A. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.

### 3.3 ADJUSTING

- A. After installation, calibrate meters according to manufacturer's written instructions.
- B. Adjust faces of meters and gages to proper angle for best visibility.
- C. Thermometer stems shall be of length to match thermowell insertion length.

### 3.4 SCALE-RANGE SCHEDULE

- A. Thermometer Scale Range for Chilled-Water Piping: 0 to 100 deg F.
- B. Thermometer Scale Range for Condenser-Water Piping: 0 to 100 deg F.

SECTION 230519 - METERS AND GAGES FOR HVAC PIPING

- C. Thermometer Scale Range for Heating, Hot-Water Piping: 0 to 250 deg F.
- D. Thermometer Scale Range for Air Ducts: Minus 40 to plus 110 deg F.
- E. Pressure Gauge Scale Range for Chilled-Water Piping: 0 to 60 PSI.

END OF SECTION 230519



## SECTION 230523 - 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. Bronze angle valves.
2. Brass ball valves.
3. Bronze ball valves.
4. Iron ball valves.
5. Iron, single-flange butterfly valves.
6. Iron, grooved-end butterfly valves.
7. High-performance butterfly valves.
8. Bronze lift check valves.
9. Bronze swing check valves.
10. Iron swing check valves.
11. Iron swing check valves with closure control.
12. Iron, grooved-end swing-check valves.
13. Iron, center-guided check valves.
14. Iron, plate-type check valves.
15. Bronze gate valves.
16. Iron gate valves.
17. Bronze globe valves.
18. Iron globe valves.
19. Chainwheels.

##### B. Related Sections:

1. Division 23 HVAC piping Sections for specialty valves applicable to those Sections only.
2. Division 23 Section "Identification for HVAC Piping and Equipment" for valve tags and schedules.

#### 1.3 DEFINITIONS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene copolymer rubber.
- C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- D. NRS: Nonrising stem.

## SECTION 230523 - GENERAL-DUTY VALVES FOR HVAC PIPING

- E. OS&Y: Outside screw and yoke.
- F. RS: Rising stem.

### 1.4 SUBMITTALS

- A. Product Data: For each type of valve indicated.

### 1.5 QUALITY ASSURANCE

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:
  - 1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
  - 2. ASME B31.1 for power piping valves.
  - 3. ASME B31.9 for building services piping valves.

### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
  - 1. Protect internal parts against rust and corrosion.
  - 2. Protect threads, flange faces, grooves, and weld ends.
  - 3. Set angle, gate, and globe valves closed to prevent rattling.
  - 4. Set ball and plug valves open to minimize exposure of functional surfaces.
  - 5. Set butterfly valves closed or slightly open.
  - 6. Block check valves in either closed or open position.
- B. Use the following precautions during storage:
  - 1. Maintain valve end protection.
  - 2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

## SECTION 230523 - GENERAL-DUTY VALVES FOR HVAC PIPING

### 2.2 VALVES, GENERAL

- A. Refer to Part 3 "Valve Applications" Article for applications of valves.
- B. Bronze Valves: NPS 2 and smaller with threaded ends, unless otherwise indicated.
- C. Ferrous Valves: NPS 2-1/2 and larger with flanged ends, unless otherwise indicated.
- D. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- E. Valve Sizes: Same as upstream pipe, unless otherwise indicated.
- F. Valve Actuators:
  - 1. Chainwheel: For attachment to valves, of size and mounting height, as indicated in the "Valve Installation" Article in Part 3.
  - 2. Gear Drive: For quarter-turn valves NPS 8 and larger.
  - 3. Handwheel: For valves other than quarter-turn types.
  - 4. Lever Handle: For quarter-turn valves NPS 6 and smaller, except plug valves.
  - 5. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every 10 plug valves, for each size square plug head.
- G. Extended Valve Stems: On insulated valves.
- H. Valve Flanges: ASME B16.1 for cast-iron valves, ASME B16.5 for steel valves, and ASME B16.24 for bronze valves.
- I. Valve Grooved Ends: AWWA C606.
  - 1. Threaded: With threads according to ASME B1.20.1.
- J. Valve Bypass and Drain Connections: MSS SP-45.

### 2.3 COPPER-ALLOY BALL VALVES

- A. Manufacturers:
  - 1. Copper-Alloy Ball Valves:
    - a. Crane Co.; Crane Valve Group; Stockham Div.
    - b. Grinnell Corporation.
    - c. NIBCO INC.
    - d. Watts Industries, Inc.; Water Products Div.
    - e. Kitz Corporation
- B. Copper-Alloy Ball Valves, General: MSS SP-110.
- C. Two-Piece, Copper-Alloy Ball Valves: bronze body with full-port, chrome-plated bronze ball; PTFE or TFE seats; and 600-psig minimum CWP rating and blowout-proof stem.

## SECTION 230523 - GENERAL-DUTY VALVES FOR HVAC PIPING

- D. Copper-Alloy Ball Valves: Two-piece bronze body with exhaust vent opening, chrome-plated ball with vent, blowout-proof stem, locking handle, and working pressure rating 600-psigCWP.

### 2.4 PLUG VALVES

- A. Plug Valves: MSS SP-78, 175-psi CWP, ASTM A 126 cast-iron body and bonnet, cast-iron plug, Buna N, Viton, or teflon packing, flanged or grooved end connections:
  - 1. Operator: Lever.

### 2.5 FERROUS-ALLOY BALL VALVES

- A. Manufacturers:
  - 1. Crane Co.; Crane Valve Group; Stockham Div.
  - 2. NIBCO INC.
  - 3. Kitz Corporation
- B. Ferrous-Alloy Ball Valves, General: MSS SP-72, with flanged ends.
- C. Ferrous-Alloy Ball Valves: Class 150, full port.

### 2.6 FERROUS-ALLOY BUTTERFLY VALVES

- A. Manufacturers:
  - 1. Ferrous-Alloy Butterfly Valves:
    - a. Keystone
    - b. Kitz Corporation
    - c. Nibco
- B. Butterfly Valves: MSS SP-67, 200-psi CWP, for tight shutoff, 150-psi maximum pressure differential, ASTM A 126 cast-iron body and bonnet, extended neck, stainless-steel stem, field-replaceable EPDM or Buna N sleeve and stem seals, fully flanged style:
  - 1. Disc Type: Elastomer-coated ductile iron.
  - 2. Gear Drive: For quarter-turn valves NPS 8 and larger.
  - 3. Operator for Sizes 2 Inchesto 6 Inches: Standard lever handle with memory stop.

### 2.7 BRONZE CHECK VALVES

- A. Manufacturers:
  - 1. Type 4, Bronze, Swing Check Valves with Nonmetallic Disc:
    - a. Crane Co.; Crane Valve Group; Stockham Div.
    - b. Grinnell Corporation.
    - c. Milwaukee Valve Company.
    - d. NIBCO INC.
    - e. Red-White Valve Corp.

## SECTION 230523 - GENERAL-DUTY VALVES FOR HVAC PIPING

- f. Watts Industries, Inc.; Water Products Div.
- g. Kitz Corporation

B. Bronze Check Valves, General: MSS SP-80.

C. Type 4, Class 125, Bronze, Swing Check Valves: Bronze body with nonmetallic disc and bronze seat.

### 2.8 FERROUS-ALLOY WAFER CHECK VALVES

A. Manufacturers:

- 1. Dual-Plate, Ferrous-Alloy, Wafer Check Valves:
  - a. Crane Co.; Crane Valve Group; Stockham Div.
  - b. Grinnell Corporation.
  - c. NIBCO INC.
  - d. Red-White Valve Corp.
  - e. Watts Industries, Inc.; Water Products Div.
  - f. Kitz Corporation

B. Ferrous-Alloy Wafer Check Valves, General: API 594, spring loaded.

C. Dual-Plate, Class 125 or 150, Ferrous-Alloy, Wafer Check Valves: Flangeless body.

### 2.9 CAST-IRON GLOBE VALVES

A. Manufacturers:

- 1. Type I, Cast-Iron Globe Valves with Metal Seats:
  - a. Crane Co.; Crane Valve Group; Stockham Div.
  - b. Grinnell Corporation.
  - c. NIBCO INC.
  - d. Red-White Valve Corp.
  - e. Kitz Corporation

B. Cast-Iron Globe Valves, General: MSS SP-85.

C. Type I, Class 125, Cast-Iron Globe Valves: Gray-iron body with bronze seats.

### 2.10 BRONZE GATE VALVES

A. Manufacturers:

- 1. Bronze, Gate Valves:
  - a. Crane Co.; Crane Valve Group; Stockham Div.
  - b. Grinnell Corporation.
  - c. NIBCO INC.
  - d. Powell, Wm. Co.
  - e. Red-White Valve Corp.

## SECTION 230523 - GENERAL-DUTY VALVES FOR HVAC PIPING

- f. Watts Industries, Inc.; Water Products Div.
- g. Kitz Corporation

- B. Bronze Gate Valves, General: MSS SP-80, with ferrous-alloy handwheel.
- C. Type 1, Class 125, Bronze Gate Valves: Bronze body with nonrising stem and bronze solid wedge and union-ring bonnet.

### 2.11 BRONZE GLOBE VALVES

- A. Manufacturers:
  - 1. Type 2, Bronze Globe Valves with Nonmetallic Disc:
    - a. Crane Co.; Crane Valve Group; Stockham Div.
    - b. Grinnell Corporation.
    - c. NIBCO INC.
    - d. Red-White Valve Corp.
    - e. Kitz Corporation
- B. Bronze Globe Valves, General: MSS SP-80, with ferrous-alloy handwheel.
- C. Type 2, Class 125, Bronze Globe Valves: Bronze body with PTFE or TFE disc and union-ring bonnet.

### 2.12 CHAINWHEELS

- A. Manufacturers:
  - 1. Babbitt Steam Specialty Co.
  - 2. Roto Hammer Industries.
  - 3. Trumbull Industries.
- B. Description: Valve actuation assembly with sprocket rim, brackets, and chain.
  - 1. Brackets: Type, number, size, and fasteners required to mount actuator on valve.
  - 2. Attachment: For connection to butterfly valve stems.
  - 3. Sprocket Rim with Chain Guides: Ductile iron of type and size required for valve. Include zinc coating.
  - 4. Chain: Hot-dip, galvanized steel, of size required to fit sprocket rim.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance.
  - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

## SECTION 230523 - GENERAL-DUTY VALVES FOR HVAC PIPING

- B. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- C. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- D. Examine threads on valve and mating pipe for form and cleanliness.
- E. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- F. Do not attempt to repair defective valves; replace with new valves.

### 3.2 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.
- E. Install chainwheels on operators for valves NPS 4 and larger and more than 96 inches above floor. Extend chains to 60 inches above finished floor.
- F. Install check valves for proper direction of flow and as follows:
  - 1. Swing Check Valves: In horizontal position with hinge pin level.
  - 2. Plate-Type Check Valves: In horizontal or vertical position, between flanges.
  - 3. Lift Check Valves: With stem upright and plumb.

### 3.3 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:
  - 1. Shutoff Service: Ball, butterfly or plug valves.
  - 2. Butterfly Valve Dead-End Service: Single-flange (lug) type.
  - 3. Throttling Service: Globe, angle or ball valves.
  - 4. Pump-Discharge Check Valves: Spring-loaded, lift-disc check valves
- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.
- C. Select valves, except wafer types, with the following end connections:

## SECTION 230523 - GENERAL-DUTY VALVES FOR HVAC PIPING

1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
3. For Steel Piping, NPS 2 and Smaller: Threaded ends.
4. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
5. For Steel Piping, NPS 5 and Larger: Flanged ends.
6. For Grooved-End Steel Piping: Valve ends may be grooved.

### 3.4 CHILLED-WATER AND HEATING-WATER VALVE SCHEDULE

#### A. Chilled-Water Systems: Use the following valve types:

1. Gate Valves: Class 150, bronze body; or Class 125, cast-iron body.
2. Ball Valves: Class 150, 600-psi CWP, with stem extension and memory stop.
3. Plug Valves: Buna N packing.
4. Globe Valves: Class 125, bronze body with bronze or teflon disc; or Class 125, cast-iron body.
5. Butterfly Valves: Nickel-plated ductile iron, aluminum bronze, or elastomer-coated ductile iron disc; EPDM sleeve and stem seals.
6. Check Valves: Dual-plate, wafer, Class 150 ferrous alloy.

### 3.5 JOINT CONSTRUCTION

- A. Refer to Division 23 Sections for basic piping joint construction.
- B. Grooved Joints: Assemble joints with keyed coupling housing, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.
- C. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.

### 3.6 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

END OF SECTION 230523



## SECTION 230529 - 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. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Metal framing systems.
4. Thermal-hanger shield inserts.
5. Fastener systems.
6. Pipe stands.
7. Equipment supports.

- B. Related Sections:

1. Section 055000 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Section 230516 "Expansion Fittings and Loops for HVAC Piping" for pipe guides and anchors.
3. Section 230548.13 "Vibration Controls for HVAC" for vibration isolation devices.
4. Section 233113 "Metal Ducts" and Section 233116 "Nonmetal Ducts" for duct hangers and supports.

#### 1.3 DEFINITIONS

- A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

#### 1.4 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
  1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.

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2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

### 1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. 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.
- C. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
  1. Detail fabrication and assembly of trapeze hangers.
  2. Design Calculations: Calculate requirements for designing trapeze hangers.

### 1.6 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

### 1.7 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.

## PART 2 - PRODUCTS

### 2.1 METAL PIPE HANGERS AND SUPPORTS

- A. Carbon-Steel Pipe Hangers and Supports:
  1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
  2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.

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### 2.2 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

### 2.3 METAL FRAMING SYSTEMS

- A. MFMA Manufacturer Metal Framing Systems:
  - 1. Manufacturers:
    - a. Allied Tube & Conduit.
    - b. Cooper B-Line, Inc.
    - c. Flex-Strut Inc.
    - d. GS Metals Corp.
    - e. Thomas & Betts Corporation.
    - f. Unistrut Corporation; Tyco International, Ltd.
    - g. Wesanco, Inc.
  - 2. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.
  - 3. Standard: MFMA-4.
  - 4. Channels: Continuous slotted steel channel with inturred lips.
  - 5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
  - 6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
  - 7. Metallic Coating: Hot-dipped galvanized.
  - 8. Paint Coating: Epoxy.

### 2.4 THERMAL-HANGER SHIELD INSERTS

- A. Manufacturers:
  - 1. Carpenter & Paterson, Inc.
  - 2. ERICO/Michigan Hanger Co.
  - 3. PHS Industries, Inc.
  - 4. Pipe Shields, Inc.
  - 5. Rilco Manufacturing Company, Inc.
  - 6. Value Engineered Products, Inc.
- B. Insulation-Insert Material for Piping: ASTM C 552, Type II cellular glass with 100-psig minimum compressive strength and vapor barrier.
- C. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- D. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- E. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

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### 2.5 FASTENER SYSTEMS

- A. Mechanical-Expansion Anchors: Insert-wedge-type, stainless- steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

### 2.6 PIPE STANDS

- A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.
- B. Compact Pipe Stand: One-piece plastic unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.
- C. Low-Type, Single-Pipe Stand: One-piece stainless-steel base unit with plastic roller, for roof installation without membrane penetration.
- D. High-Type, Single-Pipe Stand:
  - 1. Description: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
  - 2. Base: Plastic.
  - 3. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
  - 4. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.
- E. High-Type, Multiple-Pipe Stand:
  - 1. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
  - 2. Bases: One or more; plastic.
  - 3. Vertical Members: Two or more protective-coated-steel channels.
  - 4. Horizontal Member: Protective-coated-steel channel.
  - 5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.
- F. Curb-Mounted-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

### 2.7 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

### 2.8 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.

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- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
  - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
  - 2. Design Mix: 5000-psi, 28-day compressive strength.

### PART 3 - EXECUTION

#### 3.1 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
  - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
  - 2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.
- D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- E. Fastener System Installation:
  - 1. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- F. Pipe Stand Installation:
  - 1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
  - 2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Section 077200 "Roof Accessories" for curbs.
- G. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- H. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- I. 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.

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- J. Install lateral bracing with pipe hangers and supports to prevent swaying.
- K. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- L. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- M. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- N. 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.
    - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 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.
    - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 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: 12 inches long and 0.048 inch thick.
    - b. NPS 4: 12 inches long and 0.06 inch thick.
    - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
    - d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
    - e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
  - 5. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
  - 6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

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### 3.2 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

### 3.3 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and 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. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

### 3.4 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

### 3.5 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
  - 1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 Sections.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

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### 3.6 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel pipe hangers and supports metal trapeze pipe hangers and attachments for general service applications.
- F. Use stainless-steel pipe hangers and stainless-steel attachments for hostile environment applications.
- G. Use copper-plated pipe hangers and copper attachments for copper piping and tubing.
- H. Use padded hangers for piping that is subject to scratching.
- I. Use thermal-hanger shield inserts for insulated piping and tubing.
- J. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
  - 2. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
  - 3. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
  - 4. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction might occur.
  - 5. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
  - 6. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
  - 7. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.
- K. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:



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1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
  2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.
- L. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
  2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
  3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
  4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
  5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
- M. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
  2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joint construction, to attach to top flange of structural shape.
  3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
  4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
  5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
  6. C-Clamps (MSS Type 23): For structural shapes.
  7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
  8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
  9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
  10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
  11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
  12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
    - a. Light (MSS Type 31): 750 lb.
    - b. Medium (MSS Type 32): 1500 lb.
    - c. Heavy (MSS Type 33): 3000 lb.
  13. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- N. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.

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2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
  3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- O. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- P. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
- Q. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION 230529

## SECTION 230548.13 - VIBRATION CONTROLS 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. Elastomeric isolation pads.
2. Elastomeric isolation mounts.
3. Restrained elastomeric isolation mounts.
4. Housed-restrained-spring isolators.
5. Elastomeric hangers.
6. Spring hangers.
7. Vibration isolation equipment bases.

- B. Related Requirements:

1. Section 210548.13 "Vibration Controls for Fire Suppression" for devices for fire-suppression equipment and systems.
2. Section 220548.13 "Vibration Controls for Plumbing" for devices for plumbing equipment and systems.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of vibration isolation device type required.

- B. Shop Drawings:

1. Detail fabrication and assembly of equipment bases. Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

- C. Delegated-Design Submittal: For each vibration isolation device.

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1. Include design calculations for selecting vibration isolators and for designing vibration isolation bases.

### D. Wind-Restraint Details:

1. Basic Wind Speed: Refer to Arch.
2. Building Classification Category: Refer to Arch.
3. Code recommended wind pressure multiplied by the maximum area of the HVAC component projected on a vertical plane that is normal to the wind direction, and 45 degrees either side of normal.
4. Design Analysis: To support selection and arrangement of **wind** restraints. Include calculations of combined tensile and shear loads.
- 5.

## 1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Show coordination of vibration isolation device installation for HVAC piping and equipment with other systems and equipment in the vicinity, including other supports and restraints, if any.
- B. Qualification Data: For testing agency.
- C. Welding certificates.

## 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: Provide operation and maintenance manuals.

## 1.6 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

## PART 2 - PRODUCTS

### 2.1 VIBRATION ISOLATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Ace Mountings Co., Inc.
  2. Amber/Booth Company, Inc.
  3. California Dynamics Corporation.
  4. Isolation Technology, Inc.
  5. Kinetics Noise Control.
  6. Mason Industries.
  7. Vibration Eliminator Co., Inc.

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8. Vibration Isolation.
  9. Vibration Mountings & Controls, Inc.
- B. Elastomeric Isolation Pads:
1. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.
  2. Size: Factory or field cut to match requirements of supported equipment.
  3. Pad Material: Oil and water resistant with elastomeric properties.
  4. Surface Pattern: Ribbed or Waffle pattern.
  5. Infused nonwoven cotton or synthetic fibers.
  6. Load-bearing metal plates adhered to pads.
  7. Sandwich-Core Material: Resilient and elastomeric.
    - a. Surface Pattern: Ribbed or Waffle pattern.
    - b. Infused nonwoven cotton or synthetic fibers.
- C. Double-Deflection, Elastomeric Isolation Mounts:
1. Mounting Plates:
    - a. Top Plate: Encapsulated steel load transfer top plates, factory drilled and threaded.
    - b. Baseplate: Encapsulated steel bottom plates with holes provided for anchoring to support structure.
  2. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.
- D. Restrained Elastomeric Isolation Mounts
1. Description: All-directional isolator with restraints containing two separate and opposing elastomeric elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
    - a. Housing: Cast-ductile iron or welded steel.
    - b. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.
- E. Freestanding, Laterally Stable, Open-Spring Isolators:
1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
  2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
  3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
  4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
  5. Baseplates: Factory-drilled steel plate for bolting to structure with an elastomeric isolator pad attached to the underside. Baseplates shall limit floor load to 500 psig.
  6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.
- F. Freestanding, Laterally Stable, Open-Spring Isolators with Vertical-Limit Stop Restraint:
1. Housing: Steel housing with vertical-limit stops to prevent spring extension due to weight being removed.

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- a. Base with holes for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig.
  - b. Top plate with threaded mounting holes elastomeric pad.
  - c. Internal leveling bolt that acts as blocking during installation.
2. Restraint: Limit stop as required for equipment and authorities having jurisdiction.
  3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
  4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
  5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
  6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
- G. Elastomeric Mount in a Steel Frame with Upper and Lower Steel Hanger Rods:
1. Frame: Steel, fabricated with a connection for an upper threaded hanger rod and an opening on the underside to allow for a maximum of 30 degrees of angular lower hanger-rod misalignment without binding or reducing isolation efficiency.
  2. Dampening Element: Molded, oil-resistant rubber, neoprene, or other elastomeric material with a projecting bushing for the underside opening preventing steel to steel contact.
- H. Combination Coil-Spring and Elastomeric-Insert Hanger with Spring and Insert in Compression:
1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
  2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
  3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
  4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
  5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
  6. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
  7. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
  8. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.
- I. Steel Rails: Factory-fabricated, welded, structural-steel rails.
1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide rails.
    - a. Include supports for suction and discharge elbows for pumps.
  2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Rails shall have shape to accommodate supported equipment.
  3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.

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- J. Steel Bases: Factory-fabricated, welded, structural-steel bases and rails.
  - 1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.
    - a. Include supports for suction and discharge elbows for pumps.
  - 2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
  - 3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.

### 2.2 VIBRATION ISOLATION EQUIPMENT BASES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Amber/Booth Company, Inc.
  - 2. California Dynamics Corporation.
  - 3. Isolation Technology, Inc.
  - 4. Kinetics Noise Control.
  - 5. Mason Industries.
  - 6. Vibration Eliminator Co., Inc.
  - 7. Vibration Isolation.
  - 8. Vibration Mountings & Controls, Inc.
- B. Inertia Base: Factory-fabricated, welded, structural-steel bases and rails ready for placement of cast-in-place concrete.
  - 1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.
    - a. Include supports for suction and discharge elbows for pumps.
  - 2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
  - 3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
  - 4. Fabrication: Fabricate steel templates to hold equipment anchor-bolt sleeves and anchors in place during placement of concrete. Obtain anchor-bolt templates from supported equipment manufacturer.

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### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation 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 APPLICATIONS

- A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.

#### 3.3 VIBRATION ISOLATION EQUIPMENT BASES 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 Division 03 Sections.

#### 3.4 VIBRATION-CONTROL AND WIND-RESTRAINT DEVICE INSTALLATION

- A. Comply with requirements in Division 07 Section "Roof Accessories" for installation of roof curbs, equipment supports, and roof penetrations.
- B. Install cables so they do not bend across edges of adjacent equipment or building structure.
- C. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.
- D. 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.
- E. 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.
- F. 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.



## SECTION 230548.13 - VIBRATION CONTROLS FOR HVAC

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.

### 3.5 ADJUSTING

- A. Adjust isolators after piping system is at operating weight.
- B. Adjust active height of spring isolators.

END OF SECTION 230548.13

## SECTION 230553 - 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. Equipment labels.
  - 2. Warning signs and labels.
  - 3. Pipe labels.
  - 4. Duct labels.
  - 5. Stencils.
  - 6. Valve tags.
  - 7. Warning tags.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- D. Valve numbering scheme.
- E. Valve Schedules: For each piping system to include in maintenance manuals.

#### 1.4 COORDINATION

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

## SECTION 230553 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

### PART 2 - PRODUCTS

#### 2.1 EQUIPMENT LABELS

- A. Plastic Labels for Equipment:
  - 1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
  - 2. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
  - 3. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
  - 4. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
  - 5. Fasteners: Stainless-steel rivets or self-tapping screws.
  - 6. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.
- C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number, and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

#### 2.2 WARNING SIGNS AND LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
- B. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- C. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- D. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
- E. Fasteners: Stainless-steel rivets or self-tapping screws.
- F. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- G. Label Content: Include caution and warning information plus emergency notification instructions.

## SECTION 230553 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

### 2.3 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction according to ASME A13.1.
- B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings; also include pipe size and an arrow indicating flow direction.
  - 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.
  - 2. Lettering Size: At least 1-1/2 inch for viewing distances up to 72 inches and proportionately larger lettering for greater viewing distances.

### 2.4 DUCT LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
- B. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- C. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- D. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
- E. Fasteners: Stainless-steel rivets or self-tapping screws.
- F. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- G. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings; also include duct size and an arrow indicating flow direction.
  - 1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions or as separate unit on each duct label to indicate flow direction.
  - 2. Lettering Size: At least 1-1/2 inches high.

### 2.5 VALVE TAGS

- A. Description: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.

## SECTION 230553 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

1. Tag Material: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
  2. Fasteners: Brass beaded chain.
- B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
1. Valve-tag schedule shall be included in operation and maintenance data.

### 2.6 WARNING TAGS

- A. Description: Preprinted or partially preprinted accident-prevention tags of plasticized card stock with matte finish suitable for writing.
1. Size: 3 by 5-1/4 inches minimum.
  2. Fasteners: Brass grommet and wire.
  3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
  4. Color: Safety-yellow background with black lettering.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

### 3.2 GENERAL INSTALLATION REQUIREMENTS

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

### 3.3 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

## SECTION 230553 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

### 3.4 PIPE LABEL INSTALLATION

- A. Piping Color Coding: Painting of piping is specified in Division 09 Sections.
- B. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels, complying with ASME A13.1, with painted, color-coded bands or rectangles on each piping system.
  - 1. Identification Paint: Use for contrasting background.
  - 2. Stencil Paint: Use for pipe marking.
- C. Pipe Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
  - 1. Near each valve and control device.
  - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
  - 3. Near penetrations and on both sides of through walls, floors, ceilings, and inaccessible enclosures.
  - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
  - 5. Near major equipment items and other points of origination and termination.
  - 6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
  - 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- D. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.
- E. Pipe Label Color Schedule: Coordinate with Owner.

### 3.5 DUCT LABEL INSTALLATION

- A. Install self-adhesive duct labels with permanent adhesive on air ducts in the following color codes: Coordinate with Owner.
- B. Locate labels near points where ducts enter into and exit from concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

### 3.6 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, shutoff valves, faucets, convenience and lawn-watering hose connections, and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

## SECTION 230553 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

### 3.7 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

### 3.8 PAINTING

- A. Clarification: In exposed areas (with no acoustic ceiling tiles), piping and piping insulation shall be painted. Although Division 9 may not specifically call for painting of MEP items, it states paint type and requirements for different materials. To extent possible coordinate painting with Division 9 and with Architect. Where adequate specifications are not available, use the following general guidelines:
  - 1. Ferrous Metal: Semi-Gloss, Alkyd-Enamel Finish: 2 finish coats over an enamel undercoat and primer.
    - a. Primer: Quick-drying, rust-inhibitive, alkyd-based or epoxy-metal primer, as recommended by the manufacturer for this substrate, applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 1.5 mils. S-W: Kem Kromik Universal Metal Primer B50NZ6/B50WZ1.
    - b. Undercoat: Alkyd, interior enamel undercoat or semi-gloss, interior, alkyd-enamel finish coat, as recommended by the manufacturer for this substrate, applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 1.2 mils. S-W: Pro-mar 200 Interior Alkyd Enamel B34W200 Series.
    - c. Finish Coat: Same as undercoat. Semi-gloss, alkyd, interior enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 1.2 mils.
  - 2. ASJ Jacket: Semi-Gloss, Acrylic-Enamel Finish: 2 finish coats.
    - a. Undercoat: Semi-gloss acrylic latex enamel applied at spreading rate recommended by manufacturer to achieve a dry film thickness of 2.0 mils. S-W: Pro-Mar Interior Latex Egg-Shell Enamel B20W200.
    - b. Finish Coat: Same as undercoat. Semi-gloss, acrylic latex enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 1.2 mils
- B. Final colors shall be coordinated with Owner and Architect during construction.

END OF SECTION 230553

## SECTION 230593 - 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. TAB work shall not be contracted under Division 23 Contractor. Third party TAB Contractor shall be contracted by the Prime Contractor. Coordinate activities and assist TAB Contractor as needed.
- B. Section Includes:
  - 1. Balancing Air Systems:
    - a. Constant-volume air systems.
    - b. Variable-air-volume systems.
  - 2. Balancing Hydronic Piping Systems:
  - 3. Testing, Adjusting, and Balancing Equipment:
    - a. Motors.
    - b. Chillers.
    - c. Pumps.
    - d. AHUs.
    - e. VAV boxes
    - f. Condensing units.
  - 4. Testing, adjusting, and balancing existing systems and equipment.
  - 5. Duct leakage tests.
  - 6. Control system verification.
  - 7. Other tests as specified.

#### 1.3 DEFINITIONS

- A. AABC: Associated Air Balance Council.
- B. BAS: Building automation systems.
- C. TAB: Testing, adjusting, and balancing.
- D. TABB: Testing, Adjusting, and Balancing Bureau.
- E. TAB Specialist: An independent entity meeting qualifications to perform TAB work.



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- F. TDH: Total dynamic head.

### 1.4 PREINSTALLATION MEETING

- A. TAB Conference: If requested by the Owner, conduct a TAB conference at Project site after approval of the TAB strategies and procedures plan to develop a mutual understanding of the details. Provide a minimum of 14 days' advance notice of scheduled meeting time and location.
  - 1. Minimum Agenda Items:
    - a. The Contract Documents examination report.
    - b. The TAB plan.
    - c. Needs for coordination and cooperation of trades and subcontractors.
    - d. Proposed procedures for documentation and communication flow.

### 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation that the TAB specialist and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.
- B. Certified TAB reports.
- C. Sample report forms.
- D. Instrument calibration reports, to include the following:
  - 1. Instrument type and make.
  - 2. Serial number.
  - 3. Application.
  - 4. Dates of use.
  - 5. Dates of calibration.

### 1.6 QUALITY ASSURANCE

- A. TAB Specialists Qualifications: Certified by AABC.
  - 1. TAB Field Supervisor: Employee of the TAB specialist and certified by AABC.
  - 2. TAB Technician: Employee of the TAB specialist and certified by AABC as a TAB technician.
- B. Aerodynamics, PHI, and TAC are pre-approved TAB Contractors. All other companies shall obtain pre-approval from the engineer.**
- C. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."
- D. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."

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- E. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.7.2.3 - "System Balancing."

### 1.7 PROJECT CONDITIONS

- A. The Owner will occupy portions of existing buildings Owner will occupy the site and existing building during entire TAB period. Reference SECTION 011000 - SUMMARY for more precise dates and stipulations.
- B. Cooperate with the Owner during testing, adjusting, and balancing operations to minimize conflicts with the Owner's operations.

## PART 2 - PRODUCTS (Not Applicable)

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems designs that may preclude proper TAB of systems and equipment.
- B. Examine installed systems for balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are applicable for intended purpose and are accessible.
- C. Examine the approved submittals for HVAC systems and equipment.
- D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems output, and statements of philosophies and assumptions about HVAC system and equipment controls.
- E. Examine ceiling plenums and underfloor air plenums used for supply, return, or relief air to verify that they are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.
- F. Examine equipment performance data including fan and pump curves.
  - 1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
  - 2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.
- G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.

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- H. Examine test reports specified in individual system and equipment Sections.
- I. Examine HVAC equipment and verify that bearings are greased, belts are aligned and tight, filters are clean, and equipment with functioning controls is ready for operation.
- J. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.
- K. Examine strainers. Verify that startup screens have been replaced by permanent screens with indicated perforations.
- L. Examine control valves for proper installation for their intended function of throttling, diverting, or mixing fluid flows.
- M. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- N. Examine system pumps to ensure absence of entrained air in the suction piping.
- O. Examine operating safety interlocks and controls on HVAC equipment.
- P. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

### 3.2 PREPARATION

- A. At least 15 calendar days prior to any on-site TAB measurements taking place, prepare and submit to Engineer a TAB plan that includes the following:
  - 1. Equipment and systems to be tested.
  - 2. Strategies and step-by-step procedures for balancing the systems.
  - 3. Instrumentation to be used.
  - 4. Sample forms with specific identification for all equipment.
- B. Perform system-readiness checks of HVAC systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:
  - 1. Airside:
    - a. Verify that leakage and pressure tests on air distribution systems have been satisfactorily completed.
    - b. Duct systems are complete with terminals installed.
    - c. Volume, smoke, and fire dampers are open and functional.
    - d. Clean filters are installed.
    - e. Fans are operating, free of vibration, and rotating in correct direction.
    - f. Variable-frequency controllers' startup is complete and safeties are verified.
    - g. Automatic temperature-control systems are operational.
    - h. Ceilings are installed.
    - i. Windows and doors are installed.
    - j. Suitable access to balancing devices and equipment is provided.

## SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

2. Hydronics:
  - a. Verify leakage and pressure tests on water distribution systems have been satisfactorily completed.
  - b. Piping is complete with terminals installed.
  - c. Water treatment is complete.
  - d. Systems are flushed, filled, and air purged.
  - e. Strainers are pulled and cleaned.
  - f. Control valves are functioning per the sequence of operation.
  - g. Shutoff and balance valves have been verified to be 100 percent open.
  - h. Pumps are started and proper rotation is verified.
  - i. Pump gage connections are installed directly at pump inlet and outlet flanges or in discharge and suction pipe prior to valves or strainers.
  - j. Variable-frequency controllers' startup is complete and safeties are verified.
  - k. Suitable access to balancing devices and equipment is provided.

### 3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance" and in this Section.
- B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.
  1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
  2. After testing and balancing, install test ports and duct access doors that comply with requirements in Section 233300 "Air Duct Accessories."
  3. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Section 230713 "Duct Insulation," Section 230716 "HVAC Equipment Insulation," and Section 230719 "HVAC Piping Insulation."
- C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.
- D. Take and report testing and balancing measurements in inch-pound (IP) units.

### 3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Cross-check the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' "as-built" duct layouts.
- C. For variable-air-volume systems, develop a plan to simulate diversity.

## SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

- D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.
- E. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.
- F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- G. Verify that motor starters are equipped with properly sized thermal protection.
- H. Check dampers for proper position to achieve desired airflow path.
- I. Check for airflow blockages.
- J. Check condensate drains for proper connections and functioning.
- K. Check for proper sealing of air-handling-unit components.
- L. Verify that air duct system is sealed as specified in Section 233113 "Metal Ducts."

### 3.5 SENSOR ACCURACY TESTING

- A. Measure accuracy of all sensors (temperature, humidity, dewpoint, pressure, CO<sub>2</sub>, etc.) associated with air conditioning systems and the Building Automation System (BAS), including all chilled water system temperature and pressure sensors, and all sensors associated with air handlers and VAV boxes.
- B. Provide a written report, separate from and prior to the final TAB report, to include the following:
  - 1. List of each different type of sensor, manufacturer and model, and its accuracy as stated by manufacturer.
  - 2. List of every sensor in the project, identified by room number and associated HVAC unit name.
  - 3. Reading of sensor as measured by TAB, and as simultaneously reported by the BAS and/or other HVAC system, and difference between. (Example format for temperature sensor below.)

Temperature Sensors			
ID	BAS reading deg F	TAB reading deg F	Difference
Room 100 / RTU-100	72.4	72.5	-0.1
Room 124 / RTU-124	72.1	71.7	0.4
Room 124 / RTU-124	73.5	71.6	1.9

- 4. List observations regarding sensors installation which may impact satisfactory operation of HVAC systems, such as improper location of sensors.
- C. At direction of Engineer, BAS and/or HVAC systems providers will be required to replace or calibrate sensors based upon this TAB sensors accuracy report. Subsequent to such replacement

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and calibration, re-measure accuracy of those sensors which were calibrated or replaced and submit report per directions above.

### 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. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.
    - b. Where duct conditions allow, measure airflow by Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.
    - c. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
    - d. If a reliable Pitot-tube traverse or coil traverse is not possible, measure airflow at terminals and calculate the total airflow.
  2. Measure fan static pressures as follows:
    - a. Measure static pressure directly at the fan outlet or through the flexible connection.
    - b. Measure static pressure directly at the fan inlet or through the flexible connection.
    - c. Measure static pressure across each component that makes up the air-handling system.
    - d. Report artificial loading of filters at the time static pressures are measured.
  3. 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.
  4. Obtain approval from Architect 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.
  5. 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 occurs. 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.
  1. Measure airflow of submain and branch ducts.
  2. Adjust submain and branch duct volume dampers for specified airflow.
  3. Re-measure each submain and branch duct after all have been adjusted.
- C. Adjust air inlets and outlets for each space to indicated airflows.
  1. Set airflow patterns of adjustable outlets for proper distribution without drafts.

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2. Measure inlets and outlets airflow.
3. Adjust each inlet and outlet for specified airflow.
4. Re-measure each inlet and outlet after they have been adjusted.

### D. Verify final system conditions.

1. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to design if necessary.
2. Re-measure and confirm that total airflow is within design.
3. Re-measure all final fan operating data, rpms, volts, amps, and static profile.
4. Mark all final settings.
5. Test system in economizer mode. Verify proper operation and adjust if necessary.
6. Measure and record all operating data.
7. Record final fan-performance data.

## 3.7 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

### A. Adjust the variable-air-volume systems as follows:

1. Verify that the system static pressure sensor is located two-thirds of the distance down the duct from the fan discharge.
2. Verify that the system is under static pressure control.
3. Select the terminal unit that is most critical to the supply-fan airflow. Measure inlet static pressure, and adjust system static pressure control set point 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.
4. Calibrate and balance each terminal unit for maximum and minimum design airflow as follows:
  - a. Adjust controls so that terminal is calling for maximum airflow. Some controllers require starting with minimum airflow. Verify calibration procedure for specific project.
  - b. Measure airflow and adjust calibration factor as required for design maximum airflow. Record calibration factor.
  - c. When maximum airflow is correct, balance the air outlets downstream from terminal units.
  - d. Adjust controls so that terminal is calling for minimum airflow.
  - e. Measure airflow and adjust calibration factor as required for design minimum airflow. Record calibration factor. If no minimum calibration is available, note any deviation from design airflow.
  - f. When in full cooling or full heating, ensure that there is no mixing of hot-deck and cold-deck airstreams unless so designed.
  - g. On constant volume terminals, in critical areas where room pressure is to be maintained, verify that the airflow remains constant over the full range of full cooling to full heating. Note any deviation from design airflow or room pressure.
5. After terminals have been calibrated and balanced, test and adjust system for total airflow. Adjust fans to deliver total design airflows within the maximum allowable fan speed listed by fan manufacturer.

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- a. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.
  - b. Set terminals for maximum airflow. If system design includes diversity, adjust terminals for maximum and minimum airflow so that connected total matches fan selection and simulates actual load in the building.
  - c. Where duct conditions allow, measure airflow by Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.
  - d. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
  - e. If a reliable Pitot-tube traverse or coil traverse is not possible, measure airflow at terminals and calculate the total airflow.
6. Measure fan static pressures as follows:
- a. Measure static pressure directly at the fan outlet or through the flexible connection.
  - b. Measure static pressure directly at the fan inlet or through the flexible connection.
  - c. Measure static pressure across each component that makes up the air-handling system.
  - d. Report any artificial loading of filters at the time static pressures are measured.
7. Set final return and outside airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.
- a. Balance the return-air ducts and inlets the same as described for constant-volume air systems.
  - b. Verify that terminal units are meeting design airflow under system maximum flow.
8. Re-measure the inlet static pressure at the most critical terminal unit and adjust the system static pressure set point to the most energy-efficient set point to maintain the optimum system static pressure. Record set point and give to controls contractor.
9. Verify final system conditions as follows:
- a. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to match design if necessary.
  - b. Re-measure and confirm that total airflow is within design.
  - c. Re-measure final fan operating data, rpms, volts, amps, and static profile.
  - d. Mark final settings.
  - e. Test system in economizer mode. Verify proper operation and adjust if necessary. Measure and record all operating data.
  - f. Verify tracking between supply and return fans.
- B. To obtain scheduled outside air (OA) flow rates for AHUs with Variable Frequency Drives: Balance OA and RA dampers at the AHUs to get scheduled OA Flow CFM at fan speeds of 100%, 50%, and 30%. Coordinate OA and RA dampers with BAS Controls Contractor.

### 3.8 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

- A. Prepare test reports for pumps, coils, and heat exchangers. Obtain approved submittals and manufacturer-recommended testing procedures. Crosscheck the summation of required coil and heat exchanger flow rates with pump design flow rate.



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- B. Prepare schematic diagrams of systems' "as-built" piping layouts.
- C. In addition to requirements in "Preparation" Article, prepare hydronic systems for testing and balancing as follows:
  - 1. Check liquid level in expansion tank.
  - 2. Check highest vent for adequate pressure.
  - 3. Check flow-control valves for proper position.
  - 4. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
  - 5. Verify that motor starters are equipped with properly sized thermal protection.
  - 6. Check that air has been purged from the system.

### 3.9 PROCEDURES FOR PRIMARY-SECONDARY HYDRONIC SYSTEMS

- A. Balance the primary circuit flow first.
- B. Balance the secondary circuits after the primary circuits are complete.
- C. Adjust pumps to deliver total design gpm.
  - 1. Measure total water flow.
    - a. Position valves for full flow through coils.
    - b. Measure flow by main flow meter, if installed.
    - c. If main flow meter is not installed, determine flow by pump TDH or exchanger pressure drop.
  - 2. Measure pump TDH as follows:
    - a. Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
    - b. Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
    - c. Convert pressure to head and correct for differences in gage heights.
    - d. Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
    - e. With valves open, read pump TDH. Adjust pump discharge valve until design water flow is achieved.
  - 3. Monitor motor performance during procedures and do not operate motor in an overloaded condition.
- D. Adjust flow-measuring devices installed in mains and branches to design water flows.
  - 1. Measure flow in main and branch pipes.
  - 2. Adjust main and branch balance valves for design flow.
  - 3. Re-measure each main and branch after all have been adjusted.
- E. Adjust flow-measuring devices installed at terminals for each space to design water flows.

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1. Measure flow at terminals.
  2. Adjust each terminal to design flow.
  3. Re-measure each terminal after it is adjusted.
  4. Position control valves to bypass the coil and adjust the bypass valve to maintain design flow.
  5. Perform temperature tests after flows have been balanced.
- F. For systems with pressure-independent valves at terminals:
1. Measure differential pressure and verify that it is within manufacturer's specified range.
  2. Perform temperature tests after flows have been verified.
- G. For systems without pressure-independent valves or flow-measuring devices at terminals:
1. Measure and balance coils by either coil pressure drop or temperature method.
  2. If balanced by coil pressure drop, perform temperature tests after flows have been verified.
- H. Verify final system conditions as follows:
1. Re-measure and confirm that total water flow is within design.
  2. Re-measure final pumps' operating data, TDH, volts, amps, and static profile.
  3. Mark final settings.
- I. Verify that memory stops have been set.
- J. Test flow meters provided by BAS, and verify flow meter accuracy at expected max flow rate, expected min flow rate, and midway between. Include findings in final report.

### 3.10 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. Phase and hertz.
  5. Nameplate and measured voltage, each phase.
  6. Nameplate and measured amperage, each phase.
  7. Starter size and thermal-protection-element rating.
  8. Service factor and frame size.
- B. Motors Driven by Variable-Frequency Controllers: Test manual bypass of controller to prove proper operation.

### 3.11 PROCEDURES FOR CHILLERS

- A. Balance water flow through each evaporator to within specified tolerances of indicated flow with all pumps operating. With only one chiller operating in a multiple chiller installation, do

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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. Evaporator and condenser refrigerant temperatures and pressures, [using readings taken from the chiller control panel](#).
3. Kilowatt input.
4. Capacity: Calculate in tons of cooling.
5. For air-cooled chillers, verify condenser-fan rotation and record fan and motor data including number of fans.

### 3.12 PROCEDURES FOR CONDENSING UNITS

- A. Verify proper rotation of fans.
- B. Measure entering- and leaving-air temperatures.
- C. Record fan and motor operating data.

### 3.13 PROCEDURES FOR SPACE PRESSURIZATION MEASUREMENTS AND ADJUSTMENTS

- A. Before testing for space pressurization, observe the space to verify the integrity of the space boundaries. Verify that windows and doors are closed and applicable safing, gaskets, and sealants are installed. Report deficiencies and postpone testing until after the reported deficiencies are corrected.
- B. Measure, adjust, and record the pressurization of each room, each zone, and each building by adjusting the supply, return, and exhaust airflows to achieve the indicated conditions.
- C. Measure space pressure differential where pressure is used as the design criteria, and measure airflow differential where differential airflow is used as the design criteria for space pressurization.
  1. For pressure measurements, measure and record the pressure difference between the intended spaces at the door with all doors in the space closed. Record the high-pressure side, low-pressure side, and pressure difference between each adjacent space.
  2. For applications with cascading levels of space pressurization, begin in the most critical space and work to the least critical space.
  3. Test room pressurization first, then zones, and finish with building pressurization.
- D. To achieve indicated pressurization, set the supply airflow to the indicated conditions and adjust the exhaust and return airflow to achieve the indicated pressure or airflow difference.
- E. For spaces with pressurization being monitored and controlled automatically, observe and adjust the controls to achieve the desired set point.
  1. Compare the values of the measurements taken to the measured values of the control system instruments and report findings.
  2. Check the repeatability of the controls by successive tests designed to temporarily alter the ability to achieve space pressurization. Test overpressurization and

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- underpressurization, and observe and report on the system's ability to revert to the set point.
- 3. For spaces served by variable-air-volume supply and exhaust systems, measure space pressurization at indicated airflow and minimum airflow conditions.
- F. In spaces that employ multiple modes of operation, such as normal mode and emergency mode or occupied mode and unoccupied mode, measure, adjust, and record data for each operating mode.
- G. Record indicated conditions and corresponding initial and final measurements. Report deficiencies.

### 3.14 PROCEDURES FOR INDOOR-AIR QUALITY MEASUREMENTS

- A. After air balancing is complete and with HVAC systems operating at indicated conditions, perform indoor-air quality testing.
- B. Observe and record the following conditions for each HVAC system:
  1. The distance between the outside-air intake and the closest exhaust fan discharge, flue termination, or vent termination.
  2. Specified filters are installed. Check for leakage around filters.
  3. Cooling coil drain pans have a positive slope to drain.
  4. Cooling coil condensate drain trap maintains an air seal.
  5. Evidence of water damage.
  6. Insulation in contact with the supply, return, and outside air is dry and clean.

### 3.15 DUCT LEAKAGE TESTS

- A. Duct leakage testing will be performed by mechanical installation contractor.
- B. Witness the duct pressure testing and provide written report on results immediately thereafter.
  1. Verify that proper test methods are used and that leakage rates are within specified tolerances.
  2. Report results of all testing and any deficiencies observed. Provide floor plans in report indicating sections of duct tested, and test criterion.

### 3.16 CONTROLS VERIFICATION

- A. In conjunction with system balancing, perform the following:
  1. Verify temperature control system is operating within the design limitations.
  2. Verify the operation of lockout or interlock systems.
  3. Verify the operation of valve and damper actuators.
  4. Verify that controlled devices travel freely and are in position indicated by controller: open, closed, or modulating.
  5. Verify location and installation of sensors to ensure that they sense only intended temperature, humidity, or pressure.

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6. Verify damper leakage is in accordance with submitted performance and not so excessive that it prevents system operation in accordance with design intent.
7. Confirm that the sequences of operation are in compliance with Contract Documents.

### 3.17 TOLERANCES

- A. Set HVAC system's airflow rates and water flow rates within the following tolerances:
  1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent.
  2. Air Outlets and Inlets: Plus or minus 10 percent.
  3. Cooling-Water Flow Rate: Plus or minus 10 percent.
- B. Maintaining pressure relationships as designed shall have priority over the tolerances specified above.

### 3.18 PROGRESS REPORTING

- A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems balancing devices. Recommend changes and additions to systems balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.
- B. Status Reports: Prepare progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

### 3.19 FINAL REPORT

- A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
  1. Report shall be in pdf format where all data in the entire report is searchable. Reports containing PDF scans of paper copies are not acceptable and will be rejected without review.
- B. Report Format:
  1. Title page.
    - a. Project name and location.
    - b. Name and address of:
      - 1) TAB specialist.
      - 2) General Contractor.
      - 3) Architect's name and address.

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- 4) Engineer's name and address.
  - 5) General Contractor's name and address.
- c. Date of report submission.
2. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
  3. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer, certifying validity and accuracy of field data. Include signature of TAB supervisor who certifies the report.
  4. **Include a page summarizing equipment, devices, and systems which cannot be balanced to specified conditions, reasons why they cannot be so balanced, and recommendations for resolving these issues.**
  5. **Provide a summary list of every air handler and fan, with a column for its design and actual CFM and GPM, and % deviation from design CFM and GPM.**
  6. Include a list of instruments used for procedures, along with proof of calibration.
  7. Certified field-report data.
  8. List of abbreviations used in report.
  9. Nomenclature and data sheets for each item of equipment, including manufacturer's name, type, size. Include, at minimum:
    - a. Fan curves.
    - b. Pump curves.
    - c. Manufacturers' test data.
    - d. Field test reports prepared by system and equipment installers.
    - e. Other information relative to equipment performance; do not include Shop Drawings and Product Data.
- C. Final Report Contents: In addition to items listed above, include:
1. Original test report of sensor accuracy testing.
  2. Duct leakage test report.
  3. Summary of observations on proper drainage of condensate drain pans for every item of equipment having a condensate drainage system.
    - a. Proper pan slope and pan condensate evacuation.
    - b. Adequate condensate trap depth versus static requirement.
    - c. Adequate slope and lack of 'bellies' in condensate pipe drainage system.
    - d. Proper pumped condensate operation.
  4. Field observations list of conditions of filters (verify construction filters are removed and final filters are clean) and filter racks.
  5. Field measurements and observations regarding leakage of outdoor air and control air dampers.
  6. Certified field-report data for each balanced system, including specified versus final performance, notable characteristics of systems, description of system operation sequence if it varies from the Contract Documents
  7. Layouts of air distribution systems from construction as-built drawings.
    - a. Number all air devices and systems referenced in report body.

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- b. Scans of paper drawings are not acceptable. Hand-written notes for numbering devices, duct runs, etc., are permissible, but the basic floor plans and duct / piping layouts, equipment and devices locations, etc., must be from original pdf files.
- c. Indicate duct, outlet, and inlet sizes, pipe and valve sizes and locations, locations of major equipment items such as air handlers, fans, air terminal units, pumps, etc., balancing stations.

8. Summary Of Critical Measurements and Setpoints:

- a. **Provide a table which summarizes critical measurements and settings for all HVAC equipment 1HP and larger.** Sample tables provided below for pumps and air-side systems showing minimum required information:

Unit Name	Design CFM	Measured CFM	Design ESP	Measured ESP	Tap or VFD Speed Setting	Req'd Static Stpt
AHU-A	1,000	990	1.50"	1.10"	55%	NA

\* Individual system/unit.

- a. Nameplate, design, and measured performance as described in this specification.
  - 1) The intent of TAB measurements is to prove unit performs in accordance with manufacturer’s specified and submitted data. Change setpoints as required to achieve this result. Clearly indicate in report the setpoints in effect when measurements were taken.
- b. Include fan and pump curves for units 1.5HP and larger.
- c. For units with VFD speed control: Indicate required VFD speed and whether VFD was speed-limited in its controller settings.

10. Floor plans (as-built) showing HVAC unit locations, duct layouts, air terminal devices numbered to match measured data points.

- a. Show location of air-side pressure sensors, differential or straight pressure, where such sensors are used in control

12. List of Abbreviations.

13. Checklist of HVAC unit inspections: **Sample checklists below.** Include comments as required to explain anomalies or deficiencies. (Engineer will provide sample file in Excel format upon request.)

## Unit Inspection Checklist

AH Units	AHU-1	AHU-2	AHU-3
Condensate drain pan is clean			
Condensate pan fully draining, no ponding in pan			
No excessive damper air leakage			
No air leakage @ cabinet, doors, duct connections			
Final air filters installed and clean			
Final filters of type/MERV rating specified			
Coil fins undamaged and/or combed straight			

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Fan free of vibration, rotating in correct direction			
Unit interior cleaned and vacuumed			
Access doors open fully & freely			

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 airflow rate in cfm.
- b. Total system static pressure in inches wg.
- c. Fan rpm.
- d. Discharge static pressure in inches wg.
- e. Filter static-pressure differential in inches wg.



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- f. Cooling-coil static-pressure differential in inches wg.
  - 1) Entering- and leaving-water temperature.
  - 2) Water flow rate.
  - 3) Water pressure drop.
  - 4) Dry-bulb temperature of entering and leaving air.
  - 5) Wet-bulb temperature of entering and leaving air for cooling coils.
  - 6) Air flow
  - 7) Air pressure drop
- g. Outdoor airflow in cfm.
- h. Return airflow in cfm.
- i. Outdoor-air damper position.
- j. Return-air damper position.
- k. Vortex damper position.
- l. Settings for outdoor-, return-air dampers.
  - 1) Air handling units may be designed to operate with fan varying from high to low speed.
  - 2) For such units, TAB must measure required outside air damper (& return, where applicable) position for intake of design ventilation air not only at full fan speed, but at low fan speed as well.
  - 3) Minimum damper position shall be determined by TAB Contractor such that building remains positively pressurized when building exhaust fans are on. Report results in final TAB report.
  - 4) Convey required damper positions to BAS contractor as soon as they are known, prior to submission of final TAB report.

F. Packaged Chiller Reports: For each chiller, include the following:

- 1. Unit Data: Include the following:
  - a. Unit identification.
  - b. Make and model number.
  - c. Manufacturer's serial number.
  - d. Refrigerant type and capacity in lbs.
  - e. Starter type and size.
  - f. Starter thermal protection size.
- 2. Condenser Test Data: Include design and actual values for the following:
  - a. Refrigerant pressure in psig.
  - b. Refrigerant temperature in deg F.
  - c. Entering-water temperature in deg F.
  - d. Leaving-water temperature in deg F.
  - e. Entering-water pressure in feet of head or psig.
  - f. Water pressure differential in feet of head or psig.
- 3. Evaporator Test Reports: Include design and actual values for the following:
  - a. Refrigerant pressure in psig.
  - b. Refrigerant temperature in deg F.
  - c. Entering-water temperature in deg F.

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- d. Leaving-water temperature in deg F.
  - e. Entering-water pressure in feet of head or psig.
  - f. Water pressure differential in feet of head or psig.
4. Compressor Test Data: Include design and actual values for the following:
- a. Make and model number.
  - b. Manufacturer's serial number.
  - c. Suction pressure in psig.
  - d. Suction temperature in deg F.
  - e. Discharge pressure in psig.
  - f. Discharge temperature in deg F.
  - g. Oil pressure in psig.
  - h. Oil temperature in deg F.
  - i. Voltage at each connection.
  - j. Amperage for each phase.
  - k. The kW input.
  - l. Crankcase heater kW.
  - m. Chilled water control set point in deg F.
  - n. Condenser water control set point in deg F.
  - o. Refrigerant low-pressure-cutoff set point in psig.
  - p. Refrigerant high-pressure-cutoff set point in psig.
5. Refrigerant Test Data: Include design and actual values for the following:
- a. Oil level.
  - b. Refrigerant level.
  - c. Relief valve setting in psig.
  - d. Unloader set points in psig.
  - e. Percentage of cylinders unloaded.
  - f. Bearing temperatures in deg F.
  - g. Vane position.
  - h. Low-temperature-cutoff set point in deg F.
- G. 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.
    - h. Required net positive suction head in feet of head or psig.
    - i. Pump rpm.
    - j. Impeller diameter in inches.
    - k. Motor make and frame size.
    - l. Motor horsepower and rpm.
    - m. Voltage at each connection.

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- 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.
    - b. Pump shutoff pressure in feet of head or psig.
    - c. Actual impeller size in inches.
    - d. Full-open flow rate in gpm.
    - e. Full-open pressure in feet of head or psig.
    - f. Final discharge pressure in feet of head or psig.
    - g. Final suction pressure in feet of head or psig.
    - h. Final total pressure in feet of head or psig.
    - i. Final water flow rate in gpm.
    - j. Voltage at each connection.
    - k. Amperage for each phase.
- H. 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.
    - c. Fan rpm.
    - d. Discharge static pressure in inches wg.
    - e. Suction static pressure in inches wg.
- I. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:

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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.
  - e. Duct size in inches.
  - f. Duct area in sq. ft..
  - g. Indicated airflow rate in cfm.
  - h. Indicated velocity in fpm.
  - i. Actual airflow rate in cfm.
  - j. Actual average velocity in fpm.
  - k. Barometric pressure in psig.
  
- J. Air-Terminal-Device Reports:
  1. Unit Data:
    - a. System and air-handling unit identification.
    - b. Make, type and model number, size.
    - c. Number from system diagram.
    - d. Final k-factor.
  
  2. Test Data (Indicated and Actual Values):
    - a. Airflow rate in cfm.
    - b. Air velocity in fpm.
    - c. Preliminary airflow rate as needed in cfm.
    - d. Preliminary velocity as needed in fpm.
    - e. Final airflow rate in cfm.
    - f. Final velocity in fpm.
    - g. Space temperature in deg F.
  
- K. VFD-served equipment:
  1. A pump or fan served by a VFD must be balanced for maximum energy efficiency by limiting maximum speed via the VFD (“Maximum Allowed Speed”). It is not acceptable to operate VFD at 60hz (or higher) and then balance system by throttling valves or dampers.
  2. VFD Maximum Allowed Speed is to be determined such that design flow is met in the most critical (highest pressure drop) flow path with no throttling in that path. Other flow paths may then be balanced by throttling as needed with VFD at Maximum Allowed Speed.
  3. VFD Maximum Allowed Speed shall be programmed at the VFD controller or AHU/RTU.
  
- L. Indoor-Air Quality Measurement Reports for Each HVAC System:
  1. HVAC system designation.
  2. Date and time of test.
  3. Outdoor temperature, relative humidity, wind speed, and wind direction at start of test.
  4. Room number or similar description for each location.

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5. Measurements at each location.
6. Observed deficiencies.

### M. Instrument Calibration Reports:

1. Report Data:
  - a. Instrument type and make.
  - b. Serial number.
  - c. Application.
  - d. Dates of use.
  - e. Dates of calibration.

### 3.20 ADDITIONAL TESTS

- A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
- B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer conditions, perform additional TAB during near-peak summer conditions.

### 3.21 SUMMARY OF SYSTEMS SCOPE WORK FOR TESTING AND BALANCING

- A. The following systems are to be included in scope of TAB work for this project:
  1. Air distribution systems (ducts, dampers, outlets, etc.)
  2. Hydronic distribution systems (piping, valves, etc.)
  3. Chiller plants (pumps, chillers)
  4. Hydronic dual path AHUs.
  5. Split System DX units.
  6. Exhaust fans.
  7. Supply fans.
  8. VAV Boxes

END OF SECTION 230593

## SECTION 230713 - 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

- A. Section includes insulating the following duct services:
  - 1. Indoor, concealed supply and outdoor air.
  - 2. Indoor, concealed return located in unconditioned space.
  - 3. Indoor, exposed ductwork.
- B. Related Sections:
  - 1. Section 230719 "HVAC Piping Insulation."
  - 2. Section 233113 "Metal Ducts" for duct liners.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied if any).
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
  - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
  - 2. Detail insulation application at elbows, fittings, dampers, specialties and flanges for each type of insulation.
  - 3. Detail application of field-applied jackets.
  - 4. Detail application at linkages of control devices.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Field quality-control reports.

#### 1.5 QUALITY ASSURANCE

- A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

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1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

### 1.7 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
- B. Coordinate clearance requirements with duct Installer for duct insulation application. Before preparing ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heat tracing.

### 1.8 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.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, and are limited to, the following:
  1. Mineral-Fiber Insulation:
    - a. CertainTeed
    - b. Manson.
    - c. Knauf FiberGlass GmbH.
    - d. Owens-Corning Fiberglas Corp.
    - e. Schuller International, Inc.

### 2.2 INSULATION MATERIALS

- A. Comply with requirements in "Duct Insulation Schedule, General," "Indoor Duct and Plenum Insulation Schedule," and "Aboveground, Outdoor Duct and Plenum Insulation Schedule" articles for where insulating materials shall be applied.

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- 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. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type II for sheet materials.
- G. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

### 2.3 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
  - 1. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  - 2. Adhesive 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."
- C. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
  - 1. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  - 2. Adhesive 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."

### 2.4 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
  - 1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).



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### 2.5 LAGGING ADHESIVES

- A. Description: Comply with MIL-A-3316C, Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.
  - 1. For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  - 2. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct insulation.
  - 3. Service Temperature Range: 0 to plus 180 deg F.
  - 4. Color: White.

### 2.6 SEALANTS

- A. FSK and Metal Jacket Flashing Sealants:
  - 1. Materials shall be compatible with insulation materials, jackets, and substrates.
  - 2. Fire- and water-resistant, flexible, elastomeric sealant.
  - 3. Service Temperature Range: Minus 40 to plus 250 deg F.
  - 4. Color: Aluminum.
  - 5. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  - 6. Sealants 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."

### 2.7 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
  - 1. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

### 2.8 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.

### 2.9 TAPES

- A. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
  - 1. Width: 4 inches.
  - 2. Thickness: 6.5 mils.
  - 3. Adhesion: 90 ounces force/inch in width.
  - 4. Elongation: 2 percent.
  - 5. Tensile Strength: 40 lbf/inch in width.

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6. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

### 2.10 SECUREMENTS

#### A. Bands:

1. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 3/4 inch wide.

#### B. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch- diameter shank, length to suit depth of insulation indicated.
2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
  - a. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.

#### C. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.

#### D. Wire: 0.062-inch soft-annealed, stainless steel.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

#### A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.

#### B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

#### A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

### 3.3 GENERAL INSTALLATION REQUIREMENTS

#### A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.

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- B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Keep insulation materials dry during application and finishing.
- G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- H. Install insulation with least number of joints practical.
- I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
  - 1. Install insulation continuously through hangers and around anchor attachments.
  - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
  - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
- J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- K. Install insulation with factory-applied jackets as follows:
  - 1. Draw jacket tight and smooth.
  - 2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
  - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
    - a. For below ambient services, apply vapor-barrier mastic over staples.
  - 4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
  - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.
- L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

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- M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

### 3.4 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
  - 1. Seal penetrations with flashing sealant.
  - 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  - 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
  - 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
  - 1. Seal penetrations with flashing sealant.
  - 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  - 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
  - 4. Seal jacket to wall flashing with flashing sealant.
- C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.
  - 1. Comply with requirements in Section 078413 "Penetration Firestopping" and fire-resistive joint sealers.
- E. Insulation Installation at Floor Penetrations:
  - 1. Duct: For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
  - 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

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### 3.5 INSTALLATION OF MINERAL-FIBER INSULATION

- A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
  2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
  3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
    - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
    - b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
    - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
    - d. Do not overcompress insulation during installation.
    - e. Impale insulation over pins and attach speed washers.
    - f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
  4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
    - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
    - b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.
  5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
  6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
  7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

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### 3.6 FIELD-APPLIED JACKET INSTALLATION

- A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.
  - 1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
  - 2. Embed glass cloth between two 0.062-inch-thick coats of lagging adhesive.
  - 3. Completely encapsulate insulation with coating, leaving no exposed insulation.
- B. Where FSK jackets are indicated, install as follows:
  - 1. Draw jacket material smooth and tight.
  - 2. Install lap or joint strips with same material as jacket.
  - 3. Secure jacket to insulation with manufacturer's recommended adhesive.
  - 4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch-wide joint strips at end joints.
  - 5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.
- C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.
  - 1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- D. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

### 3.7 FINISHES

- A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 9.
  - 1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
    - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- C. Do not field paint aluminum or stainless-steel jackets.

### 3.8 FIELD QUALITY CONTROL

- A. Perform tests and inspections.

## SECTION 230713 - DUCT INSULATION

### B. Tests and Inspections:

1. Inspect ductwork, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation.

### C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

## 3.9 DUCT INSULATION SCHEDULE, GENERAL

### A. Plenums and Ducts Requiring Insulation:

1. Indoor, concealed supply and outdoor air.
2. Indoor, exposed supply and outdoor air.
3. Indoor, concealed return located in unconditioned space.
4. Indoor, exposed return located in unconditioned space.
5. Indoor, concealed exhaust between isolation damper and penetration of building exterior.
6. Indoor, exposed exhaust between isolation damper and penetration of building exterior.
7. Outdoor, concealed supply and return.
8. Outdoor, exposed supply and return.

### B. Items Not Insulated:

1. Fibrous-glass ducts.
2. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
3. Factory-insulated flexible ducts.
4. Factory-insulated plenums and casings.
5. Flexible connectors.
6. Vibration-control devices.
7. Factory-insulated access panels and doors.

## 3.10 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

### A. Service: Round & rectangular, supply-air ducts concealed.

1. Material: Mineral-fiber blanket.
2. Thickness: 3 inches (R-8 min).
3. Number of Layers: One.
4. Field-Applied Jacket: Foil and paper.
5. Vapor Retarder Required: Yes.

### B. Service: Round & rectangular, return, outside-air and fume hood exhaust ducts concealed.

1. Material: Mineral-fiber blanket.
2. Thickness: 2 inches (R-6 min).
3. Number of Layers: One.
4. Field-Applied Jacket: Foil and paper.
5. Vapor Retarder Required: Yes.

### C. Service: Round supply, make-up, and outside-air ducts, exposed in conditioned space.

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1. Double wall, with 2" insulation thickness, and painted.
- D. Service: Return air duct, exposed in conditioned space: No insulation. Paint duct.
- E. Service: Ten feet of supply and return air ducts closest to AHU or FCU.
1. Material: In addition to exterior wrap, provide internal liner for sound attenuation purposes.
  2. Thickness: 1 inches.
- F. Service: Ten feet of exhaust air duct closest to where duct penetrates the exterior envelope.
1. Material: Exterior wrap.
  2. Thickness: 2 inches.
- G. Unless noted otherwise, where ductwork is not completely concealed above architectural features such as above acoustical clouds, provide painted wrap insulation. Coordinate color and finish with Architect.

END OF SECTION 230713



## SECTION 230716 - 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.

#### 1.2 SUMMARY

- A. Section includes insulating the following HVAC equipment that is not factory insulated:
  - 1. Expansion/compression tanks.
  - 2. Air separators.
- B. Related Sections:
  - 1. Section 230713 "Duct Insulation."
  - 2. Section 230719 "HVAC Piping Insulation."

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied if any).
- B. Sustainability Submittals:
  - 1. Laboratory Test Reports: For adhesives and sealants, documentation indicating that products 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."
- C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
  - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
  - 2. Detail removable insulation at equipment connections.
  - 3. Detail application of field-applied jackets.
  - 4. Detail application at linkages of control devices.
  - 5. Detail field application for each equipment type.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.
- C. Field quality-control reports.

## SECTION 230716 - HVAC EQUIPMENT INSULATION

### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
  - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
  - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

### 1.7 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
- B. Coordinate clearance requirements with equipment Installer for equipment insulation application.

### 1.8 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.

## PART 2 - PRODUCTS

### 2.1 INSULATION MATERIALS

- A. Comply with requirements in "Breeching Insulation Schedule" and "Equipment Insulation Schedule" articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

## SECTION 230716 - HVAC EQUIPMENT INSULATION

- 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. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Aeroflex USA, Inc.
    - b. Armacell LLC.
    - c. K-Flex USA.

### 2.2 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Aeroflex USA, Inc.
    - b. Armacell LLC.
    - c. Foster Brand; H. B. Fuller Construction Products.
    - d. K-Flex USA.
  - 2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Childers Brand; H. B. Fuller Construction Products.
    - b. Foster Brand; H. B. Fuller Construction Products.
  - 2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

### 2.3 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

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1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Foster Brand; H. B. Fuller Construction Products.
    - b. Knauf Insulation.
  2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
  3. Service Temperature Range: Minus 20 to plus 180 deg F.
  4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
  5. Color: White.
- C. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Childers Brand; H. B. Fuller Construction Products.
    - b. Foster Brand; H. B. Fuller Construction Products.
    - c. Knauf Insulation.
  2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
  3. Service Temperature Range: Minus 20 to plus 180 deg F.
  4. Solids Content: 60 percent by volume and 66 percent by weight.
  5. Color: White.

### 2.4 LAGGING ADHESIVES

- A. Description: Comply with MIL-A-3316C, Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.
1. For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Childers Brand; H. B. Fuller Construction Products.
    - b. Foster Brand; H. B. Fuller Construction Products.
  3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over equipment insulation.
  4. Service Temperature Range: 0 to plus 180 deg F.
  5. Color: White.

## SECTION 230716 - HVAC EQUIPMENT INSULATION

### 2.5 SEALANTS

#### A. Joint Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Permanently flexible, elastomeric sealant.
3. Service Temperature Range: Minus 100 to plus 300 deg F.
4. Color: White or gray.
5. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
6. Sealants 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. ASJ, FSK and Metal Jacket Flashing Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F.
4. Color: Aluminum.
5. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
6. Sealants 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."

### 2.6 FIELD-APPLIED JACKETS

#### A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

#### B. Metal Jacket:

1. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.
  - a. Finish and thickness are indicated in field-applied jacket schedules.
  - b. Moisture Barrier for Outdoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.
  - c. Factory-Fabricated Fitting Covers:
    - 1) Same material, finish, and thickness as jacket.
    - 2) Preformed two-piece or gore, 45- and 90-degree, short- and long-radius elbows.
    - 3) Tee covers.
    - 4) Flange and union covers.
    - 5) End caps.
    - 6) Beveled collars.
    - 7) Valve covers.
    - 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

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### 2.7 TAPES

- A. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
  - 1. Width: 4 inches.
  - 2. Thickness: 3.7 mils.
  - 3. Adhesion: 100 ounces force/inch in width.
  - 4. Elongation: 5 percent.
  - 5. Tensile Strength: 34 lbf/inch in width.

### 2.8 SECUREMENTS

- A. Bands:
  - 1. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 3/4 inch wide .
  - 2. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.
- B. Insulation Pins and Hangers:
  - 1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch- diameter shank, length to suit depth of insulation indicated.
- C. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.
- D. Wire: 0.062-inch soft-annealed, stainless steel.

### 2.9 CORNER ANGLES

- A. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum according to ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
  - 1. Verify that systems and equipment to be insulated have been tested and are free of defects.
  - 2. Verify that surfaces to be insulated are clean and dry.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:

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1. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
- B. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

### 3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Keep insulation materials dry during application and finishing.
- G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- H. Install insulation with least number of joints practical.
- I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
  1. Install insulation continuously through hangers and around anchor attachments.
  2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
  3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
  4. Cover inserts with jacket material matching adjacent insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- K. Install insulation with factory-applied jackets as follows:
  1. Draw jacket tight and smooth.
  2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.

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3. Overlap jacket longitudinal seams at least 1-1/2 inches. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches o.c.
    - a. For below ambient services, apply vapor-barrier mastic over staples.
  4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
  5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints.
- L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- O. For above ambient services, do not install insulation to the following:
1. Vibration-control devices.
  2. Testing agency labels and stamps.
  3. Nameplates and data plates.
  4. Manholes.
  5. Handholes.
  6. Cleanouts.

### 3.4 INSTALLATION OF EQUIPMENT, TANK, AND VESSEL INSULATION

- A. Flexible Elastomeric Thermal Insulation Installation for Tanks and Vessels: Install insulation over entire surface of tanks and vessels.
1. Apply 100 percent coverage of adhesive to surface with manufacturer's recommended adhesive.
  2. Seal longitudinal seams and end joints.
- B. Insulation Installation on Pumps:
1. Fabricate metal boxes lined with insulation. Fit boxes around pumps and coincide box joints with splits in pump casings. Fabricate joints with outward bolted flanges. Bolt flanges on 6-inch centers, starting at corners. Install 3/8-inch-diameter fasteners with wing nuts. Alternatively, secure the box sections together using a latching mechanism.
  2. Fabricate boxes from galvanized steel, at least 0.050 inch thick.
  3. For below ambient services, install a vapor barrier at seams, joints, and penetrations. Seal between flanges with replaceable gasket material to form a vapor barrier.

### 3.5 FIELD-APPLIED JACKET INSTALLATION

- A. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof



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sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

### 3.6 FINISHES

- A. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- B. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- C. Do not field paint aluminum or stainless-steel jackets.

### 3.7 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections: Inspect field-insulated equipment, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.
- C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

### 3.8 EQUIPMENT INSULATION SCHEDULE

- A. Insulation materials and thicknesses are identified below. If more than one material is listed for a type of equipment, selection from materials listed is Contractor's option.
- B. Insulate indoor and outdoor equipment that is not factory insulated.
- C. Chilled-water expansion/compression tank, air-separator, and any other cold surface capable of forming condensation: Insulation shall be the following:
  - 1. Flexible Elastomeric: 2 inch thick.
- D. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
  - 1. Aluminum, smooth: 0.020 inch thick.

END OF SECTION 230716

## SECTION 230719 - 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 insulating the following HVAC piping systems:

1. Condensate drain piping, indoors.
2. Chilled-water and brine piping, indoors.
3. Refrigerant piping, indoors and outdoors.

- B. Related Sections:

1. Section 230713 "Duct Insulation."

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied if any).

- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Detail attachment and covering of heat tracing inside insulation.
3. Detail insulation application at pipe expansion joints for each type of insulation.
4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
5. Detail removable insulation at piping specialties.
6. Detail application of field-applied jackets.
7. Detail application at linkages of control devices.

#### 1.4 QUALITY ASSURANCE

- A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

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2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

### 1.6 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heat tracing.

### 1.7 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.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  1. Cellular-Glass Insulation:
    - a. Pittsburgh-Corning Corp.
    - b. Cell-U-Foam Corporation; Ultra-CUF.
  2. Flexible Elastomeric Thermal Insulation:
    - a. Aeroflex USA Inc.; Aerocel.
    - b. Armacell LLC; AP Armaflex.
    - c. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180.
  3. Closed-Cell Phenolic-Foam Insulation:
    - a. Kooltherm Insulation Products, Ltd.

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### 2.2 INSULATION MATERIALS

- A. Mineral-fiber insulation will NOT be allowed for use on any cold piping systems.
- B. Mineral-fiber wrap is NOT approved for use on piping insulation.
- C. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials shall be applied.
- D. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- E. 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.
- F. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- G. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- H. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
  - 1. Block Insulation: ASTM C 552, Type I.
  - 2. Special-Shaped Insulation: ASTM C 552, Type III.
  - 3. Preformed Pipe Insulation with Factory-Applied: Comply with ASTM C 552, Type II, Class 2.
  - 4. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.
- I. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.
- J. Phenolic:
  - 1. Preformed pipe insulation of rigid, expanded, closed-cell structure. Comply with ASTM C 1126, Type III, Grade 1.
  - 2. Block insulation of rigid, expanded, closed-cell structure. Comply with ASTM C 1126, Type II, Grade 1.
  - 3. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.
  - 4. Factory-Applied Jacket: Requirements are specified in "Factory-Applied Jackets" Article.
    - a. Preformed Pipe Insulation: ASJ.

### 2.3 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of minus 100 to plus 200 deg F.

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1. Products:
    - a. Childers Products, Division of ITW; CP-96.
    - b. Foster Products Corporation, H. B. Fuller Company; 81-33.
  2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  3. Adhesive 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."
- C. Phenolic Adhesive: Solvent-based resin adhesive, with a service temperature range of minus 75 to plus 300 deg F.
1. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  2. Adhesive 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."
- D. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
1. Products:
    - a. Aeroflex USA Inc.; Aeroseal.
    - b. Armacell LCC; 520 Adhesive.
    - c. Foster Products Corporation, H. B. Fuller Company; 85-75.
    - d. RBX Corporation; Rubatex Contact Adhesive.
  2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  3. Adhesive 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."
- E. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
1. Products:
    - a. Childers Products, Division of ITW; CP-82.
    - b. Foster Products Corporation, H. B. Fuller Company; 85-20.
    - c. ITW TACC, Division of Illinois Tool Works; S-90/80.
    - d. Marathon Industries, Inc.; 225.
    - e. Mon-Eco Industries, Inc.; 22-25.
  2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  3. Adhesive 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."

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### 2.4 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
  - 1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

### 2.5 LAGGING ADHESIVES

- A. Description: Comply with MIL-A-3316C, Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.
  - 1. For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  - 2. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over pipe insulation.
  - 3. Service Temperature Range: 0 to plus 180 deg F.
  - 4. Color: White.

### 2.6 SEALANTS

- A. Joint Sealants:
  - 1. Materials shall be compatible with insulation materials, jackets, and substrates.
  - 2. Permanently flexible, elastomeric sealant.
  - 3. Service Temperature Range: Minus 100 to plus 300 deg F.
  - 4. Color: White or gray.
  - 5. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  - 6. Sealants 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. FSK and Metal Jacket Flashing Sealants:
  - 1. Materials shall be compatible with insulation materials, jackets, and substrates.
  - 2. Fire- and water-resistant, flexible, elastomeric sealant.
  - 3. Service Temperature Range: Minus 40 to plus 250 deg F.
  - 4. Color: Aluminum.
  - 5. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  - 6. Sealants 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."
- C. ASJ Flashing Sealants, Jacket Flashing Sealants:
  - 1. Materials shall be compatible with insulation materials, jackets, and substrates.
  - 2. Fire- and water-resistant, flexible, elastomeric sealant.
  - 3. Service Temperature Range: Minus 40 to plus 250 deg F.

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4. Color: White.
5. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
6. Sealants 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."

### 2.7 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
  1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
  2. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

### 2.8 FIELD-APPLIED FABRIC-REINFORCING MESH

- A. Woven Glass-Fiber Fabric: Approximately 2 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in. for covering pipe and pipe fittings.

### 2.9 FIELD-APPLIED CLOTHS

- A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd..

### 2.10 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.
- C. Metal Jacket:
  1. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.
    - a. Factory cut and rolled to size.
    - b. Finish and thickness are indicated in field-applied jacket schedules.
    - c. Moisture Barrier: 3-mil-thick, heat-bonded polyethylene and kraft paper.
    - d. Factory-Fabricated Fitting Covers:
      - 1) Same material, finish, and thickness as jacket.
      - 2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
      - 3) Tee covers.
      - 4) Flange and union covers.
      - 5) End caps.

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- 6) Beveled collars.
  - 7) Valve covers.
  - 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.
- D. Underground Direct-Buried Jacket: 125-mil-thick vapor barrier and waterproofing membrane consisting of a rubberized bituminous resin reinforced with a woven-glass fiber or polyester scrim and laminated aluminum foil.

### 2.11 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
1. Width: 3 inches.
  2. Thickness: 11.5 mils.
  3. Adhesion: 90 ounces force/inch in width.
  4. Elongation: 2 percent.
  5. Tensile Strength: 40 lbf/inch in width.
  6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
1. Width: 3 inches.
  2. Thickness: 6.5 mils.
  3. Adhesion: 90 ounces force/inch in width.
  4. Elongation: 2 percent.
  5. Tensile Strength: 40 lbf/inch in width.
  6. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
1. Width: 2 inches.
  2. Thickness: 3.7 mils.
  3. Adhesion: 100 ounces force/inch in width.
  4. Elongation: 5 percent.
  5. Tensile Strength: 34 lbf/inch in width.

### 2.12 SECUREMENTS

- A. Bands:
1. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 3/4 inch wide.
- B. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.
- C. Wire: 0.062-inch soft-annealed, stainless steel.



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### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
  - 1. Verify that systems to be insulated have been tested and are free of defects.
  - 2. Verify that surfaces to be insulated are clean and dry.
  - 3. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:
  - 1. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range. **NO EXCEPTION: PIPES SHALL BE PAINTED.**
- C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

#### 3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.

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- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
  - 1. Install insulation continuously through hangers and around anchor attachments.
  - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
  - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
  - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
  - 1. Draw jacket tight and smooth.
  - 2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
  - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install 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 2 inches o.c.
    - a. For below-ambient services, apply vapor-barrier mastic over staples.
  - 4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
  - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- P. For above-ambient services, do not install insulation to the following:
  - 1. Vibration-control devices.

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2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Manholes.
5. Handholes.
6. Cleanouts.

### 3.4 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
  1. Seal penetrations with flashing sealant.
  2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
  4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
  1. Seal penetrations with flashing sealant.
  2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
  4. Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
  1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.
- F. Insulation Installation at Floor Penetrations:
  1. Pipe: Install insulation continuously through floor penetrations.
  2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

## SECTION 230719 - HVAC PIPING INSULATION

### 3.5 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
  - 1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
  - 2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
  - 3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
  - 4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
  - 5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
  - 6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
  - 7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
  - 8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
  - 9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

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- D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
  2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
  3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
  4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
  5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

### 3.6 INSTALLATION OF CELLULAR-GLASS INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient services, secure laps with outward-clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below-ambient services, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as pipe insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.

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2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.

### D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of cellular-glass insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

## 3.7 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

### A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

### B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

### C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

### D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

## 3.8 INSTALLATION OF PHENOLIC INSULATION

### A. General Installation Requirements:

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1. Secure single-layer insulation with stainless-steel bands at 12-inch intervals and tighten bands without deforming insulation materials.
2. Install 2-layer insulation with joints tightly butted and staggered at least 3 inches. Secure inner layer with 0.062-inch wire spaced at 12-inch intervals. Secure outer layer with stainless-steel bands at 12-inch intervals.

### B. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient services, secure laps with outward-clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets with vapor retarders on below-ambient services, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

### C. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of block insulation of same material and thickness as pipe insulation.

### D. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed insulation sections of same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions.

### E. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed insulation sections of same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

## 3.9 FIRE-RATED INSULATION SYSTEM INSTALLATION

- A. Where fire-rated insulation system is indicated, secure system to ducts and duct hangers and supports to maintain a continuous fire rating.
- B. Insulate duct access panels and doors to achieve same fire rating as duct.
- C. Install firestopping at penetrations through fire-rated assemblies. Fire-stop systems are specified in Division 07 Section "Penetration Firestopping."

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### 3.10 FIELD-APPLIED JACKET INSTALLATION

- A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.
  - 1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
  - 2. Embed glass cloth between two 0.062-inch-thick coats of lagging adhesive.
  - 3. Completely encapsulate insulation with coating, leaving no exposed insulation.
- B. Where FSK jackets are indicated, install as follows:
  - 1. Draw jacket material smooth and tight.
  - 2. Install lap or joint strips with same material as jacket.
  - 3. Secure jacket to insulation with manufacturer's recommended adhesive.
  - 4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch-wide joint strips at end joints.
  - 5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.
- C. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

### 3.11 FINISHES

- A. Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 9 Sections.
  - 1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
    - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless-steel jackets.

### 3.12 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
  - 1. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of



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inspection shall be limited to three locations of straight pipe, three locations of fittings, two locations of strainers, three locations of valves, for each pipe service defined in the "Piping Insulation Schedule, General" Article.

- C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

### 3.13 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
  - 1. Drainage piping located in crawl spaces.
  - 2. Underground piping.
  - 3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

### 3.14 INDOOR PIPING INSULATION SCHEDULE

- A. Condensate and Equipment Drain Water below 60 Deg F:
  - 1. All Pipe Sizes: Insulation shall be the following:
    - a. Flexible Elastomeric: 3/4 inch thick.
  - 2. Vapor Retarder Required: Yes.
- B. Chilled Water and Brine, 60 Deg F and below:
  - 1. NPS 3 and Smaller: Insulation shall be one of the following:
    - a. Cellular Glass: 2 inches thick.
    - b. Phenolic: 2 inches thick.
  - 2. NPS 4 to NPS 12: Insulation shall be one of the following:
    - a. Cellular Glass: 3 inches thick.
    - b. Phenolic: 3 inches thick.
  - 3. Vapor Retarder Required: Yes.
- C. Refrigerant Suction and Hot-Gas Piping:
  - 1. All Pipe Sizes: Insulation shall be:
    - a. Flexible Elastomeric: **1-inch** thick minimum, with two coats of protective coating recommended by the insulation manufacturer.
  - 2. Vapor Retarder Required: Yes.

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- D. Where piping is exposed to view or not completely concealed above wall-to-wall suspended ceiling tiles, insulation shall be painted. Coordinate color and finish with Architect.

### 3.15 OUTDOOR PIPING INSULATION SCHEDULE (INCLUDES PUMP ROOM)

- A. Condensate and Equipment Drain Water below 60 Deg F:
  - 1. All Pipe Sizes: Insulation shall be the following:
    - a. Flexible Elastomeric: 3/4 inch thick.
  - 2. Vapor Retarder Required: Yes.
  - 3. Field-Applied Jacket: Aluminum jacket.
- B. Chilled Water and Brine, 60 Deg F and below:
  - 1. NPS 3 and Smaller: Insulation shall be one of the following:
    - a. Cellular Glass: 2.5 inches thick.
    - b. Phenolic: 2.5 inches thick.
  - 2. NPS 4 to NPS 12: Insulation shall be one of the following:
    - a. Cellular Glass: 3 inches thick.
    - b. Phenolic: 3 inches thick.
  - 3. Vapor Retarder Required: Yes.
  - 4. Field-Applied Jacket: Aluminum jacket.
- A. Refrigerant Suction and Hot-Gas Piping:
  - 1. All Pipe Sizes: Insulation shall be:
    - a. Flexible Elastomeric: **1 inch** thick minimum, with two coats of protective coating recommended by the insulation manufacturer.
  - 2. Vapor Retarder Required: Yes.
  - 3. Field-Applied Jacket: Aluminum jacket.

### 3.16 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
  - 1. Aluminum, Smooth with Z-Shaped Locking Seam: 0.020 inch thick.

### 3.17 UNDERGROUND, FIELD-INSTALLED INSULATION JACKET

- A. For underground direct-buried piping applications, install underground direct-buried jacket over insulation material.

END OF SECTION 230719

## SECTION 230800 - 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 the following MEP systems, assemblies, and equipment:
  - 1. HVAC equipment.
  - 2. Controls and instrumentation, including BAS energy monitoring and control system.
- B. Related Requirements:
  - 1. Section 019113 "General Commissioning Requirements" for general commissioning process requirements and Commissioning Coordinator responsibilities.

#### 1.3 DEFINITIONS

- A. Refer to Section 019113 "General Commissioning Requirements" for additional definitions and assignment of responsibilities.

#### 1.4 CONTRACTOR'S RESPONSIBILITIES

- A. Refer to Section 019113 "General Commissioning Requirements".
- B. Perform commissioning tests at the direction of the CxA.**
- C. Attend construction phase controls coordination meeting.
- D. Attend testing, adjusting, and balancing review and coordination meeting.
- E. Participate in mechanical systems, assemblies, equipment, and component maintenance orientation and inspection.
- F. Provide information requested by the CxA for final commissioning documentation.
- G. 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 required test period.
- H. Provide Project-specific construction checklists and commissioning process test procedures for actual mechanical systems, assemblies, equipment, and components to be furnished and installed as part of the construction contract.
- I. Direct and coordinate commissioning testing among subcontractors, suppliers, and vendors.

## SECTION 230800 - COMMISSIONING OF HVAC

- J. Verify testing, adjusting, and balancing of Work are complete.
- K. Provide test data, inspection reports, and certificates in Systems Manual.

### 1.5 COMMISSIONING DOCUMENTATION

- A. Provide the following information to the CxA for inclusion in the commissioning plan:
  - 1. Plan for delivery and review of 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 pre-start and startup checklists for mechanical systems, assemblies, equipment, and components to be verified and tested.
  - 4. Certificate of completion certifying that installation, pre-start checks, and startup procedures have been completed.
  - 5. Certificate of readiness certifying that mechanical 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.

### 1.6 INFORMATIONAL SUBMITTALS

- A. Construction Checklists: See related Sections for technical requirements, and generate construction checklists for the following:
  - 1. Instrumentation and control for MEP systems.
  - 2. Chiller plant, Fans, Air-handling units and fan coil units.
- B. Certificates of readiness.
- C. Certificates of completion of installation, pre-start, and startup activities.

## PART 2 - PRODUCTS (Not Used)

## PART 3 - EXECUTION

### 3.1 GENERAL REQUIREMENTS

- A. Refer to Section 019113 "General Commissioning Requirements".

### 3.2 SYSTEMS READINESS CHECKLISTS

- A. Construction Checklists: Assist CxA in the preparation of detailed Systems Readiness checklists for systems, subsystems, equipment, and components.
  - 1. Contributors to the development of checklists shall include, but are not limited to:
    - a. Systems and equipment installers.

## SECTION 230800 - COMMISSIONING OF HVAC

- b. TAB technicians.
  - c. Instrumentation and controls installers.
- B. Contractor shall conduct Systems Readiness Testing to document compliance with installation and Systems Readiness checklists prepared by Commissioning Authority for Division-23 items.
- C. Refer to Section 019113 "General Commissioning Requirements" for issues relating to Systems Readiness checklists and testing, description of process, details on non-conformance issues relating to pre-functional checklists and test.

### 3.3 SYSTEM START-UP

- A. Contractor is solely responsible for system start-up. CxA may, at his discretion, witness start up procedures, but will not perform any Functional Testing of systems until Contractor has completed start-up and resolved all operating deficiencies.

### 3.4 TESTING PREPARATION

- A. Certify that systems, subsystems, and equipment have been installed, calibrated, and started and are operating according to the Contract Documents.
- B. Certify that instrumentation and control systems have been completed and calibrated, that they are operating according to the Contract Documents and approved Shop Drawings and submittals, and that pretest set points have been recorded.
- C. Certify that TAB procedures have been completed and that TAB reports have been submitted, discrepancies corrected, and corrective work approved.
- D. Set systems, subsystems, and equipment into operating mode to be tested according to approved test procedures (e.g., normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).

### 3.5 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. Provide technicians, instrumentation, and tools to verify testing and balancing of mechanical systems at the direction of the CxA.
1. The CxA will notify Contractor 4 days in advance of the date of field verification. Notice will not include data points to be verified.
  2. The testing and balancing Subcontractor shall use the same instruments (by model and serial number) that were used when original data were collected.
  3. Failure of an item includes 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.
  4. Remedy deficiency and notify CxA so verification of failed portions can be performed.

## SECTION 230800 - COMMISSIONING OF HVAC

### 3.6 GENERAL TESTING REQUIREMENTS

- A. Provide technicians, instrumentation, and tools to perform commissioning test at the direction of the CxA.
- B. Scope of mechanical testing shall include entire HVAC installation, from equipment through distribution systems to each space served. 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. Tests will be performed using design conditions whenever possible.
- E. 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 Contracting Officer and document simulated conditions and methods of simulation. After tests, return settings to normal operating conditions.
- F. The CxA may direct that set points be altered when simulating conditions is not practical.
- G. 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.
- H. If tests cannot be completed because of a deficiency outside the scope of the mechanical system, document the deficiency and report it to the Owner. After deficiencies are resolved, reschedule tests.
- I. If the testing plan indicates specific seasonal testing, complete appropriate initial performance tests and documentation and schedule seasonal tests.

### 3.7 GENERAL TESTING PROCEDURES FOR HVAC SYSTEMS, SUBSYSTEMS, AND EQUIPMENT

- A. HVAC Instrumentation and Control System Testing: Contractor shall fully test operation of controls system prior to requesting Functional Testing with CxA. Point-to-point check out sheets and as-built control diagrams shall be provided to CxA so he may develop testing procedures.
- B. HVAC Distribution System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of air distribution systems; special exhaust; and other distribution systems, including HVAC terminal equipment and unitary equipment.

### 3.8 FUNCTIONAL TEST PROCEDURES FOR SYSTEMS TO BE COMMISSIONED

- A. General
  - 1. The following paragraphs outline the functional test procedures for the various Div. 23 items to be commissioned. Functional testing will take place only after System Readiness

## SECTION 230800 - COMMISSIONING OF HVAC

checklists have been completed, equipment has been started-up, TAB has been verified, and Contractor has certified that systems are ready for functional testing.

2. All systems controlled via the Building Automation System shall have all control points and sequences tested by Controls Contractor prior to requesting testing by CX Authority.
3. Functional testing of HVAC systems shall include testing of the BAS.

### B. All Equipment:

1. Verify nameplate information (serial numbers, model numbers, etc.); verify that equipment capacity is in accordance with requirements of construction documents.
2. Verify unit runs smoothly and quietly.
3. Verify operation of safeties.
4. Verify electrical wiring and grounding is correct.
5. Verify maintenance and NEC clearances are maintained.
6. Verify Systems Readiness Checklists have been completed.

## 3.9 COMMISSIONING TESTS

### A. Functional testing will be performed on all HVAC equipment, including but limited to the following:

1. Chiller plant
2. AHUs
3. FCUs
4. Split systems
5. Exhaust fans
6. Air distribution system
7. Building automation system

### B. Sample requirements are as follows:

1. Record temperatures, pressures.
2. Record programmed setpoints (unocc/occ temperature, RH, CO2, runtime, safeties, alarms).
3. Record programmed schedules and interlocks.
4. Verify equipment installation
5. Verify equipment operation.
6. Verify electrical voltage and amperages are within tolerance.
7. Verify unit data in TAB report.
8. Verify alarms and safeties.
9. Verify all sequences.
10. Verify setpoint resets, adaptive controls for energy conservation.

### C. Customized system readiness checklists and function testing requirements will be released after the submittal review phase.

## 3.10 TRAINING AND O&M MANUALS

### A. Refer to Div. 23 specifications.

END OF SECTION 230800

## SECTION 230900 – INSTRUMENTATION AND CONTROLS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:

- 1. Design Intent is to get Full-DDC controls, that is fully integrated with the equipment, and fully accessible via the web. Coordinate with equipment manufacturer, and integrate controls as needed to ensure that all safeties and warranties are retained. BACnet interface will be used to monitor all alarms and parameters from the unitary controllers.
- 2. Delivery of selected control devices to equipment and systems manufacturers for factory installation and to HVAC systems installers for field installation.

- B. Related Requirements:

- 1. Section 230993 "Sequence of Operations for HVAC Controls" for control sequences in DDC systems.

#### 1.3 CODE REQUIREMENTS

- A. All equipment and material and its installation shall conform to the current requirements of the following authorities, and local amendments:

- 1. Occupational Safety and Health Act (OSHA)
- 2. International Electric Code (IEC)
- 3. International Fire Code
- 4. International Building Code
- 5. International Mechanical Code
- 6. International Plumbing Code
- 7. International Energy Conservation Code
- 8. UL 916

- B. Where two or more codes conflict, the most restrictive shall apply. Nothing in these specifications shall be construed to permit work not conforming to applicable codes.

#### 1.4 ACTION SUBMITTALS

- A. **All submittals must be in native PDF format, wherein all text is searchable. Submittals which contain scanned documents which are not 'searchable' will be rejected without being reviewed.**

- B. Product Data: For each type of product include the following:



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1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Operating characteristics, electrical characteristics, and furnished accessories indicating process operating range, accuracy over range, control signal over range, default control signal with loss of power, calibration data specific to each unique application, electrical power requirements, and limitations of ambient operating environment, including temperature and humidity.
3. Product description with complete technical data, performance curves, and product specification sheets.
4. Bill of materials of indicating quantity, manufacturer, and extended model number for each unique product.
5. When manufacturer's product datasheets apply to a product series rather than a specific product model, clearly indicate and highlight only applicable information.
6. Each submitted piece of product literature shall clearly cross reference specification and drawings that submittal is to cover.

### C. System Description:

1. Full description of DDC system architecture, network configuration, operator interfaces and peripherals, servers, controller types and applications, gateways, routers and other network devices, and power supplies.
2. General Requirements:
  - a. Include cover drawing with Project name, location, Owner, Architect, Contractor and issue date with each Shop Drawings submission.
  - b. Include a drawing index sheet listing each drawing number and title that matches information in each title block.
3. Schematic drawings for each controlled HVAC system indicating the following:
  - a. I/O points labeled with point names shown. Indicate instrument range, normal operating set points, and alarm set points. Indicate fail position of each damper and valve, if included in Project.
  - b. I/O listed in table format showing point name, type of device, manufacturer, model number, and cross-reference to product data sheet number.
  - c. A graphic showing location of control I/O in proper relationship to HVAC system.
  - d. Wiring diagram with each I/O point having a unique identification and indicating labels for all wiring terminals.
  - e. Unique identification of each I/O that shall be consistently used between different drawings showing same point.
  - f. Elementary wiring diagrams of controls for HVAC equipment motor circuits including interlocks, switches, relays and interface to DDC controllers.
  - g. Narrative sequence of operation.
    - 1) Contractor is expected to review all specified sequences and submit questions concerning any ambiguities, potential errors or omissions, prior to turning in submittals. Submittals which simply restate control sequences as written in specifications are not acceptable. Submittals must include a restatement of sequences as they will actually be programmed.
4. DDC system network riser diagram; indicate each device connected to network with unique identification for each, communication protocol, speed and physical means of

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interconnecting network devices, such as copper cable type, or fiber-optic cable, network port(s) for connection of an operator workstation or other type of operator interface, etc.

5. Color graphics.
  - a. Submit samples and an itemized list of ALL the various graphics pages being proposed for control system. Show layout of pictures, graphics and data displayed, navigation icons, etc.
  - b. Graphics for equipment must be schematically correct versus equipment as actually installed (e.g., all sensors, coils, devices, shown in correct locations & sequential order).
  - c. Engineer's approval of submitted sample graphics pages represents preliminary approval and does not preclude the possibility that graphics' deficiencies may be found in subsequent testing and inspections.

### D. Software Submittal:

1. Cross-referenced listing of software to be loaded on each operator workstation, server, gateway, and DDC controller.
2. Description and technical data of all software provided, and cross-referenced to products in which software will be installed.
3. Operating system software, operator interface and programming software, color graphic software, DDC controller software, maintenance management software, and third-party software.
4. Include a flow diagram and an outline of each subroutine that indicates each program variable name and units of measure.
5. Listing and description of each engineering equation used with reference source.
6. Listing and description of each constant used in engineering equations and a reference source to prove origin of each constant.
7. Description of operator interface to alphanumeric and graphic programming.
8. Description of each network communication protocol.
9. Description of system database, including all data included in database, database capacity and limitations to expand database.
10. Description of each application program and device drivers to be generated, including specific information on data acquisition and control strategies showing their relationship to system timing, speed, processing burden and system throughout.
11. Controlled Systems: Instrumentation list with element name, type of device, manufacturer, model number, and product data. Include written description of sequence of operation including schematic diagram.

## 1.5 INFORMATIONAL SUBMITTALS

- A. All submittals must be in native PDF format, wherein all text is searchable. Submittals which contain scanned documents which are not 'searchable' will be rejected without being reviewed.
- B. Coordination Drawings: Plan drawings and corresponding product installation details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved.
- C. Systems Provider Qualification Data: Resume of project manager, installation and programming technician, and service technicians assigned to Project, including name, phone number, and e-mail address.

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- D. Product Certificates: Data Communications Protocol Certificates: Certifying that each proposed DDC system component complies with ASHRAE 135.

### 1.6 CLOSEOUT SUBMITTALS

- A. As-built record documentation per section 017700 – Closeout Procedures.
- B. Operation and Maintenance Data: For DDC system to include in emergency, operation and maintenance manuals.
  - 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
    - a. Names, addresses, e-mail addresses and 24-hour telephone numbers of Installer and service representatives for DDC system and products.
    - b. Operator's manual with procedures for operating control systems including logging on and off, handling alarms, producing point reports, trending data, overriding computer control and changing set points and variables.
    - c. Programming 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.
    - d. Engineering, installation, and maintenance manuals.
    - e. Documentation of all programs created using custom programming language including set points, tuning parameters, and object database.
    - f. Backup copy of graphic files, programs, and database in electronic media form.
    - g. List of recommended spare parts with part numbers and suppliers.
    - h. Complete original-issue documentation, installation, and maintenance information for furnished third-party hardware including computer equipment and sensors.
    - i. Complete original-issue copies of furnished software, including operating systems, custom programming language, operator workstation software, and graphics software.
    - j. Licenses, guarantees, and warranty documents.
    - k. Recommended preventive maintenance procedures for system components, including schedule of tasks such as inspection, cleaning, and calibration; time between tasks; and task descriptions.
    - l. Owner training materials.
    - m. For all BACnet-connected devices, on a separate dedicated page, document only selected points readable BACnet points.

### 1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials and parts that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
- B. Include product manufacturers' recommended parts lists for proper product operation over five-year period following warranty period. Parts list shall be indicated for each year.

### 1.8 COORDINATION

- A. Coordinate location of thermostats, humidistats, and other exposed control sensors with plans and room details before installation.

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- B. Coordinate supply of conditioned electrical circuits for control units.
- C. Coordinate equipment with Division 16 Section "Panelboards".

### 1.9 PAYMENTS

- A. 10% of controls cost will be withheld until documentation is provided that the Commissioning and Acceptance Test was carried out, and that it was verified by Engineer.
- B. 5% of controls cost will be withheld until documentation is provided that the Training was carried out, and that it was acceptable by the Owner.

### 1.10 CONTRACTOR RESPONSIBILITY

- A. All control items, services, and work shown in specifications and drawings shall be provided by Controls Contractor either directly or by subcontract. These shall include, but are not necessarily limited to, the following:
  1. Install control equipment incorporating DDC for energy management, equipment monitoring and control, software, programming, including color graphic workstations.
  2. Provide control relays and devices, air flow monitoring devices, pressure and temperature sensing devices, valves, dampers and actuators, etc.
  3. Provide electrical work associated with control system and as called for on Drawings. Perform all wiring in accordance with all local and national codes. Provide all line voltage wiring, concealed or exposed, in accordance with Div. 26. All low voltage electrical control wiring throughout the building when exposed shall be run in conduit in accordance with Division 26. All low voltage wiring run in concealed accessible areas shall be run using plenum rated wire only.
  4. Provide 120V power for direct digital control systems PCU's, and LCU's, as defined later in these specifications, and make final panel hook-up and all final electrical connections to each controller. Provide power for all valve, and damper-actuators including VAV boxes.
    - a. Power circuit to PCU/LCU shall serve PCU/LCU and no other equipment.
    - b. Use spares or provide new circuit breaker.
  5. Use spare circuit breakers or provide new where no spares exist.
  6. Provide all wiring and conduit for all DDC temperature controls, monitoring devices including DDC signal wiring.
  7. Provide all control relays. Where motor starters are not called for or do not exist for 1-phase equipment, provide relays and contactors as required for start/stop control by BAS.
  8. Provide surge transient protection shall be incorporated in design of system to protect electrical components in all primary control units.
  9. Provide all warranty related work, products, materials, and labor.
  10. Provide all software programming.
  11. Provide consulting and programming services to Owner and Installing Contractor as required to resolve operating problems after system installation.
  12. Provide shop drawings indicating equipment locations, points allocation, and schematic wiring. Submittals shall indicate all information pertinent to PCU locations, PCU capacity and spare points, input/output module configuration within PCUs, communication trunks, sensors, valves, pneumatic interface, wiring, and other pertinent equipment information requiring approval prior to field installation. Provide a DDC system riser diagram showing buildings, controller or device within each building, and listing equipment controlled or monitored by each.

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13. Provide graphics programming, showing floor plans of all buildings, equipment locations, and operating parameters.
14. Provide commissioning of system.
15. Provide reference manuals.
16. Provide Owner training.
17. Warranty work.
18. Other services, materials, and products as called for in construction documents.

B. The following equipment and services shall be coordinated with the Owner:

1. Network connections.

C. Coordinate with Mechanical Contractor. Mechanical Contractor provides:

1. Installation of control valves, control dampers, actuators and all manual dampers.
2. Temporary 24V thermostat for new equipment, if required.
3. Fan coil units with factory-installed dampers (where indicated).
4. Rooftop / AH units with factory-installed outside air damper actuator and controls.

### 1.11 QUALITY ASSURANCE

A. DDC System Manufacturer Qualifications:

1. Nationally recognized manufacturer of DDC systems and products.
2. DDC systems with similar requirements to those indicated for a continuous period of ten years within time of bid.
3. Having complete published catalog literature, installation, operation and maintenance manuals for all products intended for use.
4. Having full-time in-house employees for the following:
  - a. Product research and development.
  - b. Product and application engineering.
  - c. Product manufacturing, testing and quality control.
  - d. Technical support for DDC system installation training, commissioning and troubleshooting of installations.
  - e. Owner operator training.

B. DDC System Provider / Installer Qualifications:

1. A direct factory owned office of the manufacturer, for the brand or make of control equipment to be supplied, with engineers capable of providing instructions, routine maintenance, design services, programming, and emergency system service on staff.
2. Project supervisor and programmers shall be DDC system manufacturer employees. Only construction services not directly related to DDC system operation (such as provision of electrical power, conduit installation and wire-pulling, etc.) may be subcontracted to non-manufacturer workers.
3. A manufacturer's employee working on this project shall be officed within 40 miles of Project and assigned to support Project during warranty period.
4. Each manufacturer employee assigned to Project shall be a competent and experienced full-time employee with demonstrated past experience on at least 5 projects of similar complexity, scope and value.

### 1.12 WARRANTY

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- A. **Manufacturer's Warranty:** Manufacturer and Installer agree to repair or replace products that fail in materials or workmanship within specified warranty period.
1. Failures shall be adjusted, repaired, or replaced at no additional cost or reduction in service to Owner.
  2. Include updates or upgrades to software and firmware if necessary to resolve deficiencies.
    - a. Install updates only after receiving Owner's written authorization.
  3. Warranty service shall occur during normal business hours and commence **no later than 8 hours following Owner's warranty service request.**
  4. Warranty Period: **Two years from date of final system acceptance.**
    - a. Final Acceptance of system is not related to nor dependent upon Substantial Completion. Final system acceptance will be granted only after system is operating without any substantive problems for a minimum of 30 consecutive days, and all issues on Commissioning Issues Log and Engineer's punch lists have been resolved. Obtain formal written approval from Engineer and Owner contractual date of system Final Acceptance.

### B. Warranty Inspections

1. At approximately 12 months and 24 months after Final Acceptance of control system, provide a minimum 5 hour on-site inspection of system.
2. Inspection will include an evaluation of performance of the system, including an accuracy of all sensors (re-calibration or replacement is required for sensors obviously inaccurate), solicitation of operator's input of system problems and inadequacies, review of operating sequences and alarm logs to discover potential recurring problems or nuisances, discovery of any failed points, and general system reliability.
3. Provide a written report of each site visit summarizing activities and findings, and recommendations for improving system performance.
4. Failure to provide the on-site inspections at a time near that specified, or by the end of Warranty, does not relieve contractor of obligation to provide such inspections.

### 1.13 EXTRA MATERIALS

- A. Furnish quantity indicated of matching product(s) in Project inventory **for each unique size and type** of following:
1. Room Relative Humidity Sensor and Transmitter: Five.
  2. Adjustable Range Room Temperature Sensors: Five.
  3. CO2 sensor: Five.
  4. Current-Sensing Relay: Five.

### 1.14 EQUIPMENT AND SOFTWARE UPDATES / UPGRADES / REVISIONS

- A. **Equipment:** All equipment, components, parts, materials, etc. provided shall be fully compatible with all other equipment provided at any other time throughout the warranty period. Should updated versions be provided that are not fully compatible with earlier equipment provided (e.g.: a requirement to add hardware or software "interfacing" between an earlier and

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later generation results in the system not being fully compatible), Controls contractor shall replace earlier equipment with the later version at no cost to Owner.

- B. Software: **If acceptable to the Owner**, all software upgrades applicable to the system and offered by the manufacturer / contractor for this system shall be provided at no cost to the Owner throughout the warranty period. This no cost upgrade shall include installation, programming, modification to field equipment, data base revisions, etc. all as appropriate.
- C. Revisions: Hardware / software revisions made related to refining sequences of control, adding/monitoring control points, or other similar operations shall be made with all "burn-in" performed at the contractor's expense, throughout the warranty period.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Following Manufacturer's are allowed to bid on this project:
  - 1. Automated Logic Controls.
  - 2. Trane
  - 3. Johnson Controls
  - 4. Climatec

### 2.2 DDC SYSTEM DESCRIPTION

- A. Modular, microprocessor-based, high-speed, peer-to-peer network of distributed DDC controllers, operator interfaces, and software monitoring and control, including analog/digital conversion and program logic, utilizing stand-alone controllers operating over a local area network allowing peer-to-peer communication among all system controllers, and communications interface to Owner's Central Operator's Station.
- 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.

### 2.3 WEB ACCESS

- A. DDC system shall be Web based.
  - 1. DDC system software shall be based on server thin-client architecture, designed around open standards of Web technology. DDC system server shall be accessed using a Web browser over DDC system network, using Owner's LAN, and remotely over Internet.
  - 2. Intent of thin-client architecture is to provide operators complete access to DDC system via a Web browser. No special software other than a Web browser shall be required to access graphics, point displays, and trends; to configure trends, points, and controllers; and to edit programming.
  - 3. Web access shall be password protected.

### 2.4 PERFORMANCE REQUIREMENTS

- A. Network Bandwidth: Design each network of DDC system to include at least 30 percent available spare bandwidth with DDC system operating under normal and heavy load conditions

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indicated. Calculate bandwidth usage, and apply a safety factor to ensure that requirement is satisfied when subjected to testing under worst case conditions.

### B. System Response Time:

1. Graphic display refresh shall update within eight seconds.
2. AI point value shall update within 5 seconds, BI point values within 10 seconds.
3. AO and BO points shall begin to respond to controller output commands within three second(s).
4. Alarms of analog and digital points connected to DDC system shall be displayed within 15 seconds of activation or change of state.
5. Global commands shall also comply with this requirement.

### C. Future Expandability:

1. DDC system size shall be expandable to an ultimate capacity of at least four times total I/O points indicated.
2. Additional DDC controllers, I/O and associated wiring shall be all that is needed to achieve ultimate capacity. Initial network infrastructure shall be designed and installed to support ultimate capacity.
3. Operator interfaces installed initially shall not require hardware and software additions and revisions for ultimate capacity.

### D. Environmental Conditions for Controllers, Gateways, and Routers:

1. Products, instruments and actuators shall operate without performance degradation under the ambient environmental temperature, pressure, humidity, and vibration conditions specified and encountered for installed location.
  - a. If product alone cannot comply with requirement, install product in a protective enclosure that is isolated and protected from conditions impacting performance. Enclosure shall be internally insulated, electrically heated, cooled and ventilated as required by product and application.
2. Products shall be protected with enclosures satisfying the following minimum requirements unless more stringent requirements are indicated. Products not available with integral enclosures complying with requirements indicated shall be housed in protective secondary enclosures. Installed location shall dictate the following NEMA 250 enclosure requirements:
  - a. Outdoors, Protected: Type 3.
  - b. Outdoors, Unprotected: Type 4X.
  - c. Indoors, Heated with Ventilation: Type 2.
  - d. Indoors, Heated and Air Conditioned: Type 1.
  - e. Unconditioned Chiller and Boiler Rooms: Type 4X.
  - f. Conditioned Mechanical Equipment Rooms: Type 1.
  - g. Air-Moving Equipment Rooms: Type 1.
  - h. Localized Areas Exposed to Washdown: Type 4X.

### E. Electric Power Quality:

1. Protect DDC system products connected to ac power circuits from power-line surges to comply with requirements of IEEE C62.41. Do not use fuses for surge protection.



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2. Ground Fault: Protect products from ground fault by providing suitable grounding. Products shall not fail due to ground fault condition.
- F. UPS: Provide UPS power protection for Servers, and DDC controllers (except application-specific controllers), and Gateways.
- G. Continuity of Operation after Electric Power Interruption: Equipment and associated factory-installed controls, field-installed controls, electrical equipment, and power supply connected to building normal and backup power systems shall automatically return equipment and associated controls to operating state occurring immediately before loss of normal power, without need for manual intervention by operator when power is restored either through backup power source or through normal power if restored before backup power is brought online.

### 2.5 PANEL-MOUNTED, MANUAL OVERRIDE SWITCHES

- A. Manual Override of Control Dampers:
  1. Include panel-mounted, two-position, selector switch for each automatic control damper being controlled by DDC controller. Label each switch with damper designation served by switch, and switch positions to indicate either "Manual" or "Auto" control signal to damper. With switch in "Auto" position signal to control damper actuator shall be control loop output signal from DDC controller.
    - a. For Binary Control Dampers: Manual two-position switch shall have "Close" and "Open" switch positions indicated. With switch in "Close" position, damper shall close. With switch in "Open" position, damper shall open.
    - b. For Analog Control Dampers: A gradual switch shall have "Close" and "Open" switch limits indicated. Operator shall be able to rotate switch knob to adjust damper to any position from close to open.
  2. DDC controller shall monitor and report position of each manual override selector switch. With switch placed in "manual" position, DDC controller shall signal an override condition to alert operator that damper is under manual, not automatic, control.

### 2.6 SYSTEM ARCHITECTURE

- A. System architecture shall consist of no more than two levels of LANs.
  1. Level one LAN shall connect network controllers and operator workstations.
  2. Level two LAN shall connect application-specific controllers to application-specific controllers.
- B. Minimum Data Transfer and Communication Speed:
  1. LAN Connecting Operator Workstations and Network Controllers: 100 Mbps.
  2. LAN Connecting Programmable Application Controllers: 1000 kbps.
  3. LAN Connecting Application-Specific Controllers: 19,200 bps.
- C. DDC system shall consist of dedicated LANs that are not shared with other building systems and tenant data and communication networks.
- D. System architecture shall be modular and have inherent ability to expand to not less than three times system size indicated with no impact to performance indicated.

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- E. Number of LANs and associated communication shall be transparent to operator. All I/O points residing on any LAN shall be capable of global sharing between all system LANs.
- F. System design shall eliminate dependence on any single device for system alarm reporting and control execution. Each controller shall operate independently by performing its' own control, alarm management and historical data collection.
- G. Special Network Architecture Requirements:
  - 1. Air-Handling Systems: For control applications of an air-handling system that consists of air-handling unit(s) and VAV terminal units, include a dedicated LAN of application-specific controllers serving VAV terminal units connected directly to controller that is controlling air-handling system air-handling unit(s).

### 2.7 DDC SYSTEM OPERATOR INTERFACES

- A. Operator Means of System Access: Operator shall be able to access entire DDC system through any of multiple means, including, but not limited to, the following:
  - 1. Desktop and portable operator workstation with hardwired connection through LAN port.
  - 2. Portable operator terminal with hardwired connection through LAN port.
  - 3. Portable operator workstation with wireless connection through LAN router.
  - 4. PDA with wireless connection through LAN router.
  - 5. Remote connection using outside-of-system computer or PDA through Web access.
- B. Access to system, regardless of operator means used, shall be transparent to operator.
- C. Network Ports: For hardwired connection of desktop or portable operator workstation. Network port shall be easily accessible, properly protected, and clearly labeled.
- D. Desktop and Portable Workstations:
  - 1. Connect to DDC system Level one LAN through a communications port directly on LAN or through a communications port on a DDC controller.
  - 2. Able to communicate with any device located on any DDC system LAN.
  - 3. Able to communicate remotely with any device connected to any DDC system LAN.
  - 4. Connect to DDC system sub-LANs through a communications port on an application-specific controller, or a room temperature sensor connected to an application-specific controller.
  - 5. Monitor, program, schedule, adjust set points, and report capabilities of I/O connected anywhere in system.
- E. Personal Digital Assistant:
  - 1. Connect to system through a wireless router connected to LAN.
  - 2. Able to communicate with any DDC controller connected to DDC system.
- F. Critical Alarm Reporting:
  - 1. Operator-selected critical alarms shall be sent by DDC system to notify operator of critical alarms that require immediate attention. System shall send alarm notification to multiple recipients that are assigned for each alarm.

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2. Alarms must be set to observe proper time delays and other logic to avoid nuisance tripping.
3. Coordinate with Owner's representatives to set up Owner's desired alarm notification procedures and methodologies by means including e-mail, text message and pre-recorded phone message to mobile and landline phone numbers.
4. Any alarm that registers and appears in alarm history or event viewer history must have clear description of what the alarm is and the name equipment.
5. Any alarm that is created by a Bacnet signal from controlled/monitored equipment must be read and displayed in alarm history by BAS.
6. Email and text alarm notifications must be sent to designated owner's representatives for any alarm deemed critical by owner or these specifications.
7. Alarms registering must be configured to avoid nuisance and irrelevant alarms, and to avoid repetitive alarm registering with high frequency.

- G. Simultaneous Operator Use: Capable of accommodating simultaneous operators that are accessing DDC system through any one of operator interfaces indicated.

### 2.8 NETWORK COMMUNICATION PROTOCOL

- A. Network communication protocol(s) used throughout entire DDC system shall be open to public and available to other companies for use in making future modifications to DDC system.

- B. ASHRAE 135 Protocol:

1. ASHRAE 135 communication protocol shall be a required protocol used throughout entire DDC system. The Web Server shall support the BACnet Interoperable Building Blocks (BIBBS) for Read (Initiate) and Write (Execute) Services.
2. System shall not require use of gateways except to integrate HVAC equipment and other systems and equipment not required to use ASHRAE 135 communication protocol.
  - a. Review manufacturer's communications protocols for all systems with which BAS will integrate, and provide gateways as required to allow full communication, such as, for examples, Modbus Application Protocol Specification V1.1b, LonWorks technology using CEA-709.1-C.

### 2.9 DESKTOP OPERATOR WORKSTATIONS

- A. Not Applicable. Use Owner's existing.

### 2.10 PORTABLE OPERATOR WORKSTATIONS

- A. Not Applicable. Use Owner's existing.

### 2.11 PRINTERS

- A. Not Applicable. Use Owner's existing.

### 2.12 SERVERS

- A. Furnish a Web Server to allow daily operations functions, using real-time system data, to be accomplished from any network connected web browser, from within the facility or in remote locations throughout the world.

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- B. Servers shall include software license(s), and CAT-5e or CAT-6 cable installation between server(s) and network.
- C. Operators shall be able to utilize any commercially available browser such as Microsoft Internet Explorer or Netscape Navigator. No additional software shall have to be installed on the client PC for normal operation of the system.
- D. All communications between the web browser and web server shall be encrypted using 128 bit SSL encryption.
- E. Web server shall be able to be located on the Owner's Intranet or on the Internet.
- F. Web server shall have the ability to automatically obtain an IP (Internet Protocol) address using DHCP. Use of static IP addressing shall also be supported.
- G. Web server will have adequate capacity to store and serve 500 user defined graphics, and to archive not less than 12 consecutive months of historical data for all I/O points connected to system, including alarms, event histories, transaction logs, trends and other information indicated.
- H. Server(s) shall use IT industry-standard database platforms such as Microsoft SQL Server and Microsoft Data Engine (MSDE). The Web browser client shall support Sun Microsystems Java 2 (JRE 1.4.0 or higher) plug-in.
- I. Functionality:
  - 1. A minimum of 30 users shall be able to utilize the system device at the same time. Operators with proper security shall be able to:
    - a. View graphical information about a facility, change setpoints, perform overrides.
    - b. View and change schedules.
    - c. View and acknowledge alarms.
    - d. View historical information.
  - 2. Operators must enter in a valid unique user name and password to access the system.
  - 3. Operator security: The Web server shall include industry standard security protocols to prohibit access by unauthorized users over the World Wide Web. Provide firewalls between server Web and networks with password protection for access to server from Web server.
  - 4. The web server shall display the same graphics that have been created for the Operators Workstation.
  - 5. Operators with proper access shall be able to configure the web server using their web browser.
- J. Web Server Hardware.
  - 1. Provide a solid-state web server. This device may not contain any moving parts including but not limited to cooling fans, disk drives, CD Rom drives etc.
  - 2. All user entered information (web pages, security, etc.) shall be stored in non-volatile memory. System operational information and clock functions shall be backed up by battery or other device for a minimum of 72 hours.

### 2.13 SYSTEM SOFTWARE

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### A. System Software Minimum Requirements:

1. Provide all software required for efficient operation of all the automatic system functions required by this specification. Software shall be modular in design for flexibility in expansion or revision of the system. It is the intent of this specification to require provisions of a system which can be fully utilized by individuals with no, or limited, previous exposure to PC's and programming techniques and languages.
2. The software in the system shall consist of both "firmware" resident in the PCU's and "software" resident in the operator work stations. The architecture of the system, and the application software/firmware shall be distributed with no single system component responsible for a control function for the entire Controller LAN. Each PCU shall contain the necessary firmware and I/O capability to function independently in case of a network failure. No active energy management or environmental control sequences shall be resident in the PC work stations. All PC work stations shall be removable from the system without loss of control function - only alarm monitoring, long term history collection, and operator monitor/command/edit functions would be lost.
3. Software: **All software upgrades applicable to the system and offered by the manufacturer / contractor for this system shall be provided at no cost to the Owner throughout the warranty period.** This no-cost upgrade shall include installation, programming, modification to field equipment, data base revisions, etc. all as appropriate.
4. Real-time multitasking and multiuser 32- or 64-bit operating system that allows concurrent multiple operator workstations operating and concurrent execution of multiple real-time programs and custom program development.
5. Operating system shall be capable of operating DOS and Microsoft Windows applications.
6. Database management software shall manage all data on an integrated and non-redundant basis. Additions and deletions to database shall be without detriment to existing data. Include cross linkages so no data required by a program can be deleted by an operator until that data have been deleted from respective programs.
7. Network communications software shall manage and control multiple network communications to provide exchange of global information and execution of global programs.
8. Operator interface software shall include day-to-day operator transaction processing, alarm and report handling, operator privilege level and data segregation control, custom programming, and online data modification capability.
9. Scheduling software shall schedule centrally based time and event, temporary, and exception day programs.

### B. Basic Interface Description

1. Operator workstation interface software shall minimize operator training through the use of English language prompting, English language point identification and industry standard PC application software. The software shall provide, as a minimum, the following functionality:
  - a. Graphical viewing and control of environment
2. Scheduling and override of building operations
3. Collection and analysis of historical data
4. Definition and construction of dynamic color graphic displays
5. Editing, programming, storage and downloading of controller databases
6. Provide a graphical user interface which shall minimize the use of a typewriter style keyboard through the use of a mouse or similar pointing device and "point and click" approach to menu selection. Users shall be able to start and stop equipment or change setpoints from graphical displays through the use of a mouse or similar pointing device.

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- a. Provide functionality such that all operations can also be performed using the keyboard as a backup interface device.
  - b. Provide additional capability that allows at least 10 special function keys to perform often used operations.
7. The software shall provide a multi-tasking type environment that allows the user to run several applications simultaneously. The mouse shall be used to quickly select and switch between multiple applications. This shall be accomplished through the use of Microsoft Windows or similar industry standard software that supports concurrent viewing and controlling of systems operations.
  - a. Provide functionality such that any of the following may be performed simultaneously, and in any combination, via user-sized windows:
    - a. Dynamic color graphics and graphic control
    - b. Alarm management coordinated with section 2.04.E.
    - c. Time-of-day scheduling
    - d. Trend data definition and presentation
    - e. Graphic definition
    - f. Graphic construction
8. If the software is unable to display several different types of displays at the same time, the EMS contractor shall provide at least two operator workstations.
9. Multiple-level password access protection (minimum of five levels of access) shall be provided to allow the user/manager to limit workstation control, display and data base manipulation capabilities as he deems appropriate for each user, based upon an assigned password.
  - a. Level 1 = View all applications, but perform no database modifications
  - b. Level 2 = Custodial privileges plus the ability to acknowledge alarms
  - c. Level 3 = All privileges except system configuration
  - d. Level 4 = All configuration privileges except passwords
  - e. Level 5 = All privileges
10. A minimum of 50 unique passwords, including user initials, shall be supported.
11. Operators will be able to perform only those commands available for their respective passwords. Menu selections displayed shall be limited to only those items defined for the access level of the password used to log-on.
  - a. The system shall automatically generate a report of log-on/log-off time and system activity for each user.
  - b. User-definable, automatic log-off timers of from 5 to 60 minutes shall be provided to prevent operators from inadvertently leaving devices on-line.
12. Software shall allow the operator to perform commands including, but not limited to, the following:
  - a. Start-up or shutdown selected equipment
  - b. Adjust setpoints
  - c. Add/modify/delete time programming
  - d. Enable/disable process execution
  - e. Lock/unlock alarm reporting for points
  - f. Enable/disable totalization for points
  - g. Enable/disable trending for points
  - h. Override PID loop setpoints
  - i. Enter temporary override schedules

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- j. Define holiday schedules
- k. Change time/date
- l. Automatic daylight savings time adjustments
- m. Enter/modify analog alarm limits
- n. Enter/modify analog warning limits
- o. View limits
- p. Enable/disable demand limiting for each meter
- q. Enable/disable duty cycle for each load

### C. Reports and Logs:

1. Reports shall be generated and directed to either CRT displays, printers or disk. As a minimum, the system shall allow the user to easily obtain the following types of reports:
  - a. A general listing of all points in the network
  - b. List of all points currently in alarm
  - c. List of all points currently in override status
  - d. List of all disabled points
  - e. List of all points currently locked out
  - f. DDC Controller trend overflow warning
  - g. List all weekly schedules
  - h. List of holiday programming
  - i. List of limits and deadbands.
  - j. Summaries shall be provided for specific points, for a logical point group, for a user-selected group or groups or for the entire facility without restriction due to the hardware configuration of the building automation system. Under no conditions shall the operator need to specify the address of the hardware controller to obtain system information.
2. Include reporting software package that allows operator to select, modify, or create reports using DDC system I/O point data available.
3. Each report shall be definable as to data content, format, interval and date.
4. Report data shall be sampled and stored on DDC controller, within storage limits of DDC controller, and then uploaded to archive on server for historical reporting.
5. Operator shall be able to obtain real-time logs of all I/O points by type or status, such as alarm, point lockout, or normal.
6. Reports and logs shall be stored on [workstation] [and] [server] hard drives in a format that is readily accessible by other standard software applications, including spreadsheets and word processing.
7. Reports and logs shall be readily printed and set to be printed either on operator command or at a specific time each day.

### D. Standard Reports: Standard DDC system reports shall be provided and operator shall be able to customize reports later.

1. All I/O: With current status and values.
2. Alarm: All current alarms, except those in alarm lockout.
3. Disabled I/O: All I/O points that are disabled.
4. Alarm Lockout I/O: All I/O points in alarm lockout, whether manual or automatic.
5. Alarm Lockout I/O in Alarm: All I/O in alarm lockout that are currently in alarm.
6. Alarm history.

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- E. Custom Reports: Operator shall be able to easily define any system data into a daily, weekly, monthly, or annual report.
- F. Scheduling:
  - 1. Monthly calendars for a 24-month period shall be provided which allow for simplified scheduling of holidays and special days in advance.
  - 2. Weekly schedules shall be provided for each building zone or piece of equipment with a specific occupancy schedule.
  - 3. Zone schedules shall be provided for each building zone. Each commandable point may have a unique schedule of operation relative to the zone's occupancy schedule, allowing for sequential starting and control of equipment within the zone.
  - 4. Holidays and special days shall be user-selected with the pointing device and shall automatically reschedule equipment operation.
  - 5. Collection and Analysis of Historical Data
    - a. Provide trending capabilities that allow the user to easily monitor and preserve records of system activity over an extended period of time. Any system point may be trended automatically at time-based intervals or changes of value, both of which shall be user definable. Trend data may be stored on hard disk for future diagnostics and reporting.
    - b. Trend data report graphics shall be provided to allow the user to view all trended point data. Reports may be customized to include individual points or pre-defined groups of at least 6 points. Provide additional functionality to allow any trended data to be transferred easily to an off-the-shelf spreadsheet package such as Lotus 1-2-3a. This shall allow the user to perform custom calculations such as energy usage, equipment efficiency and energy costs and shall allow for generation of these reports on high-quality plots, graphs and charts.

### 2.14 GRAPHICS

- A. Provide Central Operator's Station with software and hardware as needed to meet requirements specified herein. Graphics are to be online programmable and under password control.
- B. System shall be provided with complete color graphics software package, such that graphics can be created by user from time of software installation, without need for additional hardware or software. Each operator work station shall support not less than 1,000 separate graphic pages. Contractor shall include developed graphics as approved by the Owner's representative for this project.
- C. Graphics program shall be fully user interactive, full color, incorporating the following capabilities:
  - 1. Up to 50 dynamic points of data per graphic page
  - 2. Animated objects for discrete points to illustrate point status
  - 3. On-line 'draw' utility
  - 4. Ability to import .PCX or .DXF file format graphics developed in third party programs
  - 5. "Page Linking" such that it is possible to "zoom" into a specific AHU or any other page through a sequence of graphics without using anything but the system mouse.
  - 6. Generate, store, and retrieve library symbols for use in generating graphic pages.
  - 7. Fifty (50) dynamic points of data per graphic page.
  - 8. Pixel level resolution. Graphics will be displayed on EGA monitors with a 640 X 350 resolution, and on VGA monitors with a 640 X 480 resolution, minimum. Color



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selections will be made from a color bar consisting of 16 colors, with adjacent text description.

9. Animated objects for discrete points (i.e., when a pump starts, the pipe fills with water or when a damper shuts it goes closed on the screen).
  10. Analog bar graphs for analog points. The operator shall be able to locate up to 60 bar graphs per graphic page, with options as to bar graph color, dimensions, horizontal/vertical orientation, and limit values.
- D. Provide for import of .PCX file format graphics developed in third party programs such as Paintbrush. Such imported graphics shall be used as a "backdrop", so that all other dynamic and animated system features may be superimposed on this graphic. Similarly, it shall be possible to import CAD type drawings, by first converting the CAD drawing from .DXF format to .PCX format.
- E. The EMS contractor shall provide libraries of pre-engineered screens and symbols depicting standard air handling unit components (e.g., fans, cooling coils, filters, dampers, etc.), complete mechanical systems (e.g., constant volume-terminal reheat, VAV, etc.) and electrical symbols, so that Owner may develop graphics.
- F. The graphic development package shall use a mouse or similar pointing device in conjunction with a drawing program to allow the user to perform the following:
1. Define symbols
  2. Position and size symbols
  3. Define background screens
  4. Define connecting lines and curves
  5. Locate, orient and size descriptive text
  6. Define and display colors for all elements
  7. Establish correlation between symbols or text and associated system points or other displays
- G. System shall allow graphical displays to be created to represent any logical grouping of system points or calculated data based upon building function, mechanical system, building layout or any other logical grouping of points which aids the operator in the analysis of the facility. To accomplish this, the user shall be able to build graphic displays that include point data from multiple DCU Controllers including Terminal Equipment Controllers used or DDC equipment.
- H. System Configuration and Definition
1. All temperature and equipment control strategies and energy management routines shall be definable by the operator. System definition and modification procedures shall not interfere with normal system operation and control.
  2. The system shall be provided complete with all equipment and documentation necessary to allow an operator to independently perform the following functions:
    - a. Add/delete/modify stand-alone DDC Controller panels
    - b. Add/delete/modify operator workstations
    - c. Add/delete/modify application specific controllers
    - d. Add/delete/modify points of any type and all associated point parameters and tuning constants
    - e. Add/delete/modify alarm reporting definition for points
    - f. Add/delete/modify control loops
    - g. Add/delete/modify energy management applications

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- h. Add/delete/modify time and calendar-based programming
  - i. Add/delete/modify totalization for points
  - j. Add/delete/modify historical data trending for points
  - k. Add/delete/modify custom control processes
  - l. Add/delete/modify any and all graphic displays, symbols and cross-reference to point data
  - m. Add/delete/modify dial-up telecommunication definition
  - n. Add/delete/modify all operator passwords. Add/delete/modify alarm messages
3. Definition of operator device characteristics, DCU Controllers individual points, applications and control sequences shall be performed using instructive prompting software. a. Libraries of standard application modules such as temperature, humidity and static pressure control may be used as "building blocks" in defining or creating new control sequences. In addition, the user shall have the capability to easily create and archive new modules and control sequences as desired via a word processing type format. Provide a library of standard forms to facilitate definition of point characteristics. Forms shall be self prompting and incorporate a fill-in-the-blank approach for definition of all parameters. The system shall immediately detect an improper entry and automatically display an error message explaining the nature of the mistake.
4. Inputs and outputs for any process shall not be restricted to a single DCU Controller, but shall be able to include data from any and all other network panels to allow the development of network-wide control strategies. Processes shall also allow the operator to use the results of one process as the input to any number of other processes (cascading).
5. Provide the capability to backup and store all system databases on the workstation hard disk. In addition, all database changes shall be performed while the workstation is on-line without disrupting other system operations. Changes shall be automatically recorded and downloaded to the appropriate DCU Controller. Similarly, changes made at the DCU Controllers shall be automatically uploaded to the workstation, ensuring system continuity. The user shall also have the option to selectively download changes as desired.
6. Provide context-sensitive help menus to provide instructions appropriate with operations and applications currently being performed.
- I. Alarm Handling Software:
- 1. Include alarm handling software to report all alarm conditions monitored and transmitted through DDC controllers, gateways, and other network devices.
  - 2. Alarm handling shall be active at all times to ensure that alarms are processed even if an operator is not currently signed on to DDC system.
  - 3. Alarms display shall include the following:
    - a. Indication of alarm condition such as "Abnormal Off," "Hi Alarm," and "Low Alarm."
    - b. "Analog Value" or "Status" group and point identification with native language point descriptor such as "Space Temperature, Building 110, 2nd Floor, Room 212."
    - c. Discrete per point alarm action message, such as "Call Maintenance Dept. Ext-5561."
    - d. Include extended message capability to allow assignment and printing of extended action messages. Capability shall be operator programmable and assignable on a per point basis.

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4. Alarms shall be directed to appropriate operator workstations, printers, and individual operators by privilege level and segregation assignments.
5. Send e-mail, page, text and voice messages to designated operators for critical alarms.
6. Alarms shall be categorized and processed by class.
  - a. Class 1:
    - 1) Associated with fire, security and other extremely critical equipment monitoring functions; have alarm, trouble, return to normal, and acknowledge conditions printed and displayed.
    - 2) Unacknowledged alarms to be placed in unacknowledged alarm buffer.
    - 3) All conditions shall cause an audible sound and shall require individual acknowledgment to silence audible sound.
  - b. Class 2:
    - 1) Critical, but not life-safety related, and processed same as Class 1 alarms, except do not require individual acknowledgment.
    - 2) Acknowledgement may be through a multiple alarm acknowledgment.
  - c. Class 3:
    - 1) General alarms; printed, displayed and placed in unacknowledged alarm buffer queues.
    - 2) Each new alarm received shall cause an audible sound. Audible sound shall be silenced by "acknowledging" alarm or by pressing a "silence" key.
    - 3) Acknowledgement of queued alarms shall be either on an individual basis or through a multiple alarm acknowledgement.
    - 4) Alarms returning to normal condition shall be printed and not cause an audible sound or require acknowledgment.
  - d. Class 4:
    - 1) Routine maintenance or other types of warning alarms.
    - 2) Alarms to be printed only, with no display, no audible sound and no acknowledgment required.
7. Include an unacknowledged alarm indicator on display to alert operator that there are unacknowledged alarms in system. Operator shall be able to acknowledge alarms on an individual basis or through a multiple alarm acknowledge key, depending on alarm class.
8. To ensure that no alarm records are lost, it shall be possible to assign a backup printer to accept alarms in case of failure of primary printer.

### J. Trends:

1. Trend all I/O point present values, set points, and other parameters indicated for trending.
2. Trends shall be associated into groups, and a trend report shall be set up for each group.
3. Trends shall be stored within DDC controller and uploaded to hard drives automatically on reaching 75% of DDC controller buffer limit, or by operator request, or by archiving time schedule.
4. Trend intervals shall be operator selectable from 10 seconds up to 60 minutes. Set trend intervals for each I/O point after review with Owner and CxA.
5. When drive storage memory is full, most recent data shall overwrite oldest data.

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6. Archived and real-time trend data shall be available for viewing numerically and graphically by operators.

### 2.15 GRAPHICS PAGES LAYOUT AND QUALITY

- A. All proposed graphics pages are to be submitted to engineer for approval prior to uploading to system.
  1. After uploading graphics pages to system, cooperate with Engineer and Owner to fine tune graphics pages with respect to layout, formatting, points displayed, etc.
- B. Schematic representation of all equipment and system graphics must be accurate and representative of the actual installed field conditions, such as respective locations of indicated devices, air flow patterns, etc. Changes in the field installation, variances in equipment installed versus equipment specified, etc., will require controls subcontractor to revise graphics.
- C. Control and monitored points for any system may be presented solely in tabular form, without graphic representation, only with prior approval of Engineer. Otherwise, a graphical page showing system schematic must be provided for each system.
- D. Where Modbus or Bacnet interface with equipment controllers is provided, all readable / writeable points available must be accessible via BAS. Of these total number of points, a limited, select number of critical points must be displayed on a dedicated graphics page, accessible by clicking on the schematic of the equipment/system with which associated.
  1. Provide Engineer with latest updated list of Bacnet or Modbus points, names and addresses from equipment manufacturer.
    - a. Where selected Bacnet points to display are not designated in drawings or these specifications, budget for displaying up to 24 such points to be selected by Engineer and/or Owner from the latest updated list of Bacnet or Modbus points for equipment being monitored.
  2. Equipment manufacturer's point names are often unclear or ambiguous as to what they actually reference. Contractor will modify any point text descriptor per Engineer and/or Owner direction so than the meaning is absolutely clear.
- E. Building floor plans
  1. Building floor plans are to indicate clearly separate HVAC zones. Distinction between HVAC zones may be illustrated by a variety of means acceptable to Engineer, including darker lines surrounding the zone, color variations, superimposed duct layouts, etc. A clear indication of the extent of floor plan served by each unit must be given. Depending upon temperature-dependent color-coding
  2. Engineer endeavors to provide current floor layouts in contract drawings. However, Owner may modify buildings by adding doors or walls, etc. If necessary due to changes in building floor plans, revise graphics to show accurate wall and door locations.
  3. All building floor plans must indicate final room numbers (exceptions to include only very small rooms which have no thermostat, such as janitor's closets, etc.). Prior to producing floor plan graphics, confirm in writing from Owner and/or Architect what final room numbers are. Graphics display for special purpose rooms, such as Gyms, Cafeterias, Band Halls, etc., must show this generic name of room in addition to room number (if it is indicated on drawings).

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4. Locations of all major equipment (VAV boxes, air handlers, exhaust fans, chillers, boilers, pumps, etc.) are to be indicated on floor plans, along with a clear indication of the area each serves.
5. Floor plan graphic of each zone is to be color-coded, displaying different colors to show space conditions are within or out of specified temperature range.
6. All temperature, relative humidity, and CO<sub>2</sub> sensors locations are to be indicated on floor plans in actual position where installed. A clear indication of which unit(s) is controlled by that sensor must be given (such as by a dashed or curved line connecting the two).
7. *Actual readings of temperature, relative humidity, and CO<sub>2</sub> sensors are to be indicated on floor plans.*

### F. Graphics text

1. All text displayed on graphic must be large enough to be clearly and easily readable. Font colors must be chosen for good contrast against background so that they are clearly and easily readable. Super-position of separate text lines overlapping one another or overlapping other iconography is not acceptable.
2. Text wording for labeled points must be clear and easily understood to any person with moderate experience with HVAC systems.
3. Not all text must have identical font and style on each individual graphic page. Use of varying size and style is required and helpful in identifying and distinguishing important values. However, use consistent font size and style for displaying parameters of similar nature or importance.
4. Text for all parameters must be so positioned on graphics screens that it is unquestionably obvious to what symbols, equipment, or values it applies. This is typically done by placing the text very close to the item to which it applies. Where graphics prevent this (e.g. where it would be too crowded and therefore unclear), use arrows or lines connecting value to the item.
5. Equipment indicated in graphics must be identified with the precise name as indicated in drawings in order to facilitate cross-referencing between graphics and drawings. Where equipment name has changed or Owner desires it be changed, make such modification on final graphics pages.
6. Symbols for devices such as smoke detectors, cut-out safety switches, filter dP sensors, heating or cooling coils, etc., must be labeled so that it is unambiguously clear what the symbol represents.
7. Spelling on graphics pages must be correct.

### G. Specified Points

1. *At a minimum*, every input and output listed as a point in bid documents must be displayed graphically.

### H. Units

1. Units for all parameters are to be listed on graphics screens or other screens. Use the following nomenclature, or other only as approved by Engineer.
  - a. Commanded state: On/Off or Off/Enable, as appropriate
  - b. Variable speed motor (e.g. fan or pump) commanded speed: % of full speed
    - 1) It is unacceptable to display BAS output signal to VFD when such signal does not correspond to the actual VFD/fan speed. Coordinate closely with

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VFD programming such that speed indication on BAS screen exactly matches actual VFD speed.

- c. Variable speed motor (e.g. fan or pump) speed feedback: % of full speed feedback
  - d. Duct static pressure and duct static pressure setpoint: in. WC, or "wc, following by 'setpoint' when value displayed is the setpoint
  - e. Temperature: °F, or deg F, or simply 'F'
    - 1) Outside air temperature: OAT
    - 2) Discharge or supply air temperature: use either DAT or SAT
    - 3) Return air temperature: RAT
  - f. Relative humidity: % RH
  - g. Valve or damper analog output commanded position: % open
    - 1) For cooling tower bypass valves, add descriptive text such as “% open to bypass”)
  - h. Valve or damper analog output feedback position: % open / position feedback
  - i. CO2 reading and CO2 setpoint: ppm
  - j. Hydronic system pressure: psi
  - k. Hydronic system differential pressure: psi dP, or psi ΔP
  - l. Chiller cooling load: Tons
  - m. Refrigerant system pressure: psi
  - n. Alarm state of any point: Alarm / Normal
  - o. Air flow: CFM
  - p. Water flow: GPM
  - q. Light level: fc (footcandles)
  - r. Filter status: Dirty / Clean for digital, in. WC, or "wc for analog
  - s. Power and energy: kWh, kW, KVA.
- 2. For any additional parameters not specifically listed above, use similarly descriptive, standardly accepted units designations, approved by Engineer.
  - 3. Consistent nomenclature for points must be used throughout all graphics pages.
  - 4. Graphics text MUST distinguish between On/Off and Off/Enable digital output points. Typical Off/Enable items include chillers, boilers, DX units, etc. Typical On/Off items include fan motors, pumps, etc. Do not indicate a status or command value of “ON” for equipment that is actually controlled as Off/Enable.
  - 5. **Numerical values for all units are to be displayed to decimal point values truncated to a level commensurate with the accuracy of the sensor.** Unless otherwise noted, display values to the following decimal accuracy:
    - a. List to 0 decimal points accuracy: Variable speed drive speed, relative humidity, % valve and damper position, CO2 concentration, water flow, air flow, gallons, kWh, KVA, kW, amps.
    - b. List to 1 decimal point accuracy: Temperature sensor inputs, temperature setpoints, duct static pressure, and voltage.
    - c. List to 2 decimal point accuracy: Building static pressure.
- I. Reset schedules
- 1. ALL reset schedules specified in operating sequences must be clearly indicated on the screen of the equipment to which it applies. (For example, a chilled water supply

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temperature reset schedule versus outside air temperature must be listed on the chiller graphic page.) All values in this reset schedule are to be operator adjustable by clicking on the value within the reset schedule.

- J. Forced parameters
  - 1. Provide a clear indication on graphic screen when automatic control or readout of *any* point (command or status, input or output, analog or digital) has been overridden (usually referred to as being placed in Operator or Forced or Manual mode). This may be done in a variety of ways acceptable to engineer (such as placing a large, bold M next to the point, having the point value flash red, placing a dashed rectangle around it, etc.)
  - 2. The indication of a point being in Forced mode must be placed on the main graphic screen of the equipment such that Operator is not required to access other backup screens to see which points are Forced.
- K. Provide navigation icons or “linkages” for major systems pages or major equipment items to allow the operator to switch quickly from one major system or building area screen to another.
- L. Indication of equipment Status
  - 1. Graphics must make clear with no ambiguity the meaning of the term “Status” (often as applied to equipment such as boilers and chillers, the meaning is not intuitively clear).
    - a. When Status indicates presence or absence of an alarm, it must be labeled “Alarm Status”.
    - b. When Status indicates an actual on/off or operating state of equipment, specifically indicate what status is being provided. For example, if the Status point reads whether the burner is firing or not, it must be labeled “Burner Status”; if the Status point reads whether a chiller compressor is On or not, it must be labeled “Compressor Status”; if the Status point simply indicates whether a piece of equipment has received an Enable command or not, it must be labeled “Status: Equipment Enabled”.

### 2.16 DDC CONTROLLERS

- A. DDC system shall consist of a combination of network controllers, programmable application controllers and application-specific controllers to satisfy performance requirements indicated.
- B. DDC controllers shall perform monitoring, control, energy optimization and other requirements indicated.
- C. DDC controllers shall use a multitasking, multiuser, real-time digital control microprocessor with a distributed network database and intelligence.
- D. Each DDC controller shall be capable of full and complete operation as a completely independent unit and as a part of a DDC system wide distributed network. The digital system controllers shall perform full control automation functions regardless of the condition of communications with the Central Operator's Station.
- E. Environment Requirements:
  - 1. Controller hardware shall be suitable for the anticipated ambient conditions.

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2. Controllers located in conditioned space shall be rated for operation at 32 to 120 deg F.
3. Controllers located outdoors shall be rated for operation at 32 to 150 deg F.

F. Power and Noise Immunity:

1. Controller shall operate at 90 to 110 percent of nominal voltage rating and shall perform an orderly shutdown below 80 percent of nominal voltage.
2. Operation shall be protected against electrical noise of 5 to 120 Hz and from keyed radios with up to 5 W of power located within 36 inches (900 mm) of enclosure.

G. DDC Controller Spare Processing Capacity:

1. Include spare processing memory for each controller. RAM, PROM, or EEPROM will implement requirements indicated with the following spare memory:
  - a. Network Controllers: 50 percent.
  - b. Programmable Application Controllers: Not less than 50 percent.
  - c. Application-Specific Controllers: Not less than 50 percent.
2. Memory shall support DDC controller's operating system and database and shall include the following:
  - a. Monitoring and control.
  - b. Energy management, operation and optimization applications.
  - c. Alarm management.
  - d. Historical trend data of all connected I/O points.
  - e. Maintenance applications.
  - f. Operator interfaces.
  - g. Monitoring of manual overrides.

H. DDC Controller Spare I/O Point Capacity: Include spare I/O point capacity for each controller as follows:

1. Network Controllers:
  - a. 20 percent of each AI, AO, BI, and BO points connected to controller.
  - b. Minimum Spare I/O Points per Controller:
    - 1) AIs: Two.
    - 2) AOs: Two.
    - 3) BIs: Two.
    - 4) BOs: Two.
2. Programmable Application Controllers:
  - a. Minimum Spare I/O Points per Controller:
    - 1) AIs: Two.
    - 2) AOs: Two.
    - 3) BIs: Two.
    - 4) BOs: Two.
3. Application-Specific Controllers:



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### a. Minimum Spare I/O Points per Controller:

- 1) AIs: Two.
- 2) AOs: Two.
- 3) BIs: Two.
- 4) BOs: Two.

## 2.17 NETWORK CONTROLLERS

### A. General Network Controller Requirements:

1. Include adequate number of controllers to achieve performance indicated.
2. System shall consist of one or more independent, standalone, microprocessor-based network controllers to manage global strategies indicated.
3. Controller shall have enough memory to support its operating system, database, and programming requirements.
4. Data shall be shared between networked controllers and other network devices.
5. Operating system of controller shall manage input and output communication signals to allow distributed controllers to share real and virtual object information and allow for central monitoring and alarms.
6. Controllers shall have a real-time clock.
7. Controller shall continually check status of its processor and memory circuits. If an abnormal operation is detected, controller shall assume a predetermined failure mode and generate an alarm notification.
8. Controllers shall be fully programmable.

### B. Serviceability:

1. Controller shall be equipped with diagnostic LEDs or other form of local visual indication of power, communication, and processor.
2. Wiring and cable connections shall be made to field-removable, modular terminal strips or to a termination card connected by a ribbon cable.
3. Controller shall maintain BIOS and programming information in event of a power loss for at least 72 hours.

## 2.18 PROGRAMMABLE APPLICATION CONTROLLERS

### A. General Programmable Application Controller Requirements:

1. Include adequate number of controllers to achieve performance indicated.
2. Software applications shall reside and operate in controllers. Editing of applications shall occur at operator workstations. Controllers shall be configured to use stored default values to ensure fail-safe operation.
3. Controller shall have enough memory to support its operating system, database, and programming requirements.
4. Data shall be shared between networked controllers and other network devices.
5. Operating system of controller shall manage input and output communication signals to allow distributed controllers to share real and virtual object information and allow for central monitoring and alarms.
6. Controllers that perform scheduling shall have a real-time clock.
7. Controller shall continually check status of its processor and memory circuits. If an abnormal operation is detected, controller shall assume a predetermined failure mode and generate an alarm notification.

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8. Controllers shall be fully programmable.
9. Controller shall be equipped with diagnostic LEDs or other form of local visual indication of power, communication, and processor.
10. Controller shall maintain BIOS and programming information in event of a power loss for at least 72 hours.

### 2.19 APPLICATION-SPECIFIC CONTROLLERS

- A. Description: Microprocessor-based controllers, which through hardware or firmware design are dedicated to control a specific piece of equipment. Controllers are not fully user-programmable but are configurable and customizable for operation of equipment they are designed to control.
  1. Capable of standalone operation and shall continue to include control functions without being connected to network.
  2. Data shall be shared between networked controllers and other network devices.
- B. Communication: Application-specific controllers shall communicate with other application-specific controller and devices on network, and to programmable application and network controllers.

### 2.20 SENSORS & FIELD DEVICES

- A. All sensors and field devices shall be of commercial grade quality and shall be installed according to the manufacturer's recommendations. Outdoor damper actuators shall be rated for exterior service and provided in weatherproof UV-inhibited housing.
- B. Temperature Sensors (General)
  1. All temperature inputs for the automation system shall be derived directly from analog inputs from electronic temperature sensors. Transducing of pneumatic sensor signals shall not be acceptable.
  2. Temperature sensing elements shall be RTD type, thermistor type, or solid state sensors, as specified in drawings or points list. All sensors of a particular type shall be from the same manufacturer.
  3. Characteristics for temperature sensors:
    - a. Interchangeability of +/- 0.2% at the reference temperature.
    - b. Time constant response to temperature change shall be less than three seconds per degree F.
    - c. Sensors shall be linear, drift free, and require only a one time calibration. Sensing elements shall be factory calibrated.
    - d. The sensing elements shall be hermetically sealed.
    - e. Additional linearizing, ranging, and lead length compensation may be accomplished in software if required to meet the accuracies specified within.
  4. Expected temperature sensor operating range and end to end accuracy, including errors associated with sensor, transmitter (if applicable), leadwire and A/D conversion shall be as follows:

<u>Sensed Element</u>	<u>Expected Oper. Range</u>	<u>Sensor Accuracy</u>
a. Return air	40 to 100°F	0.5°F
b. Indoor space temperature	40 to 100°F	0.5°F
c. Outside air	0 to 125°F	0.5°F

- C. Adjustable Limited Range Wall Temperature Sensors (Thermostats)

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1. **General: All wall sensors installed as part of this project shall have adjustable limited range setpoint adjustment function.**
    - a. 10K-2-R-SOD (10K, DA, Cool / Warm, OVR). Override option shall be provided.
    - b. Setpoint limits shall be adjustable via the COS and password protected.
    - c. Unit shall have a built in processor and shall communicate with local controller.
    - d. Unit shall have an LCD display for space temperature and on / off state
    - e. Unit shall have a password protection function to restrict access to service mode.
    - f. Provide extra thermostats: 5 of each type.
  2. **Following areas shall have sensors with override option in addition to adjustable setpoint range function: all sensors in Administration, Gym, Hallways.**
- D. Humidity Sensors: Bulk polymer sensor element.
1. Bulk polymer sensor element. Install humidity sensors in the space and not in ductwork unless specifically noted. Coordinate locations of duct mounted sensors with Engineer.
    - a. Accuracy: 5 percent full range with linear output.
    - b. Room Sensors: With locking cover matching room thermostats, span of 25 to 90 percent relative humidity.
    - c. Duct and Outside-Air Sensors: With element guard and mounting plate.
- E. Carbon Dioxide (CO2) sensors:
1. CO2 sensor shall monitor indoor carbon dioxide (CO2) levels in accordance with ASHRAE standard 62-2004. Complete kit shall include optional aspiration box for mounting sensor inside return air duct.
  2. Sensor shall have a 4 - 20 mA linear output over a range of 0 - 5000 ppm of CO2. A SPDT shall be provided for local control or alarm output.
  3. **Provide sensor with LCD readout.**
  4. Power: 24VAC or DC at 400mA max.
  5. Measuring range: 0-2000 ppm
  6. Accuracy: 40 ppm + 2% of reading
  7. Analog output: 4-20 mA
  8. Control relay: N.O. SPST, 0.75 amp at 24VAC/VDC
  9. Operating temperature: 32° - 122°F
  10. Operating humidity: 5-95% non-condensing
  11. Calibration adjustment: zero to span
  12. Min. req. calibration: One year
  13. Unit enclosure: UL fire rated
  14. Aspiration box: High impact styrene
- F. Equipment operation sensors as follows:
1. Status Inputs for Electric Motors: Current-sensing relay with current transformers, adjustable and set to 175 percent of rated motor current.
  2. Electronic Valve/Damper Position Indication: Visual scale indicating percent of travel and 2- to 10-V dc, feedback signal.
- G. Equipment on/off control shall use either momentary pulsed relays or magnetically latched relays, as appropriate for the equipment's control starter. Interfacing controls shall be configured such that in its last commanded state. All equipment safeties and interlocks shall remain active, and will not be bypassed by new EMS controls. For motors with VFDs provide On/Off Control as appropriate VFD terminals.
- H. Motor On/Off Status: Unless otherwise specified, status shall be proven using current sensing relays connected at VFDs and calibrated for minimal operating speed.

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- I. Pressure Sensors: Pressure sensors and differential pressure sensors shall be piezo-resistive strain-gauge with temperature compensation. Sensors shall be selected to provide linear indication with an adequate span for the application. Sensor shall be 0 - 10 V or 4 - 20 mA. Insure sensors are rated to operate at temperature of sensed media. Sensors shall have an accuracy of 1% of full scale. Sensors shall accept overpressures of at least 120 psig, at any port, without damaging the sensor.
- J. Watthour Transducers: Shall have an accuracy of +/- 2.5% at 0.5 power factor to 2.0% at 1 power factor for KW and KWH outputs. Output signals for KW and KWH shall be internally selectable without requiring the changing of current or potential transformers. Current and potential transformers shall be in accordance with ANSI C57.13.
- K. Voltage Outputs: Variable voltage outputs shall provide a voltage signal from 0 to 20 volts. All voltage outputs shall be fuse protected against shorts to 120 volts AC and capable of withstanding a short ground indefinitely. All voltage outputs shall be protected against + or - 1500 volts, 50 microseconds transients. Voltage outputs shall have a resolution of 0.1 volts.
- L. Current Outputs: Variable current outputs shall be a sinking type and shall provide 0 to 20 milliamps with a resolution of 0.1 mA and a compliance of 20 volts minimum. All current outputs shall be fuse protected to 120 volts AC and protected against + or - 1500 volts, 50 microsecond transients.
- M. Pressure Sensors: Pressure sensors and differential pressure sensors shall be piezo-resistive strain-gauge with temperature compensation. Sensors shall be selected to provide linear indication with an adequate span for the application. Sensor shall be 0 - 10 V or 4 - 20 mA. Insure sensors are rated to operate at temperature of sensed media. Sensors shall have an accuracy of 1% of full scale. Sensors shall accept overpressures of at least 120 psig, at any port, without damaging the sensor.
- N. Motor On/Off Status: Unless otherwise specified, status shall be proven using current sensing relays connected at VFDs and calibrated for minimal operating speed.
- O. Hardware Overrides: A three position manual override switch shall allow selection of the ON, OFF, or AUTO outputs state for each output point. In addition, all analog output points shall be equipped with an override potentiometer to allow manual adjustment of the analog output signal over its full range, when the 3 position manual override switch is placed in the ON position.
- P. Damper Actuators
  1. Electronic direct-coupled actuation shall be provided.
  2. The actuator shall be direct-coupled over the shaft, enabling it to be mounted directly to the damper shaft without the need for connecting linkage. The fastening clamp assemble shall be of a 'V' bolt design with associated 'V' shaped toothed cradle attaching to the shaft for maximum strength and eliminating slippage. Spring return actuators shall have a 'V' clamp assembly of sufficient size to be directly mounted to an integral jackshaft of up to 1.05 inches when the damper is constructed in this manner. Single bolt or screw type fasteners are not acceptable.
  3. The actuator shall have electronic overload or digital rotation sensing circuitry to prevent damage to the actuator throughout the entire rotation of the actuator. Mechanical end switches or magnetic clutch to deactivate the actuator at the end of rotation are not acceptable.
  4. For power failure/safety applications, an internal mechanical spring return mechanism shall be built into the actuator housing. Non-mechanical forms of fail-safe operation are not acceptable.

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5. All spring return actuators shall be capable of both clockwise or counterclockwise spring return operation by simply changing the mounting orientation.
6. Proportional actuators shall accept a 0 to 10VDC or 0 to 20mA control input and provide a 2 to 10VDC or 4 to 20mA operating range. An actuator capable of accepting a pulse width modulating control signal and providing full proportional operation of the damper is acceptable. All actuators shall provide a 2 to 10VDC position feedback signal.
7. All 24VAC/DC actuators shall operate on Class 2 wiring and shall not require more than 10VA for AC or more than 8 watts for DC applications. Actuators operating on 120VAC power shall not require more than 10VA. Actuators operating on 230VAC shall not require more than 11VA.
8. All non-spring return actuators shall have an external manual gear release to allow manual positioning of the damper when the actuator is not powered. Spring return actuators with more than 60 in-lb torque shall have a manual crank for this purpose.
9. All modulating actuators shall have an external, built-in switch to allow reversing direction of rotation.
10. Actuators shall be provided with a conduit fitting and a minimum 3ft electrical cable and shall be pre wired to eliminate the necessity of opening the actuator housing to make electrical connections.
11. Actuators shall be Underwriters Laboratories Standard 873 listed and Canadian Standards Association Class 4813 02 certified as meeting correct safety requirements and recognized industry standards.
12. Actuators shall be designed for a minimum of 60,000 full stroke cycles at the actuator's rated torque and shall have a 2-year manufacturer's warranty, starting from the date of installation. Manufacturer shall be ISO9001 certified.

### Q. Control Valves

1. Control Valves: Factory fabricated, of type, body material, and pressure class based on maximum pressure and temperature rating of piping system, unless otherwise indicated.
2. Globe or Characterized Ball Valves NPS 2 and Smaller: Bronze body, bronze trim, rising stem, renewable composition disc, and screwed ends with backseating capacity repackable under pressure.
3. Globe or Characterized Ball Valves NPS 2-1/2 and Larger: Iron body, bronze trim, rising stem, plug-type disc, flanged ends, and renewable seat and disc.
4. Hydronic system globe valves shall have the following characteristics:
  - a. Rating: Class 125 for service at 125 psig and 250 deg F operating conditions.
  - b. Internal Construction: Replaceable plugs and seats of stainless steel or brass.
  - c. Select one or both valve seating arrangements below.
  - d. Single-Seated Valves: Cage trim provides seating and guiding surfaces for plug on top and bottom of guided plugs.
  - e. Maximum pressure drops of up to 5 psig (35 kPa) are usually acceptable.
  - f. Sizing: See Schedule.
  - g. Flow Characteristics: three-way valves shall have linear characteristics. Operators shall close valves against pump shutoff head.
  - h. Butterfly Valves: 175-psi CWP, ASTM A 126 cast-iron body and bonnet, extended neck, stainless-steel stem, field-replaceable Buna N sleeve and stem seals, lug style, rated for end-of-service applications
  - i. Select one of the following subparagraphs.
  - j. Disc Type: ductile iron.

### R. Valve Actuators

1. Electric Motors: Size to operate with sufficient reserve power to provide smooth modulating action or two-position action.

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2. Small Valve Actuators: Equivalent to Johnson VA-715, except for exterior valves which must be weatherproof.
  3. Electronic **Large-Valve** Actuators: Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque.
    - a. Valves: Size for torque required for valve close-off at maximum pump differential pressure.
    - b. Overload Protection: Electronic overload or digital rotation-sensing circuitry.
    - c. Position indicator: Provide a visual position indicator for field inspection.
    - d. Temperature Rating: Minus 22 to plus 122 deg F.
    - e. Run Time: **30 seconds**.
  4. Electronic two-position **Large-Valve** Actuators: Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque.
    - a. Valves: Size for torque required for valve close-off at maximum pump differential pressure.
    - b. Manual Operator: Provide with a handwheel operator connected to the valve shaft through a gear drive. The gear drive shall be independent of the motor drive.
    - c. Local Control Switch: provide with switch on actuator for “local/remote” control.
    - d. Overload Protection: Electronic overload or digital rotation-sensing circuitry.
    - e. Position indicator: Provide 100% open and 100% closed limit switches for position indication to DDC system and a visual position indicator for field inspection.
    - f. Temperature Rating: Minus 22 to plus 122 deg F.
    - g. Run Time: 30 seconds
    - h. Enclosure: weather-proof, non-ferrous.
- S. Water Meter: Provide water meter for building chilled water flow, Onicon F-1000 Series Insertion. Install water flow meter in accordance with manufacturer’s recommendations related to straight pipe lengths upstream and downstream of the meter. Coordinate with Controls contractor for meter installation requirements.
- T. Field Testing and Programming Equipment: A portable laptop or notebook computer shall interface via standard push-in connection at an asynchronous serial port located at the Control modules and at selected enhanced zone temperature sensors as indicated on project plans. This portable unit shall be capable of full global communications with all Control modules connected within the respective network and shall provide functionally identical user interface to the Workstation, in non-graphic format. Units shall be able to interrogate all points and alter all programming.

### 2.21 ENCLOSURES

- A. General Enclosure Requirements:
1. House each controller and associated control accessories in an enclosure. Enclosure shall serve as central tie-in point for control devices such as switches, transmitters, transducers, power supplies and transformers. Do not house more than one controller in a single enclosure.
  2. Include enclosure door with key locking mechanism. Key locks alike for all enclosures and include one pair of keys per enclosure.
  3. Enclosures shall be NRTL listed according to UL 508A.
  4. Enclosures constructed of steel, finished inside and out with polyester powder coating electrostatically applied and then baked to bond to substrate.
  5. Hinged door full size of front face of enclosure and supported using:
    - a. Enclosures sizes less than 36 in. (900 mm) tall: Multiple butt hinges.

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- b. Enclosures sizes 36 in. (900 mm) tall and larger: Continuous piano hinges.

### B. Internal Arrangement:

1. Internal layout of enclosure shall group and protect components associated with a controller, but not an integral part of controller.
2. Arrange layout to group similar products together.
3. Include a barrier between line-voltage and low-voltage electrical and electronic products.
4. Factory or shop install products, tubing, cabling and wiring complying with requirements and standards indicated.
5. Terminate field cable and wire using heavy-duty terminal blocks.
6. Include spade lugs for stranded cable and wire.
7. Install a maximum of two wires on each side of a terminal.
8. Include enclosure field power supply with a toggle-type switch located at entrance inside enclosure to disconnect power.
9. Include enclosure with a line-voltage nominal 20-A GFCI duplex receptacle for service and testing tools. Wire receptacle on hot side of enclosure disconnect switch and include with a 5-A circuit breaker.
10. Mount products within enclosure on removable internal panel(s).
11. Include products mounted in enclosures with engraved, laminated phenolic nameplates (black letters on a white background). The nameplates shall have at least 1/4-inch- (6-mm-) high lettering.
12. Route tubing cable and wire located inside enclosure within a raceway with a continuous removable cover.

### C. Environmental Requirements:

1. Evaluate temperature and humidity requirements of each product to be installed within each enclosure.
2. Calculate enclosure internal operating temperature considering heat dissipation of all products installed within enclosure and ambient effects (solar, conduction and wind) on enclosure.
3. Where required by application, include temperature-controlled electrical heat to maintain inside of enclosure above minimum operating temperature of product with most stringent requirement.
4. Where required by application, include temperature-controlled ventilation fans with filtered louver(s) to maintain inside of enclosure below maximum operating temperature of product with most stringent requirement.
5. Include temperature-controlled cooling within the enclosure for applications where ventilation fans cannot maintain inside temperature of enclosure below maximum operating temperature of product with most stringent requirement.
6. Where required by application, include humidity-controlled electric dehumidifier or cooling to maintain inside of enclosure below maximum relative humidity of product with most stringent requirement and to prevent surface condensation within enclosure.

## 2.22 RELAYS

### A. All:

1. Heavy duty, rated for at least 10 A at 250-V ac and 60 Hz.
2. Construct the contacts of either silver cadmium oxide or gold.
3. Relay enclosed in a dust-tight cover.
4. Coil transient suppression to limit transients to non-damaging levels.

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5. Plug each relay into an industry-standard, 35-mm DIN rail socket. Plug all relays located in control panels into sockets that are mounted on a DIN rail.
6. Mechanical Life: At least 10 million cycles.
7. Electrical Life: At least 100,000 cycles at rated load.
8. Timing Ranges: Multiple ranges from 0.1 seconds to 100 minutes.
9. Timing Ranges, where applicable: Multiple ranges from 0.1 seconds to 100 minutes.
10. Repeatability: Within 2 percent.
11. Recycle Time: 45 ms.
12. Minimum Pulse Width Control: 50 ms.
13. Power Consumption: 5 VA or less at 120-V ac.
14. Ambient Operating Temperatures: Minus 40 to 115 deg F (Minus 40 to 46 deg C).
15. General-Purpose Relays: With LED indication and a manual reset and push-to-test button.
16. Multifunction Time-Delay Relays: With knob and dial scale for setting delay time.

### B. Current Sensing Relay:

1. Monitors ac current.
2. Independent adjustable controls for pickup and dropout current. Choose relay size to be able to read smallest current from motor at lowest speed.
3. Energized when supply voltage is present and current is above pickup setting.
4. De-energizes when monitored current is below dropout current.
5. Dropout current adjustable from 50 to 95 percent of pickup current.
6. Include a current transformer, if required for application.
7. House current sensing relay and current transformer in its own enclosure. Use NEMA 250, Type 12 enclosure for indoors and NEMA 250, Type 4 for outdoors.

## 2.23 UNINTERRUPTABLE POWER SUPPLY (UPS) UNITS

### A. 250 through 1000 VA:

1. UPS units shall provide continuous, regulated output power without using their batteries during brown-out, surge, and spike conditions.
2. Load served shall not exceed 75 percent of UPS rated capacity, including power factor of connected loads.
3. UPS shall provide up to 15 minutes of battery power.
4. Performance:
  - a. Input Voltage: Single phase, 120- or 230-V ac, compatible with field power source.
  - b. Load Power Factor Range (Crest Factor): 0.65 to 1.0.
  - c. Output Voltage: 101- to 132-V ac, while input voltage varies between 89 and 152-V ac.
  - d. On Battery Output Voltage: Sine wave.
  - e. Inverter overload capacity shall be minimum 150 percent for 30 seconds.
  - f. Recharge time shall be a maximum of six hours to 90 percent capacity after full discharge to cutoff.
  - g. Transfer Time: 6 ms.
  - h. Surge Voltage Withstand Capacity: IEEE C62.41, Categories A and B; 6 kV/200 and 500 A; 100-kHz ringwave.
5. UPS shall be automatic during fault or overload conditions.



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6. Include front panel with power switch and visual indication of power, battery, fault and temperature.

### 2.24 SURGE PROTECTION

- A. Zener diodes, silicone avalanche diode, optical isolation, varistors, or combination thereof.
- B. Transient protection
  1. Communications LAN:
    - a. Provide surge protection equipment sized specifically for expected operating current of LAN.
    - b. Exceeds severity level 4 of IEC 801-4.
    - c. Operating voltage: 12 volts.
    - d. Maximum operating current: 200 mA
    - e. Clamping action turn-on: 14.3 volts
    - f. Maximum clamping at 2 kW (8 x 20 microsecond wave): 22 volts
    - g. Maximum surge voltage: 20 kV
    - h. Maximum surge current (8 x 20 microsecond wave): 2.5 kA
    - i. Current leakage at perating voltage: 5 microamps
    - j. As manufactured by Surge Control Limited, SPR series, or approved equal.
  2. Power supply:
    - a. Provide surge protection equipment sized specifically for expected operating current of DDC controller.
    - b. Exceed recommendations for ANSI / IEEE C62.41-1991 Categories A3 and B3 and UL1449.
    - c. Design such that suppressor does not "wear out" with repeated surges.
    - d. CSA certified and UL recognized.
    - e. EMI / RFI filtering.
    - f. Differential and common mode suppression and filtering.
    - g. Less than 5 nanosecond response time.
    - h. Maximum transient voltage 6 kV.
    - i. Maximum transient current 3 kA.
    - j. Minimum clamping turn-on, 210 volts.
    - k. Maximum clamping voltage, (I-test):
      - 1) line to neutral — 245 volts.
      - 2) line to ground — 245 volts.
      - 3) neutral to ground — 245 volts.
    - l. Maximum clamping voltage @ 3 kA:
      - 1) line to neutral — 325 volts.
      - 2) line to ground — 430 volts.
      - 3) neutral to ground — 430 volts.
    - m. As manufactured by Surge Control Limited, SPP-1200 series, or approved equal.
- C. Protective devices shall be continuous duty, automatic and self restoring.

### 2.25 CONTROL WIRE AND CABLE

- A. 7/24 soft annealed copper strand with a 2- to 2.5-inch (50- to 65-mm) lay.
- B. Plenum rated LAN and Communication Cable complying with NFPA 70 and DDC system manufacturer requirements for network being installed.

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### 2.26 CONTROL POWER WIRING AND RACEWAYS

- A. Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems" for electrical power raceways and boxes.
- B. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" electrical power conductors and cables.

### 2.27 IDENTIFICATION

- A. Provide engraved phenolic tag, fastened with drive pins with min. 0.5" high white lettering on black background, bearing unique identification nomenclature for control equipment and devices.

## PART 3 - EXECUTION

### 3.1 PRE-INSTALLATION MEETINGS

- A. [Pre-installation Conference: Schedule and attend conference at location of owner's choosing. Mandatory attendees include representatives from BAS contractor, Owner, Engineer, and Commissioning Authority.](#)

### 3.2 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work. Verify compatibility with and suitability of substrates. Examine roughing-in for products to verify actual locations of connections before installation. Examine walls, floors, roofs, and ceilings for suitable conditions where product will be installed.
- B. Prepare written report listing conditions detrimental to performance of the Work.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.3 DDC SYSTEM INTERFACE WITH OTHER SYSTEMS AND EQUIPMENT

- A. Coordinate with Owner for provision of required communication infrastructure that is Owner's responsibility, including data drops, IP addresses, etc.
- B. Communication Interface to Equipment with Integral Controls: DDC system shall have communication interface with equipment having integral controls and having a communication interface for remote monitoring or control. [Reference drawings for equipment to be connected.](#)

### 3.4 GENERAL INSTALLATION REQUIREMENTS

- A. The I/O Summary on the drawings is provided as a list of the minimum points required. Provide all controls points, temperature sensors, relays, actuators, and devices necessary to achieve operational sequences at no additional cost to the Owner, whether explicitly called for or not in this specification. Coordinate with all sub-contractors to ensure all items are provided and installed.

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- B. Install in accordance with manufacturer's instructions.
- C. Controls Contractor is responsible for complete operational installation of system, including, but not limited to the following:
  - 1. Electrical power supply to all control system components, including but not limited to; controllers, actuators, sensors, from dedicated circuits in electrical panels.
  - 2. Complete installation of duct-mounted components, including but not limited to: temperature, relative humidity, pressure, and CO2 sensors, and dampers/actuators.
  - 3. Complete installation of pipe-mounted components, including but not limited to: control valves and actuators, temperature sensors, pressure sensors.
- D. All electrical material and installation shall be in accordance with local applicable codes and requirements of Division 26. All automation system equipment supplied shall be provided with adequate grounding in accordance with the manufacturer's specifications and suggested engineering applications procedures. These requirements shall include, but not be limited to:
  - 1. A "clean earth ground" for all FCUs and central operator's station.
  - 2. No "ground mixing" between equipment components.
  - 3. Insulation of all panels from metal conduits.
  - 4. Equal-potential grounding for equipment where required.
- E. Identification:
  - 1. Provide a permanent, stick-on tape marker **on the inside cover** of the space sensor (e.g. temperature, RH) to identify the name of the HVAC unit associated with the sensor.
  - 2. Provide within each enclosure with a complete set of as-built schematics, tubing, and wiring diagrams and product literature for that particular controller.
  - 3. Label each end of cable, wire and tubing in enclosures following an approved identification system that extends from field I/O connection and all intermediate connections throughout length to controller connection. **Use printed labels, not hand-written.**
  - 4. Identify all controller enclosures with **1/8 inch** thick plastic labels not less than **3 x 1.25 inches**. Fasten with stainless-steel rivets or self-tapping screws or contact-type permanent adhesive, compatible with label and with substrate
- F. Install products to satisfy more stringent of all requirements indicated.
- G. Install products level, plumb, parallel, and perpendicular with building construction. Support products, tubing, piping wiring and raceways. Brace products to prevent lateral movement and sway or a break in attachment.
- H. If codes and referenced standards are more stringent than requirements indicated, comply with requirements in codes and referenced standards.
- I. Fabricate openings and install sleeves in ceilings, floors, roof, and walls required by installation of products. Before proceeding with drilling, punching, and cutting, check for concealed work to avoid damage. Patch, flash, grout, seal, and refinish openings to match adjacent condition.
- J. Seal penetrations made in fire-rated assemblies and in acoustically rated assemblies in accordance with applicable fire codes.
- K. Fastening Hardware:

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1. Stillson wrenches, pliers, and other tools that damage surfaces of rods, nuts, and other parts are prohibited for work of assembling and tightening fasteners.
  2. Tighten bolts and nuts firmly and uniformly. Do not overstress threads by excessive force or by oversized wrenches.
  3. Lubricate threads of bolts, nuts and screws with graphite and oil before assembly.
- L. Install products in locations that are accessible and that will permit service and maintenance from floor, equipment platforms, or catwalks without removal of permanently installed furniture and equipment.
- M. Corrosive Environments:
1. Avoid or limit use of materials in corrosive airstreams and environments, including, but not limited to, the following:
    - a. Laboratory exhaust-air streams.
    - b. Process exhaust-air streams.
  2. When conduit is in contact with a corrosive airstream and environment, use Type 316 stainless-steel conduit and fittings or conduit and fittings that are coated with a corrosive-resistant coating that is suitable for environment. Comply with requirements for installation of raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."
  3. Where instruments are located in a corrosive airstream and are not corrosive resistant from manufacturer, field install products in NEMA 250, Type 4X enclosure constructed of Type 316L stainless steel.

### 3.5 CONTROLLER INSTALLATION

- A. Quantity and location of network and programmable application controllers shall be determined by DDC system manufacturer to satisfy requirements indicated.
- B. Install controllers in enclosures to comply with indicated requirements in a protected location that is easily accessible by operators.
- C. Test and adjust controllers to verify operation of connected I/O to achieve performance indicated requirements while executing sequences of operation.

### 3.6 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and installations, including connections.
  1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
  2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

### 3.7 DDC SYSTEM I/O CHECKOUT, ADJUSTMENT, CALIBRATION AND TESTING

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- A. Prepare and submit a report to Engineer and Commissioning Authority documenting results for checking, adjustment, calibration, testing. Include a description of corrective measures and adjustments made to achieve desired results for each I/O point, control sequence, and system.
  
- B. Sensor Check and Calibration:
  - 1. Calibrate every sensing device, including temperature, relative humidity, pressure, etc. by comparing field-installed sensors to a high accuracy instrument that has been calibrated within the previous 12 months. Calibrate each instrument according to instrument instruction manual supplied by manufacturer. Field instruments and equipment used to test and calibrate installed instruments shall have accuracy at least twice the instrument accuracy being calibrated. (E.g., an installed instrument with an accuracy of 1 percent shall be checked by an instrument with an accuracy of 0.5 percent).
  - 2. Provide a written description of proposed field procedures and equipment for calibrating each type of instrument. Submit procedures before calibration and adjustment.
  - 3. All field sensors must read to within accuracy range listed in these specifications. For each analog instrument, make a three-point test of calibration for both linearity and accuracy.
  - 4. Programmed offsets may be used to a certain degree to adjust sensor readings. Replace all sensors requiring an offset of more than 2F, or 10% RH, or 0.2" air static pressure or 1.5 psig water static, or 50 ppm CO<sub>2</sub>.
  - 5. Submit a report certifying that every sensor has been calibrated and is reading accurately as a prerequisite for testing by the commissioning authority. List results of each sensor (field-reading versus calibrated instrument reading).
  
- C. Control Damper Checkout:
  - 1. Verify that control dampers are installed correctly for flow direction.
  - 2. Verify that proper blade alignment, either parallel or opposed, has been provided.
  - 3. Verify that damper frame attachment is properly secured and sealed.
  - 4. Verify that actuator wiring is complete, enclosed and connected to correct power source.
  - 5. Stroke and adjust control dampers following manufacturer's recommendation, from 100 percent open to 100 percent closed and back to 100 percent open. Verify that damper blade travel is unobstructed and that damper actuator and linkage attachment is secure.
  - 6. Check and document open and close cycle times for applications with a cycle time less than 30 seconds.
  - 7. For control dampers equipped with positive position indication, check feedback signal at multiple positions to confirm proper position indication.
  
- D. Control Valve Checkout:
  - 1. Verify that control valves are installed correctly for flow direction.
  - 2. Verify that valve body attachment is properly secured and sealed.
  - 3. Verify that valve actuator and linkage attachment is secure.
  - 4. Verify that actuator wiring is complete, enclosed and connected to correct power source.
  - 5. After piping systems have been tested and put into service, but before insulating and balancing, inspect each valve for leaks. Adjust or replace packing to stop leaks. Replace the valve if leaks persist.
  - 6. Stroke and adjust control valves following manufacturer's recommended procedure, from 100 percent open to 100 percent closed and back to 100 percent open. Verify that valve ball, disc or plug travel is unobstructed.
  - 7. For control valves equipped with positive position indication, check feedback signal at multiple positions to confirm proper position indication.

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- E. Meters: Check sensors at zero, 50, and 100 percent of Project design values.
- F. Switches: Calibrate switches to make or break contact at set points indicated.
- G. Controllers:
  - 1. Verify voltage, phase and hertz.
  - 2. Verify that protection from power surges is installed and functioning.
  - 3. Verify that ground fault protection is installed.
  - 4. If applicable, verify if connected to UPS unit.
  - 5. If applicable, verify if connected to a backup power source.
  - 6. If applicable, verify that power conditioning units, transient voltage suppression and high-frequency noise filter units are installed.
  - 7. Verify that wire and cabling is properly secured to terminals and labeled with unique identification.
  - 8. Verify that spare I/O capacity is provided.
  - 9. Test every I/O point connected to DDC controller to verify that safety and operating control set points are as indicated and as required to operate controlled system safely and at optimum performance. Test every I/O point throughout its full operating range.
  - 10. Test every control loop to verify operation is stable and accurate.
  - 11. Adjust control loop proportional, integral and derivative settings to achieve optimum performance while complying with performance requirements indicated. Document testing of each control loop's precision and stability via trend logs.
  - 12. Test and adjust every control loop for proper operation according to sequence of operation.
  - 13. Test software and hardware interlocks for proper operation. Correct deficiencies.
  - 14. Operate each analog point at upper, mid, and lower portions of range
  - 15. Exercise each binary point.
  - 16. For every I/O point in DDC system, read and record each value at operator workstation, at DDC controller and at field instrument simultaneously. Value displayed at operator workstation, at DDC controller and at field instrument shall match.

### 3.8 DDC SYSTEM COMMISSIONING TESTS

- A. Provide written request to Commissioning Authority (CxA) for initiation of on-site Functional Testing. Functional Testing will not take place until:
  - 1. System has been thoroughly tested as described in this section under “DDC System I/O Checkout, Adjustment, Calibration, And Testing”, and report has been submitted.
  - 2. Certificate of Readiness has been submitted to CxA.
    - a. At his discretion, if entire control system has not been completed, CxA may test portions of system which have been completed.
  - 3. Prefunctional Checklists, if required by contract documents, have been submitted to CxA.
- B. Contractor shall set up trend logs as requested by the CxA, Engineer, or Owner, without any limits on the number of trends, to assist in testing and verification of system operation.
  - 1. Prior to start of functional testing, set up the following initial trend logs:
    - a. VAV air handler:
      - 1) Room temperature: 15 minute readings.

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- 2) Discharge air temperature: 15 minute readings.
  - 3) Commanded fan speed: 15 minute readings.
  - 4) Commanded cooling valve/heating stages: 15 minute readings.
  - 5) OA damper position: Each 5% change of value.
  - 6) Return air CO2 (where point is specified): 30 minute readings.
- b. Chiller plant:
- 1) Chiller supply and return water temperature: 15 minute readings.
  - 2) Chiller load: 15 minute readings.
  - 3) Commanded pump speed: Each 5% change of value.
  - 4) Chilled water DP: Each 5% change of value.
- C. Contractor shall set up trends and logs as requested by the Engineer or Owner, without any limits on the number of trends.
- D. CxA will perform on-site and remote Functional testing as specified in Construction Documents and in accordance with generally accepted commissioning procedures. DDC system shall demonstrate correct operation and accuracy of monitored and controlled points as well as operation capabilities of sequences, logs, trends, reports, specialized control algorithms, diagnostics, and other software indicated. Reference section 019113 “General Commissioning Requirements” for more information.
1. Contractor is to provide a qualified representative, intimately familiar with the project installation and issues, to carry out Functional Testing procedures as directed by CxA, for the duration of Functional Testing.
- E. CxA will issue reports to Contractor, in such forms as Commissioning Issues Logs, emails, written reports, detailing items which appear not to be in conformance with construction documents requirements. Take prompt action to remedy deficiencies indicated in field report and submit a second written request when all deficiencies have been corrected. Repeat process until no deficiencies are reported.
- F. Due to the complexity of control systems and potential for latent defects to go undiscovered during Functional Testing, DDC system or tested portions thereof must operate essentially trouble-free for a period of 30 consecutive days following Functional Testing before Final Acceptance of system will be granted.
- ### 3.9 WARRANTY SERVICE
- A. System deficiencies discovered subsequent to Final Acceptance of system will be treated as Warranty items. Under Warranty requirements, address all operating problems, repair or replace worn or defective components, adjust control parameters as required for proper operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
- B. Provide system inspections and reports annually during warranty period; reference paragraph “Warranty Inspections” in this specifications section.
- ### 3.10 SOFTWARE SERVICE AGREEMENT
- A. Technical Support: Beginning **at Final Acceptance of system**, service agreement shall include software support for two year(s).

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- B. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within two years from date of **Final Acceptance of system**. Upgrading software shall include operating system and new or revised licenses for using software.

### 3.11 DEMONSTRATION AND TRAINING

- A. Engage a factory-authorized service representative with complete knowledge of Project-specific system installed to train Owner's maintenance personnel to adjust, operate, and maintain DDC system. Owner may send up to **10** persons to attend training. Training shall occur within normal business hours at a mutually agreed on time.
- B. Provide not less than **14** hours of training total, **broken up into four 3.5 hour sessions**. Provide staggered training schedule as requested by Owner to accommodate Owner personnel schedules.
- C. Schedule training with Owner at least four business days before expected Substantial Completion. All training shall occur before Final Acceptance of control system.
- D. Organize training sessions into logical groupings of technical content and to reflect different levels of operators having access to system. Plan training sessions to accommodate daily operators, advanced operators, and system managers and administrators.
- E. Maintain a training attendee list and sign-in sheet. Sign-in sheet shall include training session number, date and time, instructor name, phone number and e-mail address, and brief description of content to be covered during session. List attendees with columns for name, phone number, e-mail address and a column for attendee signature or initials.
  - 1. For each session, submit a scanned copy (PDF) of circulated sign-in sheet to Owner, Engineer, and Commissioning Authority with 48 hours of end of training session.
- F. Provide each attendee with a color hard copy of all training materials and visual presentations. Hard-copy materials shall be organized in a three-ring binder with table of contents and individual divider tabs marked for each logical grouping of subject matter.
- G. Instructor Requirements:
  - 1. One or multiple qualified instructors, as required, to provide training.
  - 2. Instructors shall have not less than three years of providing instructional training on not less than five past projects with similar DDC system scope and complexity to DDC system installed.
- H. On-Site Training:
  - 1. Provide as much of training located on-site as deemed feasible and practical by Owner. Owner will provide conditioned classroom or workspace with ample desks or tables, chairs, power and data connectivity for instructor and each attendee.
  - 2. Instructor shall provide training materials, projector and other audiovisual equipment used in training.
  - 3. On-site training shall include regular walk-through tours to observe each unique product type installed with hands-on review of operation, calibration and service requirements.
  - 4. Operator workstation shall be used in training, whether Owner's or contractor-provided & via remote web access.



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### I. Training Content:

1. Basic operation of system.
2. Understanding DDC system architecture and configuration.
3. Understanding each unique product type installed including performance and service requirements for each.
4. Understanding operation of each system and equipment controlled by DDC system including sequences of operation, each unique control algorithm and each unique optimization routine.
5. Operating operator workstations, printers and other peripherals.
6. Logging on and off system.
7. Accessing graphics, reports and alarms.
8. Adjusting and changing set points and time schedules.
9. Recognizing DDC system malfunctions.
10. Understanding content of operation and maintenance manuals, and control drawings.
11. Accessing data from DDC controllers.
12. Operating portable operator workstations.
13. Review of DDC testing results to establish basic understanding of DDC system operating performance and HVAC system limitations as of Substantial Completion.
14. Running each specified report and log, setting up Trend Logs.
15. Displaying and demonstrating each data entry to show Project-specific customizing capability. Demonstrating parameter changes.
16. Stepping through graphics penetration tree, displaying all graphics, demonstrating dynamic updating, and direct access to graphics.
17. Executing digital and analog commands in graphic mode.
18. Demonstrating control loop precision and stability via trend logs of I/O for not less than 10 percent of I/O installed.
19. Demonstrating DDC system performance through trend logs and command tracing.
20. Demonstrating scan, update, and alarm responsiveness.
21. Demonstrating spreadsheet and curve plot software, and its integration with database.
22. Demonstrating on-line user guide, and help function and mail facility.
23. Demonstrating multitasking by showing dynamic curve plot, and graphic construction operating simultaneously via split screen.
24. Demonstrating operation of HVAC equipment in normal-off, -on and failed conditions while observing individual equipment, dampers and valves for correct position under each condition.
25. Demonstrating integration into DDC system is able to communicate with DDC controllers or gateways, as applicable.

END OF SECTION 230900

## SECTION 230993 - SEQUENCE OF OPERATIONS FOR HVAC 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.
- B. Related Sections include the following:
  - 1. Division 23 Section "Instrumentation and Control for HVAC" for control equipment and devices and for submittal requirements.
  - 2. Division 23 Sections for chiller, AHUs, VFDs, and other equipment.

#### 1.2 ABBREVIATIONS

- A. Abbreviations used in this specifications section:
  - 1. BAS: Building Automation System
  - 2. CO2: Carbon Dioxide
  - 3. DAT: Discharge Air Temperature
  - 4. DCV: Demand Control Ventilation
  - 5. DDC: Direct Digital Control
  - 6. dP: differential Pressure
  - 7. dT: differential Temperature
  - 8. DX: Direct Expansion
  - 9. EF: Exhaust fan
  - 10. OA: Outside Air
  - 11. RH: Relative Humidity
  - 12. RTU: Rooftop Unit
  - 13. TAB: Testing, Adjusting and Balancing

#### 1.3 SUMMARY

- A. This Section includes control sequences for HVAC systems, subsystems, and equipment. Provide controls and operating sequences for the following HVAC systems at [UTRGV/ECISD Early College High School](#):
  - 1. While design intent is for BAS to control all equipment, additional BACnet card interface to unitary controllers will be necessary for monitoring of parameters and specialized alarms with alarm codes available from integral unit controller. Coordinate with equipment manufacturer. As needed, obtain clarification from engineer and supplier, prior to bidding.
  - 2. Central plant: air-cooled chillers with integral primary pumps, and secondary pumps.
  - 3. Hydronic, dual path, multiple zone, variable air volume unit, with VAV boxes.
  - 4. Hydronic, dual path, single zone, variable air volume unit, with VAV boxes.
  - 5. Single zone, constant volume split systems.
  - 6. Exhaust Fan Sequences for all exhaust fans in building.
  - 7. Domestic water heaters
  - 8. Drinking fountains

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- 9. Power monitoring
- 10. Lighting Systems

- B. **Prior to bidding**, Controls contractor shall notify general, mechanical, and electrical contractor of any work required for operational installation of controls devices that will not be conducted by Controls Contractor. This includes, but is not limited to: installation of controls devices and sensors, interface cards for chillers, VFDs, as well as any needs for power wiring and/or conduit.
- C. A list of minimum number and type of control points required is given. Provide additional points, sensors, interface cards, etc. as required to achieve sequences and properly control and monitor the environmental systems, whether specifically called for in Points List or not.
- D. Provide all hardware, software, coordination with other trades and labor required to achieve specified sequences and properly control/ monitor the environmental system.
- E. Units or systems that are grouped together for purposes of sequence description are not meant to be controlled together. Each system shall have its own set of adjustable parameters and will respond only to values (space temperatures for example) associated with it. This means that one unit may be in heating mode while another with similar sequence may be in cooling mode.

### 1.4 EQUIPMENT TIME SCHEDULES

- A. Contractor is responsible for programming schedules for all equipment and systems prior to turning system over to Owner at final system acceptance.
- B. **Request Owner's input for on/off and optimum start/stop (OSS) programming for all equipment and systems, including both Typical and Holiday schedules, and Program holiday time schedules as directed by the Owner.**
- C. Note that OA dampers, exhaust fans, or other equipment devices may have independent dedicated time schedule different from the equipment which they serve or are associated with. For example, distinct time schedules may be required for actual Occupied time (for instance, 8AM to 5:30PM) requiring ventilation versus required equipment start/stop times for comfort.
- D. Equipment items having the same Off/Enable or Start/Stop times may not to be software interlinked such that one cannot be changed without changing the other. Each individual equipment item shall have its own individual programmable Off/Enable or Start/Stop scheduling capability.
- E. Stagger AHU start times by a minimum of 20 seconds between starts.

### 1.5 SPACE TEMPERATURE SETPOINTS

- A. Temperature and humidity setpoints and operating schedules listed in sequences of operations are initial values, based upon input from Owner's representatives and common industry practice, and are not to be considered as final. Final setpoint and schedules must be programmed in coordination with the Owner and Engineer, and Testing and Balancing firm, regardless of schedules listed in this specification.

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- B. In consultation with Owner, Engineer, and Testing and Balancing firm, controls contractor shall make necessary revisions to operating sequences that are intended to result in improved system operation. These adjustments will be considered incidental to the contract..
1. Duct static pressure and hydronic system differential pressure setpoints may be listed in control sequences. These are initial estimated values. They must be modified based upon input from the Testing and Balancing firm to final values which are optimal settings for energy efficient operation of the system.
- C. All adjustable setpoint temperature sensors / thermostats are to be software Locked from occupant adjustment, or limited as to the highest heating setpoint and lowest cooling setpoint that building occupants might select. Initial values are listed in control sequences. Determine final limits in consultation with Owner and Engineer.
- D. Whether in Occupied or Unoccupied mode, the active heating setpoint must always be lower than the active cooling setpoint by a minimum of 5F, if called for in sequences. This differential is referred to as the “deadband”.
1. With exception of that required for dehumidification, no heating operation is to take place when room temperature is within deadband. Operation of hot water coil or electric reheat is to begin only when room temperature has fallen 1°F below the heating setpoint.
  2. Cooling operation within the deadband must be at an absolute minimum, ie. specified minimum air flow to provide necessary ventilation.
- E. Room Temperature Setpoints
1. Allowable range for space temperature setpoints will be limited via control system.
    - a. Program temperature setpoints to be set only at the central operator station, with limited adjustability.
  2. System is expected to maintain room temperature no more than 0.75F above cooling setpoint / below heating setpoint during ‘normal’ steady-state operating conditions.
  3. Unless otherwise noted in drawings or operating sequences described below, program the following room temperature setpoints for all heating and cooling equipment.
    - a. Occupied Hours
      - 1) Cooling setpoint = 74F
      - 2) Heating setpoint = 69F
    - b. Unoccupied Hours
      - 1) Cooling setpoint = 85F
      - 2) Heating setpoint = 60F
  4. Run unit for a minimum 20 minutes. Disable unit once temperature has fallen 1.5F below Cooling or 1.5F above heating setpoint.
- F. Room Relative Humidity (RH) Setpoints
1. System is expected to begin dehumidification sequence at 1% RH above setpoint.
  2. Unless otherwise noted in drawings or operating sequences described below, program the following room RH setpoints for all cooling equipment.
    - a. Occupied and Unoccupied Hours
      - 1) Cooling RH setpoint = 59%
      - 2) Run unit for a minimum 20 minutes. Disable dehumidification mode once RH has fallen 3% below setpoint.

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### 1.6 BACNET CONNECTIONS

- A. Bacnet interface will be used for monitoring of parameters, specialized alarms with alarm codes that are sensed by the unitary controller:
  - 1. All points readable within equipment Bacnet register are to be communicated to and readable by BAS. With equipment manufacturer coordinate the list of all BACnet points, and provide them to the Owner and Engineer.
  - 2. Provide a dedicated graphic page to display selected Bacnet points. Navigate to this dedicated graphic by clicking on the equipment icon.
  - 3. The point descriptor text for all Bacnet points displayed on the dedicated Bacnet page are to have clear, unambiguous meaning; simply copying manufacturer's text descriptor will not be acceptable. Supply manufacturer's points text descriptors to Engineer for pre-approval. Revise descriptors if directed by Engineer.
  - 4. Display all values with proper units (deg F, psig, etc.), truncated to decimal point accuracy commensurate with accuracy of sensor.

### 1.7 OUTDOOR AIR CONDITIONS

- A. Outdoor air temperature and relative humidity are to be read from an Engineer-approved web-based weather service such as Accuweather.com. Update conditions at no longer than 30 minute intervals.
- B. Display OA temperature and RH conditions on all graphics screens. Display values rounded to nearest whole number.

### 1.8 GENERAL

- A. Individual sequence descriptions may list units to which sequence applies. Contractor must verify equipment quantities and unit types through drawings review and on-site inspections.
- B. All setpoints used in controls sequences shall be user adjustable with a minimum of keystrokes.
- C. Points lists have been provided as a general guideline, and are not all inclusive. Provide all points required for achievement of operating sequences.
- D. All delays shall be operator adjustable. Program for a minimum delay between on/off commands for HVAC equipment to prevent short cycling.
- E. VFDs:
  - 1. Unless noted otherwise, program for minimum VFD speed of 30% of full 60 Hz speed.
  - 2. VFD speed displayed on graphic must match the actual speed at which the VFD is running, measured as a % of the full hertz to which TAB firm has determined and programmed. For examples: If TAB programs 70 Hz max speed and VFD is running at X Hz, graphic must display  $X \div 70$  in percentage; if fan/VFD is Off, graphic must display 0% speed.
- F. Unless noted otherwise, close HVAC unit outside air dampers during all Unoccupied periods.
- G. Economizer Operation:

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1. Economizer operation is to be based upon a combination of return air temperature and outside air enthalpy.
  2. During Occupied periods when system is in cooling mode, place unit in Economizer mode when OA enthalpy is less than 23 Btu/lbm and outside air temperature is less than return air temperature, and modulate outside air dampers to extent required to maintain discharge air temperature or space temperature, as applicable to unit operation.
- H. Optimum Start/Stop (OSS):
1. When this feature is Enabled, control system shall automatically calculate the optimal start time for each HVAC system or unit so that comfort conditions will be achieved by the scheduled Occupied time. Control system shall determine the optimal time for equipment shutdown so that comfort conditions may be maintained until scheduled off time with minimal energy use.
  2. Coordinate with Owner for information on desired times for comfort conditions and whether OSS is to be Enabled.
- I. Interlocks:
1. Hardware: Controls shall not bypass any safeties or interlocks associated with fire protection shutdown.
  2. Provide all hardware necessary to achieve software interlocks required for proper system operation, including but not limited to control of dampers and exhaust fans. Coordinate with mechanical and electrical contractors.
- J. Damper Actuators:
1. Do not provide physical linkage between OA and return air dampers. Do not control OA and return dampers in complementary fashion (i.e., where sum of % open values of each always add to 100%) unless specifically directed in operating sequence.
- K. Pumps: To prevent dead heading of pumps and chiller failures on low or no flow, program for minimum delays as follows:
1. When there is a call for cooling or when cooling is scheduled, start SCHWPs and modulate speed to maintain differential pressure setpoint.
  2. After SCHWPs are operational, enable central plant (primary side).
  3. Delay between positioning valves and enabling chillers, and pumping systems: When plant is enabled, command respective chiller isolation valves to the new position and after a delay of 2 minutes, enable pumps. After a delay of 2 minutes when flow is established as registered by flow switches, enable chillers.
  4. Delay between disabling chillers and pumping systems and positioning valves: When changing operation modes, disable chillers and after a time delay of 2 minutes disable pumps, and command respective isolation valves to the new position.
- L. AHUs:
1. Coordinate with TAB to obtain RA and OA damper positions at different fan speeds. This will allow the AHUs to bring in the scheduled OA airflow as needed, irrespective of the AHU fan speed.
- M. VFD:
1. Speed displayed on BAS graphic must match the actual VFD speed. It is not permissible to display an output signal to the VFD, if the signal does not match actual VFD speed.
- N. AHU Fan-wall VFDs: Coordinate with equipment manufacturer for details.

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1. Each fan has its dedicated VFD. During normal operation, all VFDs operate in tandem at the same speed.
  2. Upon failure of a fan (motor or VFD), gravity backdraft damper closes. Operate the other fan at 100% (adj) speed. Issue alarm.
- O. Operator Station Display: Indicate the following on operator workstation display terminal, as applicable per points list:
1. Building floor plan, indicating individual rooms, thermostat locations, and areas served by each air handler, fan coil unit and rooftop unit.
  2. Conditioned space air temperature, all zones.
  3. Conditioned space air Base temperature setpoint, all zones.
  4. Conditioned space air Actual temperature setpoint, all zones.
  5. Distinguish different area(s) served by individual HVAC equipment items by use of color variation on floor plans graphics page.
  6. When a control point is in “Test” mode, graphic shall indicate the status such as “test” or “manual”.
  7. Summary Screens shall be provided for, at minimum, the following groups of items; include headers / parameters indicated (example values shown):

Dual Path AHU Summary table								
AHU	Unit	Ret coil	OA coil	Ret Air	Ret Air	Ret Air	OA Dmpr	Fan Speed
	DAT	DAT	DAT	Temp	RH	CO2	% open	
AH-A1	54	55	53	71	55%	750 (1)	44%	75%

VAV AHU Summary table								
AHU	Unit	OA coil	Ret Air	Ret Air	Ret Air	OA Dmpr	Fan Speed	Duct
	DAT	DAT	Temp	RH	CO2	% open		Static, In.
AH-C1	54	52	71	55%	750 (1)	44%	88%	1.24

Single Zone AHU Summary table								
AHU	Unit	OA coil	Ret Air	Ret Air	Ret Air	OA Dmpr	Fan Speed	ZN-CO2
	DAT	DAT	Temp	RH	CO2	% open		
AH-S1	54	52	71	55%	750 (1)	44%	88%	750 (1)

VAV Box (single or multi-stage heat)								
Box #	Room(s)	Zone	Disch	Damper	Supply Air	Supply Air	Htg	ZN-CO2
	Served	Temp	Air Temp	Pos	Flow cfm	Flow Stpt	Status	
1-5	Cl.Rm. 133	74	56	67%	125	130	On (2)	750 (1)

Exhaust Fans			
Equipment	Space(s)	Command	Status
EF-1	143 Boys RR	On (3)	On

Chiller Plant Summary								
Equipment	CHS	Bldg	Bldg		Loop Diff	Loop Diff	SCHP-1	SCHP-2
	Setpoint	CHS Temp	CHR Temp	GPM	Stpt, psi	Press, psi	Speed	Speed
Chiller Plant	44	43	54	183	7.0	7.5	0%	85%

(1) If no CO2 sensor exists, put "NA" in column  
 (2) If SCR type, list %. If staged, list On or Off  
 (3) List as On or Off, or as Enable or Disable as appropriate.

1.9 ALARMS

- A. General Alarm requirements:
1. Alarms described below are for multiple types of HVAC and other systems. Program as applicable for equipment which exists on this project.

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2. Except as otherwise noted below, no alarms are to be generated for equipment or sensors during Unoccupied hours.
  3. All alarm setpoints are to be easily adjustable by Operator via global commands.
  4. A delay (suggested 20 minutes) is to be incorporated before alarms are generated immediately following HVAC equipment startup in order to give equipment time to obtain desired conditions. If the programmed delay time proves inadequate to prevent nuisance alarms at equipment startup, Controls contractor must verify what delay time is appropriate, and whether such alarms are caused by mechanical issues.
  5. Alarms are to be set up scrupulously to avoid generation of nuisance alarms, e.g. alarms read from HVAC units which repeatedly fail to start, generating a new alarm each time
  6. ALARM DESCRIPTIONS MUST BE CLEARLY GIVEN IN HISTORICAL ALARMS REGISTER TO INDICATE THE NAME OF THE ITEM CAUSING THE ALARM. This description must be plainly displayed without the requirement of having to 'hover' the cursor over the alarm line in the alarm history register.
  7. Where control system connects via Bacnet to a controller of an HVAC unit, in addition to simple on/off status of alarm, alarm codes are to be read and displayed by the BAS. Provide a dedicated graphic page to list description of alarm codes.
- B. Critical HVAC Alarms:
1. Control system will send alarm notifications via text message and email to designated Owner personnel for Critical HVAC alarms for the following:
  2. When dedicated outside air coil leaving air temperature deviates from setpoint by 1.5F for 15 consecutive minutes.
  3. Any additional Critical HVAC alarms designated by engineer or owner's facility manager (FM).
- C. CO2 alarms:
1. Register alarm any time, during occupied or unoccupied hours, that a sensor reads outside of the following Minimum / Maximum expected values indicating sensor is likely malfunctioning: 370 ppm / 2000 ppm.
  2. Register alarm when any CO2 sensor (for examples, space or return duct) reads above 1300ppm for 15 consecutive minutes.
    - a. Program system to all alarm setpoint to be adjustable via a Global Command.
- D. Space temperature alarms:
1. Register alarm any time, during occupied or unoccupied hours, that a sensor reads outside of the following Minimum / Maximum expected values indicating sensor is likely malfunctioning: 45F / 100F.
  2. Register alarm when sensor remains 1.5F above cooling setpoint or 1.5F below heating setpoint for 15 consecutive minutes.
- E. Relative Humidity (RH) alarms:
1. Register alarm any time, during occupied or unoccupied hours, that a sensor reads outside of the following Minimum / Maximum expected values indicating sensor is likely malfunctioning: 10% / 100%.
  2. RH remains above setpoint for more than 20 consecutive minutes.
- F. For all HVAC units (including exhaust or ventilation fans), register alarms under the following conditions (where applicable to particular unit):
1. Discrepancy between commanded state of operation and actual state of operation, as indicated by status feedback.



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2. Discharge air temperature of any hydronic cooling coil remains 1.5F above or 2F below setpoint for more than 15 consecutive minutes.
  3. Discharge air temperature of any DX cooling coil remains below 40F for more than 2 consecutive minutes.
  4. Discharge air temperature from an electric heating coil fails to rise by 5F within 15 minutes after heater is enabled.
  5. Outside air coil leaving air temperature remains below 35F for 5 consecutive minutes.
  6. Mixed air temperature remains below 35F for 5 consecutive minutes.
  7. Unit has tripped on any safety (e.g., high static pressure, freezestat).
  8. Duct static remains above 2.5" for 15 consecutive seconds; shut down air handler.
  9. Duct static pressure deviates above or below setpoint by 20% of setpoint for more than 15 minutes.
- G. For all variable air volume boxes (terminal units), register alarms under the following conditions (where applicable to particular unit):
1. Variance between cfm setpoint and measured cfm varies by 15% or more for 15 consecutive minutes.
  2. Measured cfm exceeds 50cfm when air handler serving the box is Off.
- H. Register alarms for other equipment (e.g. refrigerant monitor, low or high static cutout switches, low temperature safety cutouts, etc.) when monitored alarm contacts close.
- I. For all utility controllers, register alarms under the following conditions:
1. System has been set to Purge mode.
  2. System remains in Purge mode for more than 30 consecutive minutes.
  3. Fan remains at high speed for more than 30 consecutive minutes.
- J. **Smoke Control:** Smoke detector, where existing on HVAC units, stops fan when products of combustion are detected in air stream.
1. Fan will be stopped directly via fire alarm system.
  2. BAS is not required to monitor smoke detector status.
  3. Stopping of fan by fire alarm system automatically signals alarm due to Command-Status mismatch at BAS.

### 1.10 CHILLER PLANT SEQUENCES

- A. System starts and stops chiller plant when the following conditions are met:
1. Start plant based on Operating Schedules and Optimized Start-Stop Routines
  2. Start plant based on call for cooling by AHU or FCU, provided there is an adequate load.
  3. Disable plant when system detects outside temperature below 50 deg F (adj).
- B. Equipment rotation: Central plant comprises of two Secondary CHWPs, three chillers with integral dual Primary CHWPs. Prior to start up, pumps and chillers shall be designated as lead/lag equipment. Lead/lag equipment shall be rotated on a weekly basis with the intent of getting equal run time.
1. At any given time, only two chillers and one SCHWP are required to meet campus loads. The third chiller and second pump shall be used as a backup only. However, equipment shall be rotated weekly for equal run times.

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- C. SCHWP Sequences: Applies to SCHWP-1 and 2
1. When there is a call for cooling, and/or based on operating schedules and optimized start stop routines, Chiller Plant is enabled.
  2. System starts and stops lead secondary chilled water pump. Signal alarm if pumps fail to start as commanded.
  3. Monitor differential water static pressures in supply and return chilled water lines upstream of motorized bypass valve at location shown in the plans at the end of the loop. Coordinate exact sensor location with Engineer.
  4. Modulate secondary pump speed between 30% and 100% via the variable frequency drive (VFD) to maintain design differential pressure setpoint (adjustable).
    - a. When pump modulates to lowest speed, and the differential pressure is still above setpoint for a period of 5 minutes, disable lag pump. Modulate bypass valve to maintain differential pressure setpoint. When dP drops below setpoint, close bypass valve and resume normal operation.
  5. Lead/lag pump shall be rotated on a weekly basis with the intent of getting equal run time.
  6. Freeze protection sequence: If OAT drops below 30F (adj.), close outside air dampers until OAT > 32F, open CHW valves in OA sections of dual path units and enable pump. Disable pump when temperature rises above 35F (adj.)
- D. Chiller Sequences:
1. Ensure that Secondary chilled water pump is operational.
  2. Open lead Chiller isolation valve and start lead primary chiller pump. Verify chilled-water flow via flow switches, and then start chiller.
  3. Signal alarm if equipment fails to start as commanded. Immediately enable lag chiller system in the event of an alarm input signal from lead chiller system.
  4. Staging: In sequence, enable lag chiller and associated primary chilled water pump under the following conditions when lead chiller cannot meet load:
    - a. If temperature sensor in bypass line shows the flow has reversed. For instance, if temperature in bypass rises above 50F adj.
    - b. If chilled water supply temperature cannot be maintained (rises 1°F above setpoint), and chiller load is above 90% (adj.) and remains there for preset time delay. To prevent short cycling of chillers, ensure that a minimum run time of 15 minutes is programmed.
    - c. First 30 minutes chiller plant is enabled for the day: Allow lead chiller sufficient time, 30 min (adj) to attain CHWST setpoint.
    - d. After the first 30 minutes, the delay to start the lag chiller shall be 10 minutes (adj).
    - e. Issue alarm, if all chillers are on and supply chilled water temperature cannot be maintained (rises 1°F above setpoint and remains there for 10 minutes).
    - f. In sequence, disable lag chillers and associated primary chilled water pumps, when load drops and chillers are operating at 35% (adj) or lower for 10 minutes (adj). Close associated valves.
- E. Reset Schedule: Reset supply chilled water temperature as follows:
1. At no time shall chilled water supply temperature to the building be allowed to rise above the level indicated by the following linear relationship:

Outdoor Air Adj Temperature	Supply Chilled Water Adj Temperature
85°F & above	44°F
55°F & below	48°F

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### F. Adaptive Controls:

1. The control system shall utilize adaptive control algorithms to directly control the following components and operations: Chiller Sequencing: add/remove chillers from service in such manner to assure that the total kW/ton of the Chilled Water plant will be minimized. Adaptive algorithms must continuously re-evaluate and dynamically adjust chiller sequencing setpoints based on variations in chiller leaving water temperature setpoint and chilled water loop water differential temperature and flow in order to assure optimum energy efficiency.
2. Secondary chilled water pump DP setpoint reset: Monitor and poll AHU CHW valve position to gauge chilled water demand. If none of the valves are fully (100%) open, gradually reset (lower) DP setpoint such that the most critical CHW valve opens to 100%. Ensure that AHUs are satisfied and that reset sequence does not affect discharge air temperature at the cooling coil. When loads rise, reverse DP setpoint reset sequence.

### G. Points List: It is Contractor's responsibility to ensure that all points required for the sequences are provided. See piping schematics for requirements for temperature sensors and valves.

<u>Point Type</u>	<u>Description</u>
DO	Chiller Off/ Enable
DI	Chiller Alarm Status
DO	PCHWP Start/Stop
DI	PCHWP Status
DO	SCHWP Start/Stop
DI	SCHWP Status
AO	SCHWP VFD Speed (% of full speed)
AI	Chilled Water Bypass Leg Temperature
DO	Chiller Isolation Valve
AI	Building Loop Supply and Return Temperature
AI	Chiller Supply and Return Temperature (from chiller BACnet points)
AO	Chiller Water Reset
AO	Chiller Demand Limit
AI	Chiller Load (Tons)
AI	Building Loop Supply Piping Pressure and Return Piping Pressure
AO	Building Loop DP setpoint
AO	Bypass valve adjacent to the DP sensor
AI	Supply Chilled Water Flow
AI	OA Temperature
AI	OA Relative Humidity

### H. Operator Station Display: Indicate the following on operator workstation display terminal:

1. System graphic
  - a. Provide text by each chiller indicating chiller ID (e.g. CH-1), manufacturer, and rated tons.
2. Chiller Off/Enable
3. Chiller alarms and alarm codes (codes may be displayed on BACnet interface page)
4. Chiller isolation valve commanded position
5. Chiller isolation valve position feedback
6. Chiller chilled-water supply and return temperature (from BACnet, insertion T sensors not required)
7. Chilled-water temperature setpoint
8. Chiller demand in % of full load
9. Total chiller Amps

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10. Primary chilled-water pump on-off status
11. Secondary chilled water pump on-off status and command
12. Secondary chilled water pump speed, % of full speed
13. Building chilled water supply and return temperatures
14. Bypass leg chilled water temperature
15. Building chilled water flow
16. Building chilled water differential pressure
17. Building chilled water differential pressure setpoint
18. Building chilled water bypass valve command and feedback
19. Outside air temperature
20. Outside air relative humidity
21. Dedicated BACnet interface page: Points shall be displayed, if available from chiller BACnet; some points may not be available for all chiller manufacturers.
  - a. Evaporator entering water temperature
  - b. Evaporator leaving water temperature
  - c. Active CHS setpoint
  - d. Code numbers for active alarms
    - 1) Provide a dedicated page that displays meaning of all code numbers.
  - e. Operating kW, chiller
  - f. Run hours, chiller
  - g. Operating amps, each compressor
  - h. Run hours, each compressor
  - i. Starts, each compressor
  - j. Capacity, % of full
  - k. Evaporator flow switch status
  - l. Chiller Demand Limit
  - m. Compressor starts, each compressor
  - n. Compressor run hours, each compressor
  - o. Evaporator refrigerant pressure, each circuit
  - p. Condenser refrigerant pressure, each circuit
  - q. VFD Alarm Status and Speed Feedback via VFD BACnet.

### 1.11 DUAL PATH, SINGLE ZONE, VARIABLE VOLUME, AIR-HANDLING UNITS

- A. Applicable to AHU-3 Pre-Engineering, AHU-7 Kitchen, AHU-11 Lecture, AHU-12 Common Space
- B. Install building pressurization sensor per manufacturer's instruction in a location shielded by the prevailing wind. Coordinate exact location with the engineer.
- C. Time Schedule:
  1. Program On and Off times as Owner's instructions.
- D. Definitions
  1. "Normal" AHU leaving discharge air temperature setpoint (**i.e., mixed air from return air coil and outside air pre-treatment coil**): 55F (adjustable).
  2. AHU: Air handling unit.
  3. CHW: Chilled water.
  4. DAT: Discharge air temperature.
  5. OA: Outside Air

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- E. Fan Operation:
1. Unoccupied periods: Cycle fan to maintain unoccupied period setback temperature.
  2. System starts fan to run continuously during occupied periods.
  3. Modulate fan speed between minimum speed (adj.) and 100% to maintain space temperature and RH setpoints.
    - a. Units with fan wall VFDs:
      - 1) Each fan has its dedicated VFD. During normal operation, VFDs operate in tandem at the same speed.
      - 2) Upon failure of a fan (motor or VFD), gravity backdraft damper closes. Operate the other fans. Issue alarm.
- F. Reset of Return Air CHW Coil Leaving Air Temperature Setpoint
1. Modulate return air section chilled water valve to maintain **normal** AHU DAT setpoint.
  2. Reset **normal** AHU DAT to maintain space T and return air RH setpoint in the most energy efficient manner possible. Program a cascading sequence as follows:
    - a. As space cooling load decreases, fan speed will modulate down. Once fan is at minimum speed, and space temperature is below cooling setpoint, gradually reset AHU DAT higher in 0.5F degree increments per 10-minute time period.
    - b. As cooling load increases reverse the above setpoint reset sequence.
  3. Dehumidification mode: If return air RH rises above setpoint (60%, adj) for 20 minutes, open Return Air CHW Coil valve to maintain DAT of 53F. Disable mode when RH setpoint is achieved.
  4. Return air coil leaving temperature setpoint shall never be allowed to exceed 65F (adj).
- G. Outside Air Section of AHU (top unit):
1. During unoccupied mode, OA damper and CHW valve remain closed.
  2. During Occupied mode, when supply fan is running, control OA CHW coil and reset OA coil leaving air temperature as follows:
    - a. OAT < 34F: Close OA damper to 0%.
    - b. 34F < OAT < 55F (adjustable): OA CHW valve to remain 0% open.
    - c. OAT > 55F: Modulate CHW valve to maintain 52F setpoint (adjustable).
- H. Heating Mode
1. SCR controlled electric heater is located downstream of the AHU in the supply duct.
  2. If space temperature is lower than the heating setpoint, close return air section chilled water valve and enable electric heating at AHU. Heaters shall adjust to control discharge air temperature setpoint (95°F, adj.).
  3. System shall modulate supply fan speed (between minimum and 100%) to maintain space temperature heating setpoint.
  4. If fan is at minimum speed and heating load continues to drop, system modulates SCR controller to maintain space temperature setpoint (instead of maintaining a fixed discharge air temperature). As heating loads increase, modulate heater to maintain 95F (adjustable) before increasing fan speed.
  5. Disable heaters if space temperature rises above setpoint.
  6. A high discharge air temperature cut-out switch shall disable electric heaters and issue alarm at COS.
- I. Ventilation Sequence
1. Dampers shall not be hardwired to open and close when units are enabled/disabled.
  2. Associated exhaust fans shall be disabled and outside air dampers shall remain closed during unoccupied hours -including cool-down and nighttime reset operation.

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3. Provide dedicated time schedule for OA dampers fan that can be set independently of AHU time schedule. Obtain actual Occupancy schedule from Owner and open / close outside air damper per Owner's actual Occupancy schedule (and not per AHU schedule).
  4. Dampers shall modulate between minimum open and maximum scheduled (fully) open position to maintain return air CO<sub>2</sub> setpoint of 1100 ppm (adj.).
  5. Initial occupied period minimum OA positions shall be set at 30% (adj) of scheduled OA flow. Minimum damper position is determined by TAB Contractor such that building remains positively pressurized when building exhaust fans are on.
  6. Open outside air dampers fully when return air (or critical zone) CO<sub>2</sub> concentration rises to 1100 ppm or higher.
    - a. If after 30 minutes of operation CO<sub>2</sub> concentration has not fallen below 900 ppm, modulate return air damper 20% closed.
    - b. If after an additional 30 minutes of operation CO<sub>2</sub> concentration has not fallen below 900 ppm, modulate return air damper 40% closed, and continue operation at that position until CO<sub>2</sub> concentration has fallen below 900 ppm.
    - c. Modulate outside air dampers to minimum position when CO<sub>2</sub> concentration falls to 900 ppm or lower; re-position return air dampers to fully open.
    - d. If CO<sub>2</sub> concentration exceeds 1,400 ppm, or OA flow drops below minimum, system shall issue an alarm at the Central Operator's Station.
- J. Exhaust fan interlocks: Coordinate software interlocks between exhaust fans and outside air dampers. Refer to schedules and plans for exhaust fan allocation to units.
1. Kitchen Unit: CO<sub>2</sub> based DCV is not required.
  2. Pre-Engineering:
    - a. To prevent extreme negative pressurization in this zone, coordinate exhaust fan operation (general EF, laser equipment material handling EF), such that general EF is temporarily disabled when material handling EF is ON.
    - b. When associated EF is enabled, override CO<sub>2</sub> based DCV, and modulate OA damper to scheduled maximum open position.
- K. Alarms:
1. Discrepancy between actual and commanded state of operation.
  2. Discharge air temperature deviates from setpoint by more than 3°F for 30 minutes.
  3. Space temperature deviates from setpoint by more than 2°F for more than 10 minutes.
  4. CO<sub>2</sub> level is above setpoint.
  5. Relative humidity setpoint is not met for more than 10 minutes (adj.)
- L. Operator Station Display: Indicate the following on operator workstation display terminal (if applicable) per each unit:
1. System occupied/unoccupied mode.
  2. A clear description of what area or room(s) unit serves.
  3. Outside-air-temperature indication.
  4. Outside-air-RH indication.
  5. Fan commanded state.
  6. Fan status.
  7. VFD Speed command.
  8. Mixed DAT setpoint at Unit Discharge (after fan).
  9. Mixed DAT setpoint and indication at Unit Discharge (after fan).
  10. Return Air Section (main bottom unit):
    - a. Return air temperature from space, upstream of coil.
    - b. Return air CO<sub>2</sub> from space (not required for AHU-7)

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- c. Return air damper commanded position and feedback.
  - d. Mixed air temperature setpoint.
  - e. Coil leaving air temperature.
  - f. Cooling control-valve commanded position for Return Air Section.
  11. Outside Air Section (top unit):
    - a. Outside air damper **commanded** position and feedback.
    - b. Coil leaving air temperature setpoint and indication.
    - c. Cooling control-valve commanded position.
  12. Heater commanded position.
  13. Discharge air temperature after heating coil, setpoint and indication.
  14. Space temperature setpoint and indication.
  15. Space air relative humidity.
- M. Safeties:
1. Smoke Control: Smoke detector, located in return air, stops fan when products of combustion are detected in air stream. Stopping of fan automatically signals alarm.
  2. Freeze protection: When OAT drops below 34F (adj), close OAD, open OA section CHW valve to 50%.
  3. Freeze-stat safety.
  4. High temperature safety.

### 1.12 DUAL PATH, VARIABLE VOLUME, AIR-HANDLING UNITS WITH VAV BOXES

- A. Time Schedule:
1. Program On and Off times as Owner's instructions.
- B. Definitions
1. Air terminal units: VAV boxes.
  2. "Critical box": VAV box with highest cooling demand, regardless of damper position. Highest cooling demand may better be determined, for examples, by cooling PID output signal or percentage of design CFM being provided.
- C. Fan Operation:
1. Unoccupied periods: Cycle fan to maintain unoccupied period setback temperature.
  2. System starts fan to run continuously during occupied periods.
  3. Modulate fan speed between minimum speed (adj.) and 100% to maintain duct static pressure setpoint. Sensor shall be installed at a location close to the end of the ducting system (field coordinate with Engineer).
    - a. Upon high static reading (above 2.5", adjustable), system shall issue an alarm at the Central Operator's Station and shut down air handler and outside air unit.
  4. Static Pressure Setpoint Reset:.
- D. Reset of Static Pressure and Return Air CHW Coil Leaving Air Temperature Setpoints
1. Reset both duct static pressure and AHU leaving air temperature to maintain space temperature and relative humidity setpoint conditions in the most energy efficient manner possible. Program a cascading sequence as follows:
    - a. **Monitor and poll VAV damper position to gauge cooling demand. If critical box % cooling demand is less than 95%, gradually reset (lower) duct static pressure setpoint as required to maintain Critical box damper at 95% open or greater, while AHU leaving air temperature remains at Normal setpoint.**

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- b. As space cooling load decreases, duct static pressure setpoint eventually reaches minimum allowable, after which Critical box damper must close below 95% to avoid overcooling space.
  - c. Reset AHU DAT (by modulating return air section chilled water valve) higher in 0.5F degree increments per 10-minute time period. Critical box damper should again eventually open to 95% or greater. Return air coil leaving air temperature shall never be allowed to exceed 65F (adj).
  - d. As cooling loads increase, reverse the above setpoint reset sequence.
  2. Dehumidification mode: If return air RH rises to greater than setpoint (60%, adj) for 20 minutes, open Return Air CHW Coil valve to maintain DAT of 53F. Disable mode when RH setpoint is achieved.
  3. Maximum and Maximum allowable discharge static setpoints are to be determined by testing, adjusting & balancing firm (TAB). Controls company must communicate and coordinate with TAB to obtain min and max allowable duct static pressure settings. Program those mix/max limits in to control system.
    - a. Minimum allowable discharge static setpoint will be 0.5", or higher if recommended by TAB.
    - b. Input from any box which has failed or lost communication shall be ignored.
- E. Outside Air Section of AHU (top unit):
1. During unoccupied mode, OA damper and CHW valve remain closed.
  2. During Occupied mode, when supply fan is running, control OA CHW coil and reset OA coil leaving air temperature as follows:
    - a. OAT < 34F: Close OA damper to 0%.
    - b. 34F < OAT < 55F (adjustable): OA CHW valve to remain 0% open.
    - c. OAT > 55F: Modulate CHW valve to maintain 53F setpoint (adjustable).
- F. Ventilation Sequence
1. Dampers shall not be hardwired to open and close when units are enabled/disabled.
  2. Associated exhaust fans shall be disabled and outside air dampers shall remain closed during unoccupied hours -including cool-down and nighttime reset operation.
  3. Provide dedicated time schedule for OA dampers and exhaust fans that *can be* set independently of AHU time schedule. Obtain actual Occupancy schedule from Owner and open / close outside air damper per Owner's actual Occupancy schedule (and **not per AHU schedule**).
  4. Dampers shall modulate between minimum open and maximum scheduled (fully) open position to maintain return air CO2 setpoint of 1100 ppm (adj.).
  5. Initial occupied period minimum OA positions shall be set at 50% (adj) of scheduled OA flow. Minimum damper position is determined by TAB Contractor such that building remains positively pressurized when building exhaust fans are on.
  6. Open OA dampers fully when return air CO2 concentration exceeds 1100 ppm (adj).
    - a. If after 30 minutes of operation CO2 concentration has not fallen below 900 ppm, modulate return air damper 20% closed.
    - b. If after an additional 30 minutes of operation CO2 concentration has not fallen below 900 ppm, modulate return air damper 40% closed, and continue operation at that position until CO2 concentration has fallen below 900 ppm.
    - c. Modulate outside air dampers to minimum position when CO2 concentration falls to 900 ppm or lower; re-position return air dampers to fully open.
    - d. If CO2 concentration exceeds 1,400 ppm, or OA flow drops below minimum, system shall issue an alarm at the Central Operator's Station.
    - e. Monitor zone CO2 levels.



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- 1) If zone CO<sub>2</sub> exceeds setpoint, modulate VAV open per VAV box sequences to allow more supply air into space.
  - 2) If CO<sub>2</sub> level does not drop below setpoint, issue alarm. Operator shall then manually reduce return air CO<sub>2</sub> setpoint by 10%. If situation does not get resolved, operator may continue to reduce setpoint. Contact engineer and contractor for recommendations if problems persist.
- G. Exhaust fan interlocks: Coordinate software interlocks between exhaust fans and outside air dampers. Refer to schedules and plans for exhaust fan allocation to units.
1. For AHUs serving Science Labs: When associated lab EF is enabled, OA damper shall modulate to scheduled maximum open position.
- H. Building pressurization and ventilation:
1. Provide a building pressurization sensor at the main entrance to the building. Initial setpoint for positive pressurization shall be 0.05" (adj.)
  2. If building pressure drops below setpoint, override CO<sub>2</sub> based DCV operation and gradually modulate OA dampers for AHUs- 1, 4, 8, 10, 11, 12 to fully open position, at a rate of 10% (adj) every 5 minutes.
  3. If all OADs are at fully open position, and pressure setpoint is not met, gradually modulate RADs to closed position, at a rate of 10% (adj) every 10 minutes.
  4. Once pressure setpoint is achieved or exceeded, return to normal operation in the same gradual manner, and eventually revert to CO<sub>2</sub> based DCV.
- I. Alarms:
1. Discrepancy between actual and commanded state of operation.
  2. Discharge air temperature deviates from setpoint by more than 3°F for 30 minutes.
  3. CO<sub>2</sub> level is above setpoint.
  4. Duct static pressure setpoint is not met for more than 3 minutes (adj.)
  5. Relative humidity setpoint is not met for more than 10 minutes (adj.)
  6. Building pressurization setpoint is not met for more than 5 minutes (adj)
- J. Operator Station Display: Indicate the following on operator workstation display terminal (if applicable) per each unit:
1. Building pressure sensor
  2. System occupied/unoccupied mode.
  3. A clear description of what area or room(s) unit serves.
  4. Outside-air-temperature indication.
  5. Outside-air-RH indication.
  6. Fan commanded state.
  7. Fan status.
  8. VFD Speed command.
  9. Duct static pressure setpoint and indication.
  10. Mixed DAT setpoint and indication at Unit Discharge (after fan).
  11. Return Air Section (main bottom unit):
    - a. Return air temperature from space, upstream of coil.
    - b. Return air CO<sub>2</sub> concentration.
    - c. Return air relative humidity.
    - d. Return air damper commanded position and feedback.
    - e. Mixed air temperature setpoint.
    - f. Coil leaving air temperature.
    - g. Cooling control-valve commanded position for Return Air Section.

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12. Outside Air Section (top unit):
  - a. Outside air damper commanded position and feedback.
  - b. Coil leaving air temperature setpoint and feedback.
  - c. Cooling control-valve commanded position.
13. Summary table of all VAV boxes served by the AHU; indicate Box ID (number & room), space temperature, CO<sub>2</sub>, and call for cooling PID output.
14. Critical Zone VAV identification, % cooling demand, CO<sub>2</sub> level.

### K. Safeties:

1. Smoke Control: Smoke detector, located in return air, stops fan when products of combustion are detected in air stream. Stopping of fan automatically signals alarm.
2. Freeze protection: When OAT drops below 34F (adj), close OAD, open OA section CHW valve to 50%.
3. High static pressure safety.
4. Freeze-stat safety.
5. High temperature safety.

## 1.13 VARIABLE AIR VOLUME BOXES

- A. Provide a Summary Page graphic screen for summarizing conditions of all associated VAV boxes, showing the following information: Box name, Space Temperature, Flow CFM actual, Flow CFM setpoint, Damper position, CO<sub>2</sub> level.

### B. Sequences:

1. Enable unit according to time schedules [of associated air handler](#).
2. Provide heating and cooling temperature setpoints with a minimum 5°F deadband.
3. Allowable adjustable range settings shall be programmable only at the COS (and not at the zone thermostat).
4. Room sensor reports temperature. System modulates VAV damper to maintain temperature set point.
5. When room temperature is below cooling setpoint, damper shall be in minimum position. During unoccupied hours, minimum position shall be closed (adj).
6. When room temperature drops below heating setpoint, damper shall be set to a preset heating setpoint (50% minimum, adjustable initial setpoint). System modulates electric heater stages to maintain space temperature in heating mode.
7. [For boxes with associated CO<sub>2</sub> sensor](#): If space CO<sub>2</sub> level rises above setpoint, [open box damper in 10% increments each 10-minutes](#). Revert to normal operation when CO<sub>2</sub> level returns to 50 ppm below setpoint.
8. Open VAV box damper to 100% when associated AHU is Off.
9. Operator Workstation: Display the following data:
  - a. Room number(s) served.
  - b. Name of room (e.g., Classroom 32; Media Center; Science Lab; etc.).
  - c. Room temperature.
  - d. Room temperature [Base](#) cooling and heating set points.
  - e. Room temperature [Effective](#) cooling and heating set points.
  - f. Air-damper position, percent open.
  - g. Heater command.
    - 1) Staged heat: On/Off status, each stage.
    - 2) SCR heat: % output.
  - h. Actual CFM.

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- i. Design maximum, minimum, and heat mode CFMs.
- j. VAV box leaving air temperature.
- k. VAV box entering air temperature (this is not a separate, additional input point for VAV box controller; display the DAT of AHU serving box, along with name of the AHU, on VAV box graphic next to box air inlet duct).
- l. CO2 ppm and CO2 setpoints, where applicable. See drawings for sensor location.

### C. Alarms:

1. Issue an alarm at Central Operator Station if systems fail to respond to commanded state, and if space T deviates more than 3°F (adjustable) from their setpoints.
  - a. Enable alarm only after system has had adequate time to reach setpoint upon morning startup (suggested 30 minutes).
  - b. If damper for any VAV box remains at >95% open for more than 30 consecutive minutes.
  - c. Base alarms only on active temperature setpoint, e.g. use Unoccupied setpoints for alarming when system is in Unoccupied mode.
  - d. When actual CFM differs from setpoint CFM by more than 10% for 15 consecutive minutes (if AHU serving box is in operation)
  - e. When cooling PID output signal is 100% for more than 3 consecutive hours (if AHU serving box is in operation)
  - f. When VAV heat is on for more than 3 hours in any given day.
2. Allow operator to enable/disable alarms.

### 1.14 FCU SCHEDULED CONTROL SEQUENCES (DX FCU and ACCU)

- A. Applicable to FCUs and associated ACCUs serving MDF, IDF and Elevator rooms.
- B. Acts as independent DX cooling system. Heating and Ventilation Modes are not applicable.
- C. Unit Default Mode: Upon start-up enable unit in cooling mode, and cycle compressors and fan to meet space temperature cooling setpoint (adj).
- D. Operator Workstation: Display the following data:
  1. FCU Tag and room number or name of room served
  2. System graphic.
  3. Unit commanded state.
  4. Fan status (on/off)
  5. Compressor Status (on/off)
  6. Space Temperature setpoint and indication.
  7. Discharge Air Temperature.

### 1.15 BUILDING EXHAUST FAN SCHEDULED CONTROL SEQUENCES

- A. Sequence:
  1. Enable/disable EFs according to occupancy schedule. Occupancy times will be initially set-up according to the Automatic Time Schedule for each fan and shall be completely operator adjustable for fans individually.
  2. Exhaust fans shall have a dedicated time schedule (that is independent of AHU time schedule). Coordinate time schedules such that exhaust fans are operational only when

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associated outside air dampers are open. Under no circumstances should exhaust fans operate when outside air dampers are closed.

3. See EF Schedule on drawings for additional controls. For instance, some fans have occupancy sensors, while others may have toggle switches, or push buttons. Coordinate with other trades to accomplish specified operation.
- B. **Manual Override:** Control may be manually overridden at the controller and at the COS. Control will remain in “Override” position for a pre-programmed time period (1 hour, adj).
- C. **Interlocks:**
1. **Hardware Interlocks:** Controls shall not bypass any safeties or interlocks associated with fire protection shutdown.
  2. **Software Interlocks:** Provide all hardware necessary to achieve software interlocks required for proper system operation. Coordinate with mechanical and electrical contractors.
- D. **Kitchen hood supply and exhaust fans:**
1. **Retain existing safeties and simply monitor Status.**
- E. **Exhaust fan at Science Labs: See EF schedule**
1. **Design Intent:** Fans shall operate either in NORMAL SCIENCE LAB ventilation mode based on time schedule and occupancy sensor, or under PURGE ventilation mode via push button for a predetermined length of time.
  2. **NORMAL Mode Sequence:** Enable/disable EFs in NORMAL mode according to SCIENCE LAB occupancy schedule. If space is used as a classroom, Owner may schedule the fans off. Once enabled, Occupancy sensor shall start/stop fan.
  3. **PURGE Mode Sequence:** EFs will be started in PURGE mode when manual pushbutton PURGE switch is activated. Fans shall remain in PURGE mode for a pre-programmed time period (15 minutes, adjustable).
  4. **Overrides and time schedule shall be programmed per sequences above.**
- F. **Pass-through Fume Hood Exhaust Fans**
1. **General:** Div. 23 is responsible for installing fume hood exhaust fans, connecting to exhaust ductwork and fume hood, and integrating with building control system.
  2. **Design Intent:** While DDC shall enable / disable fans according to occupancy schedule, fans shall (operate) be turned on / off by a manual toggle-switch.
  3. **Monitor status.**
- G. **Pre-Engineering exhaust fans:**
1. **General exhaust fan shall have a time schedule for Off/Enable, and an occupancy sensor for On/Off operation.**
  2. **Laser cutting exhaust fan shall have a toggle switch for operation.**
  3. **To prevent extreme negative pressurization in this zone, coordinate exhaust fan operation (general EF, laser equipment material handling EF), such that general EF is temporarily disabled when material handling EF is ON.**
- H. **All other exhaust fans:** Fans operate continuously via time schedules during occupied mode.
1. **Prep room and chemical cabinet fans operate continuously during occupied mode.**
  2. **Restroom fans operate continuously during occupied mode.**
  3. **Janitor room fan operates via light switch.**
  4. **General purpose exhaust fans, etc.**

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- I. Operator Workstation: Display the following data:
  - 1. Building pressurization sensor
  - 2. Sum of exhaust air CFM for all exhaust fans
  - 3. EF tag and the name of room/area which it serves
  - 4. System graphic.
  - 5. System occupied/unoccupied mode.
  - 6. Fan On/Off or Off/Enable status. For any fan controlled by BAS as well as another device (e.g. occupancy sensor or manual switch), graphic must state BAS control as ENABLE status, and not ON/OFF status. When such a fan is Enabled but Status is Off, a status mismatch alarm is not to be generated.
  - 7. Fan speed.
  - 8. Fan status.
  - 9. Purge status, where applicable. Monitor purge status relay within lab control panel, display purge status on graphic.
  - 10. Associated AHU status.

### 1.16 DOMESTIC WATER HEATER

- A. See drawings for water heater locations. Controls contractor is responsible for complete installation, including furnishing and installing control relays if not integral to water heater or circulating pump. Coordinate with Div. 26 for 480V contactor.
- B. Provide time schedules and optimal start/stop function for water heaters.
- C. Operator Workstation: Display the following data:
  - 1. System graphic.
  - 2. Water Heater Off / Enable.

### 1.17 ELECTRIC DRINKING FOUNTAINS

- A. Provide common time schedules for all electrical drinking fountains. Provide relays to control several fountains. Coordinate quantity and location with plans.
- B. Operator Workstation: Display the following data:
  - 1. System graphic.
  - 2. Drinking fountain Off / Enable.

### 1.18 ELECTRIC METER MONITORING

Applies to [Applies to Service Entrance \(wiring gutter\)](#), and 480V Panel serving Kitchen Facilities.

- A. Power meters are by Div. 26. Prior to bidding, coordinate [with Electrical for proper BACnet MSTP communications protocol](#) interface. Provide all accessories necessary for an operational system.
- B. Operator Station Display: Indicate the following on operator workstation display terminal:
  - 1. Demand (list to 0 decimal places)
    - a. Present kW demand.

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- b. Peak kW demand in current monthly billing cycle.
    - c. Present KVA demand.
    - d. Peak KVA demand in current monthly billing cycle.
  2. kWh (list to 0 decimal places)
    - a. Cumulative for current day.
    - b. Current month to date.
    - c. Cumulative for previous month.
    - d. Cumulative year to date.
  3. Power Factor (list to 2 decimal places)
  4. Amps (list to 0 decimal places)
    - a. Amps, all 3 legs.
    - b. Amps, average.
    - c. Neutral amps.
  5. Voltage (list to 0 decimal places)
    - a. Present L-L voltage, all 3 legs.
- C. Trend and store the following parameters every 15 minutes, with minimum 5 days data storage:
  1. KVA demand.
  2. kW demand.
  3. Power Factor.
  4. Amps, each leg.

### 1.19 LIGHTING SYSTEMS

- A. BAS shall monitor and control the Lighting Control System via BACnet interface. Coordinate with lighting controls provider for details, and for BACnet interface data.
- B. Via a system graphic interface displays zoning and scenes. As a minimum the listed points shall be monitored/controlled for each zone.
  1. Area Name
  2. Lighting circuit Off/Enable (Time Schedules)
  3. Lighting status (On/Off)
  4. Light intensity level status (dimming 0-100)
  5. Occupancy status
  6. Lighting power (kW)
  7. Lighting energy (kWh usage calculated by BAS) vfd

### 1.20 OTHER SEQUENCES

- A. Operator Overrides: System shall allow operator to enable / disable unit and / or control / adjust all setpoints from COS.
- B. Alarms: System shall issue alarm at COS upon failure of fan or failure to achieve setpoint within specified time (15 min. adj.)
- C. Graphics pages must have units listed beside parameter values (e.g. °F, ppm, % Open, psi, etc.)
- D. When parameters are in manual or test modes, graphics shall indicate that they are in test mode.

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- E. Provide up to 20 hours of programming, to account for additional control sequences and fine-tuning above sequences, during the course of the project.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 230993

## SECTION 232113 - HYDRONIC PIPING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section includes pipe and fitting materials and joining methods for the following:
  1. Chilled-water piping.
  2. Makeup-water piping.
  3. Condensate-drain piping.
  4. Air-vent piping.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of the following:
  1. Fittings.
  2. Piping.
- B. Sustainability Submittals:
  1. Product Data: For solvent cements and adhesive primers, documentation including printed statement of VOC content.
- C. Delegated-Design Submittal:
  1. Design calculations and detailed fabrication and assembly of pipe anchors and alignment guides, hangers and supports for multiple pipes, expansion joints and loops, and attachments of the same to the building structure.
  2. Locations of pipe anchors and alignment guides and expansion joints and loops.
  3. Locations of and details for penetrations, including sleeves and sleeve seals for exterior walls, floors, basement, and foundation walls.
  4. Locations of and details for penetration and firestopping for fire- and smoke-rated wall and floor and ceiling assemblies.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Piping layout, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  1. Suspended ceiling components.
  2. Other building services.
  3. Structural members.



## SECTION 232113 - HYDRONIC PIPING

- B. Qualification Data: For Installer.
- C. Welding certificates.
- D. Field quality-control reports.

### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications:
- B. Steel Support Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- C. Pipe Welding: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
  - 1. Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation.
  - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature unless otherwise indicated:
  - 1. Chilled-Water Piping: 175 psig at 200 deg F.
  - 2. Makeup-Water Piping: 80 psig at 150 deg F.
  - 3. Condensate-Drain Piping: 150 deg F.
  - 4. Air-Vent Piping: 200 deg F.

### 2.2 COPPER TUBE AND FITTINGS

- A. Drawn-Temper Copper Tubing: ASTM B 88, Type L.
- B. Annealed-Temper Copper Tubing: ASTM B 88, Type K.
- C. DWV Copper Tubing: ASTM B 306, Type DWV.
- D. Wrought-Copper Unions: ASME B16.22.

### 2.3 STEEL PIPE AND FITTINGS

- A. Steel Pipe: ASTM A 53/A 53M, black steel with plain ends; welded and seamless, Grade B, and wall thickness as indicated in "Piping Applications" Article.

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- B. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300 as indicated in "Piping Applications" Article.
- C. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300 as indicated in "Piping Applications" Article.
- D. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 25, 125, and 250; raised ground face, and bolt holes spot faced as indicated in "Piping Applications" Article.
- E. Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.
- F. 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.
- G. Grooved Mechanical-Joint Fittings and Couplings:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Anvil International.
    - b. Central Sprinkler Company.
    - c. Victaulic Company.
  - 2. Joint Fittings: ASTM A 536, Grade 65-45-12 ductile iron; ASTM A 47/A 47M, Grade 32510 malleable iron; ASTM A 53/A 53M, Type F, E, or S, Grade B fabricated steel; or ASTM A 106/A 106M, Grade B steel fittings with grooves or shoulders constructed to accept grooved-end couplings; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.
  - 3. Couplings: Ductile- or malleable-iron housing and EPDM gasket of central cavity pressure-responsive design; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.
- H. Steel Pipe Nipples: ASTM A 733, made of same materials and wall thicknesses as pipe in which they are installed.

### 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 otherwise indicated.
    - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
    - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

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- B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- C. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.
- D. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- E. 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. Viega LLC.
- 2. One-piece fitting with one threaded brass or copper insert and one solvent-cement-joint end of material and wall thickness to match plastic pipe material.

#### 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. NIBCO INC.
- 2. Brass or copper end, solvent-cement-joint end of material and wall thickness to match plastic pipe material, 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. Watts; a Watts Water Technologies company.
  - b. Wilkins.
  - c. Zurn Industries, LLC.
- 2. Description:

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- a. Standard: ASSE 1079.
- b. Pressure Rating: 250 psig.
- 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. Watts; a Watts Water Technologies company.
  - b. Wilkins.
  - c. Zurn Industries, LLC.
2. Description:
  - a. Standard: ASSE 1079.
  - b. Factory-fabricated, bolted, companion-flange assembly.
  - c. Pressure Rating: 175 psig.
  - 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. Central Plastics Company.
  - c. Pipeline Seal and Insulator, Inc.
2. Description:
  - a. Nonconducting 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. Grinnell Mechanical Products.
  - b. Victaulic Company.
2. Description:
  - a. Standard: IAPMO PS 66.
  - b. Electroplated steel nipple, complying with ASTM F 1545.
  - c. Pressure Rating: 300 psig at 225 deg F.

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- d. End Connections: Male threaded or grooved.
- e. Lining: Inert and noncorrosive, propylene.

### PART 3 - EXECUTION

#### 3.1 PIPING APPLICATIONS

- A. Chilled-water piping, aboveground, NPS 2 and smaller, shall be any of the following:
  - 1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
  - 2. Schedule 40 steel pipe; Class 150, malleable-iron fittings; cast-iron flanges and flange fittings; and threaded joints.
- B. Chilled-water piping, aboveground, NPS 2-1/2 and larger, shall be the following:
  - 1. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.
- C. Makeup-water piping installed aboveground shall be the following:
  - 1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
- D. Makeup-Water Piping Installed Belowground and within Slabs: Type K, annealed-temper copper tubing, wrought-copper fittings, and soldered joints. Use the fewest possible joints.
- E. Condensate-Drain Piping: Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
- F. Blowdown-Drain Piping: Same materials and joining methods as for piping specified for the service in which blowdown drain is installed.
- G. Air-Vent Piping:
  - 1. Inlet: Same as service where installed with metal-to-plastic transition fittings for plastic piping systems according to piping manufacturer's written instructions.
  - 2. 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. 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.

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- 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 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 Div. 23 sections.
- 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 shutoff valve immediately upstream of each dielectric fitting.
- T. Comply with requirements in Section 230516 "Expansion Fittings and Loops for HVAC Piping" for installation of expansion loops, expansion joints, anchors, and pipe alignment guides.
- U. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for identifying piping.
- V. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."
- W. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."

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- X. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 230518 "Escutcheons for HVAC Piping."

### 3.3 DIELECTRIC FITTING INSTALLATION

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric unions.
- C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges.
- D. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

### 3.4 HANGERS AND SUPPORTS

- A. Comply with requirements in Section 230529 "Hangers and Supports for HVAC Piping and Equipment" for hanger, support, and anchor devices. Comply with the following requirements for maximum spacing of supports.
- B. Install the following pipe attachments:
  - 1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.
  - 2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet or longer.
  - 3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
  - 4. Spring hangers to support vertical runs.
  - 5. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
- C. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:
  - 1. NPS 3/4: Maximum span, 7 feet.
  - 2. NPS 1: Maximum span, 7 feet.
  - 3. NPS 1-1/2: Maximum span, 9 feet.
  - 4. NPS 2: Maximum span, 10 feet.
  - 5. NPS 2-1/2: Maximum span, 11 feet.
  - 6. NPS 3 and Larger: Maximum span, 12 feet.
- D. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:
  - 1. NPS 3/4: Maximum span, 5 feet; minimum rod size, 1/4 inch.
  - 2. NPS 1: Maximum span, 6 feet; minimum rod size, 1/4 inch.
  - 3. NPS 1-1/4: Maximum span, 7 feet; minimum rod size, 3/8 inch.
  - 4. NPS 1-1/2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
  - 5. NPS 2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
  - 6. NPS 2-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
  - 7. NPS 3 and Larger: Maximum span, 10 feet; minimum rod size, 3/8 inch.

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- E. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.

### 3.5 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. 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/A5.8M.
- D. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
  - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- E. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.
- F. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- G. Grooved Joints: Assemble joints with coupling and gasket, lubricant, and bolts. Cut or roll grooves in ends of pipe based on pipe and coupling manufacturer's written instructions for pipe wall thickness. Use grooved-end fittings and rigid, grooved-end-pipe couplings.

### 3.6 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. Comply with requirements in Section 230519 "Meters and Gages for HVAC Piping."

### 3.7 FIELD QUALITY CONTROL

- A. Prepare hydronic piping according to ASME B31.9 and as follows:
  - 1. Leave joints, including welds, uninsulated and exposed for examination during test.



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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 the "SE" value in Appendix A in ASME B31.9, "Building Services Piping."
5. After hydrostatic test pressure has been applied for at least 10 minutes, 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 232113

## SECTION 232113.13 - UNDERGROUND HYDRONIC PIPING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. This Section includes underground insulated piping outside the building for distribution of chilled water.

#### 1.3 PERFORMANCE REQUIREMENTS

- A. Provide components and installation capable of producing hydronic piping systems with the following minimum working-pressure ratings:
  - 1. Chilled-Water Piping: 150 psig at 200 deg F.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For the following:
  - 1. Conduit piping.
  - 2. Cased piping.
  - 3. Loose-fill insulation.
- B. Shop Drawings: For underground hydronic piping. Signed and sealed by a professional engineer.
  - 1. Calculate requirements for expansion compensation for underground piping.
  - 2. Show expansion compensators, offsets, and loops with appropriate materials to allow piping movement in the required locations. Show anchors and guides that restrain piping movement with calculated loads, and show concrete thrust block dimensions.
  - 3. Show pipe sizes, locations, and elevations. Show piping in trench, conduit, and cased pipe with details showing clearances between piping, and show insulation thickness.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Profile Drawings: Show system piping in elevation. Draw profiles at horizontal scale of not less than 1 inch equals 50 feet and at vertical scale of not less than 1 inch equals 5 feet. Indicate manholes and piping. Show types, sizes, materials, and elevations of other utilities crossing hydronic piping.
- B. Qualification Data: For qualified Installer.

## SECTION 232113.13 - UNDERGROUND HYDRONIC PIPING

- C. Welding certificates.
- D. Source quality-control reports.
- E. Field quality-control reports.

### 1.6 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX.
  - 1. Comply with provisions in ASME B31.9, "Building Services Piping."
  - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- B. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation.

### 1.7 PROJECT CONDITIONS

- A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
  - 1. Notify Architect no fewer than two days in advance of proposed utility interruptions.
  - 2. Do not proceed with utility interruptions without Architect's written permission.

## PART 2 - PRODUCTS

### 2.1 STEEL PIPES AND FITTINGS

- A. Steel Pipe: ASTM A 53/A 53M, black with plain ends; type, grade, and wall thickness as indicated in "Piping Application" Article.
- B. Steel Welding Fittings: ASME B16.9 and ASTM A 234/A 234M, seamless or welded.
  - 1. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- C. Nipples: ASTM A 733, made of same materials and wall thicknesses as pipe in which they are installed.
- D. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

### 2.2 CASED PIPING SYSTEM

- A. Description: Factory-fabricated piping with carrier pipe, insulation, and casing.

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- B. Manufacturers:
1. Insul-Tek Piping Systems, Inc.
  2. PERMA-PIPE, Inc.
  3. Rovanco Piping Systems, Inc.
  4. Thermacor Process, L.P.
  5. Thermal Pipe Systems.
  6. Urecon Ltd.
  7. Insul-pipe
- C. Carrier Pipe:
1. Design Basis: High-density polyethylene, SDR 11. Heat fusion joints per manufacturer's instructions.
- D. Carrier Pipe Insulation:
1. Polyurethane Foam Pipe Insulation: Rigid, cellular, high-pressure injected between carrier pipe and jacket.
    - a. Comply with ASTM C 591; thermal conductivity (k-value) shall not exceed **0.13 Btu x in./h x sq. ft. x deg F** at **75 deg F** after 180 days of aging.
    - b. Moisture Absorption: ASTM D 2842, maximum 0.054 percent by volume.
    - c. Minimum 90 percent closed cell.
    - d. Dry Density: **2 lb/cu. ft.** maximum.
    - e. Compressive Strength: **35 psig** minimum at 5 percent deformation.
    - f. Water-Vapor Transmission: **1.26 perm inches** according to ASTM E 96.
- E. Casing: HDPE or PVC.
- F. Casing accessories include the following:
1. Joint Kit: Half-shell, pourable or split insulation, casing sleeve, and shrink-wrap sleeve.
  2. Expansion Blanket: Elastomeric foam, formed to fit over piping.
  3. End Seals: Shrink wrap the casing material to seal watertight around casing and carrier pipe.
- G. Manholes: Black steel with lifting eyes.
1. Finish: Spray-applied urethane, minimum **30 mils** thick.
  2. Access: **30-inch**-diameter waterproof cover with gasket, ladder, and two **6-inch** vents, one high and one low, extending above grade with rain caps.
  3. Conduit Stub-Outs and Seals: Welded steel with drain and vent openings.
  4. Sump: **12 inches** in diameter, **12 inches** deep.
  5. Floatation Anchor: Oversized bottom keyed into concrete base.
- H. Source Quality Control: Factory test the carrier pipe to 150 percent of the operating pressure of system. Furnish test certificates.

## SECTION 232113.13 - UNDERGROUND HYDRONIC PIPING

### PART 3 - EXECUTION

#### 3.1 EARTHWORK

- A. See Section 312000 "Earth Moving" for excavating, trenching, and backfilling.

#### 3.2 PIPING APPLICATION

- A. Chilled-Water Piping: Cased piping with polyurethane carrier-pipe insulation.
  - 1. Insulation Thickness: 2 inches.

#### 3.3 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicate piping locations and arrangements if such were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- B. Remove standing water in the bottom of trench.
- C. Do not backfill piping trench until field quality-control testing has been completed and results approved.
- D. Install piping at uniform grade of 0.2 percent. Install drains, consisting of a tee fitting, **NPS 3/4** ball valve, and short **NPS 3/4** threaded nipple with cap, at low points and elsewhere as required for system drainage. Install manual air vents at high points.
- E. In conduits, install drain valves at low points and manual air vents at high points.
- F. Install components with pressure rating equal to or greater than system operating pressure.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. See Section 230517 "Sleeves and Sleeve Seals for HVAC Piping" for sleeves and mechanical sleeve seals through exterior building walls.
- J. Secure anchors with concrete thrust blocks. Concrete is specified in Section 033000 "Cast-in-Place Concrete." **Install anchors and concrete thrust blocks per manufacturer's installation instructions for pipe.**
- K. Connect to hydronic piping where it passes through the building wall. Hydronic piping inside the building is specified in Division 15 Section "Hydronic Piping."

## SECTION 232113.13 - UNDERGROUND HYDRONIC PIPING

### 3.4 JOINT CONSTRUCTION

- A. See Section 330500 "Common Work Results for Utilities" for basic piping joint construction.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.
- E. **Install and join HDPE piping per manufacturer's installation instructions.**

### 3.5 IDENTIFICATION

- A. Install continuous plastic underground warning tapes during back filling of trenches for underground hydronic piping. Locate tapes **6 to 8 inches** below finished grade, directly over piping. See Section 312000 "Earth Moving" for warning-tape materials and devices and their installation.

### 3.6 FIELD QUALITY CONTROL

- A. 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.
- B. Tests and Inspections:
  - 1. Prepare hydronic piping for testing according to ASME B31.9 and as follows:
    - a. Leave joints, including welds, uninsulated and exposed for examination during test.
    - b. Fill system with water. Where there is risk of freezing, air or a safe, compatible liquid may be used.
    - c. Use vents installed at high points to release trapped air while filling system.
  - 2. Test hydronic piping as follows:
    - a. Subject hydronic piping to hydrostatic test pressure that is not less than 1.5 times the design pressure.
    - b. After hydrostatic test pressure has been applied for 10 minutes, examine joints for leakage. Remake leaking joints using new materials and repeat hydrostatic test until no leaks exist.
- C. Prepare test and inspection reports.

END OF SECTION 232113.13

## SECTION 232116 - HYDRONIC PIPING SPECIALTIES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section includes special-duty valves and specialties for the following:
  1. Chilled-water piping.
  2. Makeup-water piping.
  3. Air-vent piping.
  4. Safety-valve-inlet and -outlet piping.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of the following:
  1. Valves: Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.
  2. Air-control devices.
  3. Hydronic specialties.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For air-control devices, hydronic specialties, and special-duty valves to include in emergency, operation, and maintenance manuals.

#### 1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Differential Pressure Meter: For each type of balancing valve and automatic flow control valve, include flowmeter, probes, hoses, flow charts, and carrying case.

#### 1.6 QUALITY ASSURANCE

- A. Pipe Welding: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
  1. 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.

## SECTION 232116 - HYDRONIC PIPING SPECIALTIES

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature unless otherwise indicated:
1. Chilled-Water Piping: 175 psig at 200 deg F.
  2. Makeup-Water Piping: 80 psig at 150 deg F.
  3. Air-Vent Piping: 200 deg F.
  4. Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.

#### 2.2 VALVES

- A. Gate, Globe, Check, Ball, and Butterfly Valves: Comply with requirements specified in Division 23 Sections.
- B. Automatic Temperature-Control Valves, Actuators, and Sensors: Comply with requirements specified in Section 230900.
- C. Cast-Iron or Steel, Calibrated-Orifice, Balancing Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Armstrong Pumps, Inc.
    - b. Bell & Gossett; a Xylem brand.
    - c. Flow Design, Inc.
    - d. Griswold Controls.
    - e. Grundfos
    - f. Nexus Valve, Inc.
    - g. Taco.
  2. Body: Cast-iron or steel body, ball, plug, or globe pattern with calibrated orifice or venturi.
  3. Ball: Stainless steel.
  4. Stem Seals: EPDM O-rings.
  5. Disc: Glass and carbon-filled PTFE.
  6. Seat: PTFE.
  7. End Connections: Flanged or grooved.
  8. Pressure Gage Connections: Integral seals for portable differential pressure meter.
  9. Handle Style: Lever, with memory stop to retain set position.
  10. CWP Rating: Minimum 125 psig.
  11. Maximum Operating Temperature: 250 deg F.
- D. Diaphragm-Operated, Pressure-Reducing Valves: ASME labeled.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. AMTROL, Inc.



## SECTION 232116 - HYDRONIC PIPING SPECIALTIES

- b. [Armstrong Pumps, Inc.](#)
  - c. [Bell & Gossett; a Xylem brand.](#)
  - d. [Grundfos](#)
  - e. [Watts; a Watts Water Technologies company.](#)
2. Body: Bronze or brass.
  3. Disc: Glass and carbon-filled PTFE.
  4. Seat: Brass.
  5. Stem Seals: EPDM O-rings.
  6. Diaphragm: EPT.
  7. Low inlet-pressure check valve.
  8. Inlet Strainer: Stainless steel, removable without system shutdown.
  9. Valve Seat and Stem: Noncorrosive.
  10. Valve Size, Capacity, and Operating Pressure: Selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.
- E. Diaphragm-Operated Safety Valves: ASME labeled.
1. [Manufacturers:](#) Subject to compliance with requirements, provide products by one of the following:
    - a. [AMTROL, Inc.](#)
    - b. [Armstrong Pumps, Inc.](#)
    - c. [Bell & Gossett; a Xylem brand.](#)
    - d. [Grundfos](#)
    - e. [Watts; a Watts Water Technologies company.](#)
  2. Body: Bronze or brass.
  3. Disc: Glass and carbon-filled PTFE.
  4. Seat: Brass.
  5. Stem Seals: EPDM O-rings.
  6. Diaphragm: EPT.
  7. Wetted, Internal Work Parts: Brass and rubber.
  8. Inlet Strainer: Stainless steel, removable without system shutdown.
  9. Valve Seat and Stem: Noncorrosive.
  10. Valve Size, Capacity, and Operating Pressure: Comply with ASME Boiler and Pressure Vessel Code: Section IV, and selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.
- F. Automatic Flow-Control Valves:
1. [Manufacturers:](#) Subject to compliance with requirements, provide products by one of the following:
    - a. [Flow Design, Inc.](#)
    - b. [Griswold Controls.](#)
    - c. [Grundfos](#)
    - d. [Nexus Valve, Inc.](#)
  2. Body: Brass or ferrous metal.
  3. Piston and Spring Assembly: Stainless steel, tamper proof, self-cleaning, and removable.
  4. Combination Assemblies: Include bronze or brass-alloy ball valve.
  5. Identification Tag: Marked with zone identification, valve number, and flow rate.

## SECTION 232116 - HYDRONIC PIPING SPECIALTIES

6. Size: Same as pipe in which installed.
7. Performance: Maintain constant flow, plus or minus 5 percent over system pressure fluctuations.
8. Minimum CWP Rating: 175 psig.
9. Maximum Operating Temperature: 200 deg F.

### 2.3 AIR-CONTROL DEVICES

#### A. Manual Air Vents:

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
  - a. [AMTROL, Inc.](#)
  - b. [Armstrong Pumps, Inc.](#)
  - c. [Bell & Gossett; a Xylem brand.](#)
  - d. [Grundfos](#)
  - e. [Nexus Valve, Inc.](#)
  - f. [Taco, Inc.](#)
2. Body: Bronze.
3. Internal Parts: Nonferrous.
4. Operator: Screwdriver or thumbscrew.
5. Inlet Connection: NPS 1/2.
6. Discharge Connection: NPS 1/8.
7. CWP Rating: 150 psig.
8. Maximum Operating Temperature: 225 deg F.

#### B. Automatic Air Vents:

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
  - a. [AMTROL, Inc.](#)
  - b. [Armstrong Pumps, Inc.](#)
  - c. [Bell & Gossett; a Xylem brand.](#)
  - d. [Grundfos](#)
  - e. [Nexus Valve, Inc.](#)
  - f. [Taco, Inc.](#)
2. Body: Bronze.
3. Internal Parts: Nonferrous.
4. Operator: Noncorrosive metal float.
5. Inlet Connection: NPS 1/2.
6. Discharge Connection: NPS 1/4.
7. CWP Rating: 150 psig.
8. Maximum Operating Temperature: 240 deg F.

#### C. Bladder-Type Expansion Tanks:

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:

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- a. [AMTROL, Inc.](#)
  - b. [Armstrong Pumps, Inc.](#)
  - c. [Grundfos](#)
  - d. [Bell & Gossett; a Xylem brand.](#)
  - e. [Taco, Inc.](#)
2. Tank: Welded steel, rated for 125-psig working pressure and 375 deg F maximum operating temperature. Factory test after taps are fabricated and supports installed and are labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
  3. Bladder: Securely sealed into tank to separate air charge from system water to maintain required expansion capacity.
  4. Air-Charge Fittings: Schrader valve, stainless steel with EPDM seats.
- D. Tangential-Type Air Separators:
1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
    - a. [AMTROL, Inc.](#)
    - b. [Armstrong Pumps, Inc.](#)
    - c. [Bell & Gossett; a Xylem brand.](#)
    - d. [Grundfos](#)
    - e. [Taco, Inc.](#)
  2. Tank: Welded steel; ASME constructed and labeled for 125-psig minimum working pressure and 375 deg F maximum operating temperature.
  3. Air Collector Tube: Perforated stainless steel, constructed to direct released air into expansion tank.
  4. Tangential Inlet and Outlet Connections: Threaded for NPS 2 and smaller; flanged connections for NPS 2-1/2 and larger.
  5. Blowdown Connection: Threaded.
  6. Size: Match system flow capacity.
- E. In-Line Air Separators:
1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
    - a. [AMTROL, Inc.](#)
    - b. [Armstrong Products, Inc.](#)
    - c. [Bell & Gossett; a Xylem brand.](#)
    - d. [Grundfos](#)
    - e. [Taco, Inc.](#)
  2. Tank: One-piece cast iron with an integral weir constructed to decelerate system flow to maximize air separation.
  3. Maximum Working Pressure: Up to 175 psig.
  4. Maximum Operating Temperature: Up to 300 deg F.
- F. Air Purgers:
1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:

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- a. [AMTROL, Inc.](#)
  - b. [Armstrong Pumps, Inc.](#)
  - c. [Bell & Gossett; a Xylem brand.](#)
  - d. [Grundfos](#)
  - e. [Taco, Inc.](#)
2. Body: Cast iron with internal baffles that slow the water velocity to separate the air from solution and divert it to the vent for quick removal.
  3. Maximum Working Pressure: 150 psig.
  4. Maximum Operating Temperature: 250 deg F.

### 2.4 HYDRONIC PIPING SPECIALTIES

#### A. Y-Pattern Strainers:

1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
3. Strainer Screen: Stainless-steel, 40-mesh strainer, or perforated stainless-steel basket.
4. CWP Rating: 125 psig.

#### B. Basket Strainers:

1. Body: ASTM A 126, Class B, high-tensile cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
3. Strainer Screen: 40-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating: 125 psig.

#### C. Stainless-Steel Bellow, Flexible Connectors:

1. Body: Stainless-steel bellows with woven, flexible, bronze, wire-reinforcing protective jacket.
2. End Connections: Threaded or flanged to match equipment connected.
3. Performance: Capable of 3/4-inch misalignment.
4. CWP Rating: 150 psig.
5. Maximum Operating Temperature: 250 deg F.

#### D. Spherical, Rubber, Flexible Connectors:

1. Body: Fiber-reinforced rubber body.
2. End Connections: Steel flanges drilled to align with Classes 150 and 300 steel flanges.
3. Performance: Capable of misalignment.
4. CWP Rating: 150 psig.
5. Maximum Operating Temperature: 250 deg F.

#### E. Expansion Fittings: Comply with requirements in Section 230516 "Expansion Fittings and Loops for HVAC Piping." Section 15124 "Expansion Fittings and Loops for HVAC Piping."

## SECTION 232116 - HYDRONIC PIPING SPECIALTIES

### PART 3 - EXECUTION

#### 3.1 VALVE APPLICATIONS

- A. Install shutoff-duty valves at each branch connection to supply mains and at supply connection to each piece of equipment.
- B. Install calibrated-orifice, balancing valves at each branch connection to return main.
- C. Install calibrated-orifice, balancing valves in the return pipe of each heating or cooling terminal.
- D. Install check valves at each pump discharge and elsewhere as required to control flow direction.
- E. Install safety valves at hot-water generators and elsewhere as required by ASME Boiler and Pressure Vessel Code. Install drip-pan elbow on safety-valve outlet and pipe without valves to the outdoors; pipe drain to nearest floor drain or as indicated on Drawings. Comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, for installation requirements.
- F. Install pressure-reducing valves at makeup-water connection to regulate system fill pressure.

#### 3.2 HYDRONIC SPECIALTIES INSTALLATION

- A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.
- B. Install automatic air vents at high points of system piping in mechanical equipment rooms only. Install manual vents at heat-transfer coils and elsewhere as required for air venting.
- C. Install piping from air separator, or air purger to expansion tank with a 2 percent upward slope toward tank.
- D. Install in-line air separators in pump suction. Install drain valve on air separators NPS 2 and larger.
- E. Install tangential air separator in pump suction. Install blowdown piping with gate or full-port ball valve; extend full size to nearest floor drain.
- F. Install expansion tanks on the floor. Vent and purge air from hydronic system, and ensure that tank is properly charged with air to suit system Project requirements.

END OF SECTION 232116

## SECTION 232123 - 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: Separately coupled, vertically mounted, in-line centrifugal pumps.

#### 1.3 DEFINITIONS

- A. Buna-N: Nitrile rubber.
- B. EPT: Ethylene propylene terpolymer.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of pump. Include certified performance curves and rated capacities, operating characteristics, furnished specialties, final impeller dimensions, and accessories for each type of product indicated. Indicate pump's operating point on curves.
- B. Shop Drawings: For each pump.
  - 1. Show pump layout and connections.
  - 2. Include setting drawings with templates for installing base rail, anchor bolts and other anchorages.
  - 3. Include diagrams for power, signal, and control wiring.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: Include in emergency, operation, and maintenance manuals.

#### 1.6 QUALITY ASSURANCE

- A. Source Limitations: Obtain hydronic pumps through one source from a single manufacturer.
- B. Product Options: Drawings indicate size, profiles, and dimensional requirements of hydronic pumps and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."
- C. 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.

## SECTION 232123 - HYDRONIC PUMPS

- D. UL Compliance: Comply with UL 778 for motor-operated water pumps.

### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Manufacturer's Preparation for Shipping: Clean flanges and exposed machined metal surfaces and treat with anticorrosion compound after assembly and testing. Protect flanges, pipe openings, and nozzles with wooden flange covers or with screwed-in plugs.
- B. Store pumps in dry location.
- C. Retain protective covers for flanges and protective coatings during storage.
- D. Protect bearings and couplings against damage from sand, grit, and other foreign matter.
- E. Comply with pump manufacturer's written rigging instructions.

### 1.8 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

### 1.9 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Mechanical Seals: One mechanical seal(s) for each pump.

## PART 2 - PRODUCTS

### 2.1 SEPARATELY COUPLED, VERTICALLY MOUNTED, IN-LINE CENTRIFUGAL PUMPS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1.
  - 2. Grundfos
  - 3. Armstrong Pumps, Inc.
  - 4. ITT Corporation.
  - 5. TACO Incorporated.
- B. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, separately coupled, in-line pump as defined in HI 1.1-1.2 and HI 1.3; designed for installation with pump and motor shafts mounted vertically. Rate pump for exterior location.
- C. Pump Construction:
  - 1. Casing: Radially split, cast iron, with replaceable bronze wear rings, threaded gage tappings at inlet and outlet, replaceable bronze wear rings, threaded companion-flange, drain plug at bottom and air vent at top of volute, and flanged connections. Provide

## SECTION 232123 - HYDRONIC PUMPS

integral mount on volute to support the casing, and provide attached piping to allow removal and replacement of impeller without disconnecting piping or requiring the realignment of pump and motor shaft.

2. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. For pumps not frequency-drive controlled, trim impeller to match specified performance.
  3. Pump Shaft: Stainless steel.
  4. Seal: Mechanical seal consisting of carbon rotating ring against a ceramic seat held by a stainless-steel spring, and EPT bellows and gasket. Include water slinger on shaft between motor and seal.
  5. Pump Bearings: Grease-lubricated ball bearings in cast-iron housing with grease fittings.
- D. Shaft Coupling: Axially split spacer coupling.
- E. Coupling Guard: Dual rated; ANSI B15.1, Section 8; OSHA 1910.219 approved; steel; removable; attached to mounting frame.
- F. Motor: Single speed, secured to mounting frame, with adjustable alignment.
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."
    - a. Enclosure: Totally enclosed, fan cooled.
    - b. Motor Bearings: Permanently lubricated ball bearings.
    - c. Efficiency: Premium efficient.
    - d. Rated for VFD duty and with shaft grounding device.
- G. Capacities and Characteristics: See drawings.

### 2.2 PUMP SPECIALTY FITTINGS

- A. Suction Diffuser:
1. Angle pattern.
  2. 175-psig pressure rating, iron body and end cap, pump-inlet fitting.
  3. Bronze startup and stainless-steel permanent strainers.
  4. Stainless-steel straightening vanes.
  5. Drain plug.
  6. Factory-fabricated support.

## 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.



## SECTION 232123 - HYDRONIC PUMPS

- 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 PUMP INSTALLATION

- A. Comply with HI 1.4 and HI 2.4.
- B. Install pumps to provide access for periodic maintenance including removing motors, impellers, couplings, and accessories.
- 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:
  - 1. Install base-mounted pumps on structural equipment bases. Coordinate with structural.
  - 2. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."

### 3.3 ALIGNMENT

- A. Engage a factory-authorized service representative to perform alignment service.
  - 1. Certified Representative to Laser Align pump and motor shafts and piping connections after setting on foundation, grout has been set and foundation bolts have been tightened, and piping connections have been made.
  - 2. Laser alignment printed report and certification shall be furnished.
- B. Comply with requirements in Hydronics Institute standards for alignment of pump and motor shaft. Add shims to the motor feet and bolt motor to base frame. Do not use grout between motor feet and base frame.
- C. Comply with pump and coupling manufacturers' written instructions.
- D. After alignment is correct, tighten foundation bolts evenly but not too firmly. Completely fill baseplate with nonshrink, nonmetallic grout while metal blocks and shims or wedges are in place. After grout has cured, fully tighten foundation bolts.

### 3.4 CONNECTIONS

- A. Piping installation requirements are specified in other Division 23 Sections. 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.

## SECTION 232123 - HYDRONIC PUMPS

- D. Install suction and discharge pipe sizes equal to or greater than diameter of pump nozzles.
- E. Install check, shutoff, and throttling valves on discharge side of pumps.
- F. Install suction diffuser 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.
- 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. Install check valve and gate or ball valve on each condensate pump unit discharge.
- J. Ground equipment according to Sect. 260526 "Grounding and Bonding for Electrical Systems." Connect wiring according to Sect. 260519 "Low-Voltage Electrical Power Conductors and Cables."

### 3.5 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
  - 1. Complete installation and startup checks according to manufacturer's written instructions.
  - 2. Check piping connections for tightness.
  - 3. Clean strainers on suction piping.
  - 4. Perform the following startup checks for each pump before starting:
    - a. Verify bearing lubrication.
    - b. 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.
    - c. Verify that pump is rotating in the correct direction.
  - 5. Prime pump by opening suction valves and closing drains, and prepare for operation.
  - 6. Start motor.
  - 7. Open discharge valve slowly.

### 3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain hydronic pumps.

END OF SECTION 232123

## SECTION 232300 - 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 pipes and fittings.
  - 2. Refrigerant piping valves and specialties.
  - 3. Refrigerants.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of valve and refrigerant piping specialty.
  - 1. Include pressure drop, based on manufacturer's test data, for the following:
    - a. Thermostatic expansion valves.
    - b. Solenoid valves.
    - c. Hot-gas bypass valves.
    - d. Filter dryers.
    - e. Strainers.
    - f. Pressure-regulating valves.
- B. Shop Drawings:
  - 1. Show layout of refrigerant piping and specialties, including pipe, tube, and fitting sizes; flow capacities; valve arrangements and locations; slopes of horizontal runs; oil traps; double risers; wall and floor penetrations; and equipment connection details.
  - 2. Show piping size and piping layout, including oil traps, double risers, specialties, and pipe and tube sizes to accommodate, as a minimum, equipment provided, elevation difference between compressor and evaporator, and length of piping to ensure proper operation and compliance with warranties of connected equipment.
  - 3. Show interface and spatial relationships between piping and equipment.
  - 4. Shop Drawing Scale: 1/4 inch equals 1 foot.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Field quality-control reports.

## SECTION 232300 - REFRIGERANT PIPING

### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For refrigerant valves and piping specialties to include in maintenance manuals.

### 1.6 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to 2010 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."

### 1.7 PRODUCT STORAGE AND HANDLING

- A. Store piping with end caps in place to ensure that piping interior and exterior are clean when installed.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Line Test Pressure for Refrigerant R-134a:
  - 1. Suction Lines for Air-Conditioning Applications: 115 psig.
  - 2. Suction Lines for Heat-Pump Applications: 225 psig.
  - 3. Hot-Gas and Liquid Lines: 225 psig.
- B. 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.
- C. 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.

### 2.2 COPPER TUBE AND FITTINGS

- A. Copper Tube: ASTM B 88, Type L, Type ACR.
- B. Wrought-Copper Fittings: ASME B16.22.

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- C. Wrought-Copper Unions: ASME B16.22.
- D. Brazing Filler Metals: AWS A5.8/A5.8M.
- E. Flexible Connectors:
  - 1. Body: Tin-bronze bellows with woven, flexible, tinned-bronze-wire-reinforced protective jacket.
  - 2. End Connections: Socket ends.
  - 3. Offset Performance: Capable of minimum 3/4-inch misalignment in minimum 7-inch-long assembly.
  - 4. Working Pressure Rating: Factory test at minimum 500 psig.
  - 5. Maximum Operating Temperature: 250 deg F.

### 2.3 VALVES AND SPECIALTIES

- A. Diaphragm Packless Valves:
  - 1. Body and Bonnet: Forged brass or cast bronze; globe design with straight-through or angle pattern.
  - 2. Diaphragm: Phosphor bronze and stainless steel with stainless-steel spring.
  - 3. Operator: Rising stem and hand wheel.
  - 4. Seat: Nylon.
  - 5. End Connections: Socket, union, or flanged.
  - 6. Working Pressure Rating: 500 psig.
  - 7. Maximum Operating Temperature: 275 deg F.
- B. Packed-Angle Valves:
  - 1. Body and Bonnet: Forged brass or cast bronze.
  - 2. Packing: Molded stem, back seating, and replaceable under pressure.
  - 3. Operator: Rising stem.
  - 4. Seat: Nonrotating, self-aligning polytetrafluoroethylene.
  - 5. Seal Cap: Forged-brass or valox hex cap.
  - 6. End Connections: Socket, union, threaded, or flanged.
  - 7. Working Pressure Rating: 500 psig.
  - 8. Maximum Operating Temperature: 275 deg F.
- C. Check Valves:
  - 1. Body: Ductile iron, forged brass, or cast bronze; globe pattern.
  - 2. Bonnet: Bolted ductile iron, forged brass, or cast bronze; or brass hex plug.
  - 3. Piston: Removable polytetrafluoroethylene seat.
  - 4. Closing Spring: Stainless steel.
  - 5. Manual Opening Stem: Seal cap, plated-steel stem, and graphite seal.
  - 6. End Connections: Socket, union, threaded, or flanged.
  - 7. Maximum Opening Pressure: 0.50 psig.
  - 8. Working Pressure Rating: 500 psig.
  - 9. Maximum Operating Temperature: 275 deg F.
- D. Service Valves:
  - 1. Body: Forged brass with brass cap including key end to remove core.
  - 2. Core: Removable ball-type check valve with stainless-steel spring.

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3. Seat: Polytetrafluoroethylene.
  4. End Connections: Copper spring.
  5. Working Pressure Rating: 500 psig.
- E. Solenoid Valves: Comply with AHRI 760 and UL 429; listed and labeled by a National Recognized Testing Laboratory (NRTL).
1. Body and Bonnet: Plated steel.
  2. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
  3. Seat: Polytetrafluoroethylene.
  4. End Connections: Threaded.
  5. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch conduit adapter, and 24-V ac coil.
  6. Working Pressure Rating: 400 psig.
  7. Maximum Operating Temperature: 240 deg F.
- F. Safety Relief Valves: Comply with 2010 ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.
1. Body and Bonnet: Ductile iron and steel, with neoprene O-ring seal.
  2. Piston, Closing Spring, and Seat Insert: Stainless steel.
  3. Seat: Polytetrafluoroethylene.
  4. End Connections: Threaded.
  5. Working Pressure Rating: 400 psig.
  6. Maximum Operating Temperature: 240 deg F.
- G. Thermostatic Expansion Valves: Comply with AHRI 750.
1. Body, Bonnet, and Seal Cap: Forged brass or steel.
  2. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
  3. Packing and Gaskets: Non-asbestos.
  4. Capillary and Bulb: Copper tubing filled with refrigerant charge.
  5. Suction Temperature: 40 deg F.
  6. Reverse-flow option (for heat-pump applications).
  7. End Connections: Socket, flare, or threaded union.
- H. Hot-Gas Bypass Valves: Comply with UL 429; listed and labeled by an NRTL.
1. Body, Bonnet, and Seal Cap: Ductile iron or steel.
  2. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
  3. Packing and Gaskets: Non-asbestos.
  4. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
  5. Seat: Polytetrafluoroethylene.
  6. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch conduit adapter and 24-V ac coil.
  7. End Connections: Socket.
  8. Throttling Range: Maximum 5 psig.
  9. Working Pressure Rating: 500 psig.
  10. Maximum Operating Temperature: 240 deg F.
- I. Straight-Type Strainers:
1. Body: Welded steel with corrosion-resistant coating.
  2. Screen: 100-mesh stainless steel.
  3. End Connections: Socket or flare.
  4. Working Pressure Rating: 500 psig.

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5. Maximum Operating Temperature: 275 deg F.

J. Moisture/Liquid Indicators:

1. Body: Forged brass.
2. Window: Replaceable, clear, fused glass window with indicating element protected by filter screen.
3. Indicator: Color coded to show moisture content in parts per million (ppm).
4. Minimum Moisture Indicator Sensitivity: Indicate moisture above 60 ppm.
5. End Connections: Socket or flare.
6. Working Pressure Rating: 500 psig.
7. Maximum Operating Temperature: 240 deg F.

K. Permanent Filter Dryers: Comply with AHRI 730.

1. Body and Cover: Painted-steel shell.
2. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
3. Desiccant Media: Activated alumina, charcoal.
4. Designed for reverse flow (for heat-pump applications).
5. End Connections: Socket.
6. Access Ports: NPS 1/4 connections at entering and leaving sides for pressure differential measurement.
7. Working Pressure Rating: 500 psig.
8. Maximum Operating Temperature: 240 deg F.

L. Receivers: Comply with AHRI 495.

1. Comply with 2010 ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.
2. Comply with UL 207; listed and labeled by an NRTL.
3. Body: Welded steel with corrosion-resistant coating.
4. Tappings: Inlet, outlet, liquid level indicator, and safety relief valve.
5. End Connections: Socket or threaded.
6. Working Pressure Rating: 500 psig.
7. Maximum Operating Temperature: 275 deg F.

M. Liquid Accumulators: Comply with AHRI 495.

1. Body: Welded steel with corrosion-resistant coating.
2. End Connections: Socket or threaded.
3. Working Pressure Rating: 500 psig.
4. Maximum Operating Temperature: 275 deg F.

### 2.4 REFRIGERANTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Arkema Inc.
2. DuPont Fluorochemicals Div.
3. Genetron Refrigerants; Honeywell International Inc.
4. Mexichem Fluor Inc.

B. ASHRAE 34, R-134a: Tetrafluoroethane.

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- C. ASHRAE 34, R-407C: Difluoromethane/Pentafluoroethane/1,1,1,2-Tetrafluoroethane.
- D. ASHRAE 34, R-410A: Pentafluoroethane/Difluoromethane.

### 2.5 REFRIGERANT PIPING SUPPORT EXTERIOR TO BUILDING

- A. Exterior: Pre-manufactured strut supports; 3/8" stainless steel threaded rods holding 7" long aluminum cross-strut, stainless steel bolts, 3" to 6" adjustable height, molded 33% fiberglass reinforced nylon support base; UV stabilized. MAPA Products, type MS-2 or MS-3.

## PART 3 - EXECUTION

### 3.1 PIPING APPLICATIONS

- A. Suction Lines NPS 1-1/2 and Smaller for Conventional Air-Conditioning Applications: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed joints.
- B. Suction Lines NPS 2 to NPS 4 for Conventional Air-Conditioning Applications: Copper, Type ACR, drawn-temper tubing and wrought-copper fittings with brazed joints.
- C. Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed joints.
- D. Safety-Relief-Valve Discharge Piping: Schedule 40, black-steel and wrought-steel fittings with welded joints.
- E. Safety-Relief-Valve Discharge Piping: Copper, Type ACR, drawn-temper tubing and wrought-copper fittings with soldered joints.
- F. Safety-Relief-Valve Discharge Piping: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed joints.

### 3.2 VALVE AND SPECIALTY APPLICATIONS

- A. Install diaphragm packless valves in suction and discharge lines of compressor.
- B. Install service valves for gage taps at inlet and outlet of hot-gas bypass valves and strainers if they are not an integral part of valves and strainers.
- C. Install a check valve at the compressor discharge and a liquid accumulator at the compressor suction connection.
- D. Except as otherwise indicated, install diaphragm packless valves on inlet and outlet side of filter dryers.
- E. Install a full-size, three-valve bypass around filter dryers.



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- F. Install solenoid valves upstream from each expansion valve and hot-gas bypass valve. Install solenoid valves in horizontal lines with coil at top.
- G. Install thermostatic expansion valves as close as possible to distributors on evaporators.
  - 1. Install valve so diaphragm case is warmer than bulb.
  - 2. Secure bulb to clean, straight, horizontal section of suction line using two bulb straps. Do not mount bulb in a trap or at bottom of the line.
  - 3. If external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.
- H. Install safety relief valves where required by 2010 ASME Boiler and Pressure Vessel Code. Pipe safety-relief-valve discharge line to outside according to ASHRAE 15.
- I. Install moisture/liquid indicators in liquid line at the inlet of the thermostatic expansion valve or at the inlet of the evaporator coil capillary tube.
- J. Install strainers upstream from and adjacent to the following unless they are furnished as an integral assembly for the device being protected:
  - 1. Solenoid valves.
  - 2. Thermostatic expansion valves.
  - 3. Hot-gas bypass valves.
  - 4. Compressor.
- K. Install filter dryers in liquid line between compressor and thermostatic expansion valve, and in the suction line at the compressor.
- L. Install receivers sized to accommodate pump-down charge.
- M. Install flexible connectors at compressors.

### 3.3 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems; indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Shop Drawings.
- B. Install refrigerant piping according to ASHRAE 15.
- C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- D. 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.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping adjacent to machines to allow service and maintenance.

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- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Select system components with pressure rating equal to or greater than system operating pressure.
- J. Refer to Section 230923 "Direct Digital Control (DDC) System for HVAC" and Section 230993.11 "Sequence of Operations for HVAC DDC" for solenoid valve controllers, control wiring, and sequence of operation.
- K. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.
- L. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels as specified in Section 083113 "Access Doors and Frames" if valves or equipment requiring maintenance is concealed behind finished surfaces.
- M. Install refrigerant piping in protective conduit where installed belowground.
- N. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.
- O. Slope refrigerant piping as follows:
  - 1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
  - 2. Install horizontal suction lines with a uniform slope downward to compressor.
  - 3. Install traps and double risers to entrain oil in vertical runs.
  - 4. Liquid lines may be installed level.
- P. When brazing or soldering, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.
- Q. Before installation of steel refrigerant piping, clean pipe and fittings using the following procedures:
  - 1. Shot blast the interior of piping.
  - 2. Remove coarse particles of dirt and dust by drawing a clean, lintless cloth through tubing by means of a wire or electrician's tape.
  - 3. Draw a clean, lintless cloth saturated with trichloroethylene through the tube or pipe. Continue this procedure until cloth is not discolored by dirt.
  - 4. Draw a clean, lintless cloth, saturated with compressor oil, squeezed dry, through the tube or pipe to remove remaining lint. Inspect tube or pipe visually for remaining dirt and lint.
  - 5. Finally, draw a clean, dry, lintless cloth through the tube or pipe.
  - 6. Safety-relief-valve discharge piping is not required to be cleaned but is required to be open to allow unrestricted flow.

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- R. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.
- S. Identify refrigerant piping and valves according to Section 230553 "Identification for HVAC Piping and Equipment."
- T. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."
- U. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."
- V. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 230518 "Escutcheons for HVAC Piping."

### 3.4 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. Fill pipe and fittings with an inert gas (nitrogen or carbon dioxide), during brazing or welding, to prevent scale formation.
- D. Soldered Joints: Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook."
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."
  - 1. Use Type BCuP (copper-phosphorus) alloy for joining copper socket fittings with copper pipe.
  - 2. Use Type BAg (cadmium-free silver) alloy for joining copper with bronze or steel.
- F. Threaded Joints: Thread steel 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 to 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.
- G. Welded Joints: Construct joints according to AWS D10.12M/D10.12.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

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### 3.5 HANGERS AND SUPPORTS

- A. Comply with requirements for pipe hangers and supports specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
- B. Install the following pipe attachments:
  - 1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet long.
  - 2. Roller hangers and spring hangers for individual horizontal runs 20 feet or longer.
  - 3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
  - 4. Spring hangers to support vertical runs.
  - 5. Copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
- C. Install hangers for copper tubing with the following maximum spacing and minimum rod diameters:
  - 1. NPS 1/2: Maximum span, 60 inches; minimum rod, 1/4 inch.
  - 2. NPS 5/8: Maximum span, 60 inches; minimum rod, 1/4 inch.
  - 3. NPS 1: Maximum span, 72 inches; minimum rod, 1/4 inch.
  - 4. NPS 1-1/4: Maximum span, 96 inches; minimum rod, 3/8 inch.
  - 5. NPS 1-1/2: Maximum span, 96 inches; minimum rod, 3/8 inch.
  - 6. NPS 2: Maximum span, 96 inches; minimum rod, 3/8 inch.
  - 7. NPS 2-1/2: Maximum span, 108 inches; minimum rod, 3/8 inch.
  - 8. NPS 3: Maximum span, 10 feet; minimum rod, 3/8 inch.
  - 9. NPS 4: Maximum span, 12 feet; minimum rod, 1/2 inch.
- D. Support multifloor vertical runs at least at each floor.

### 3.6 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
  - 1. Comply with ASME B31.5, Chapter VI.
  - 2. Test refrigerant piping, specialties, and receivers. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.
  - 3. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in "Performance Requirements" Article.
    - a. Fill system with nitrogen to the required test pressure.
    - b. System shall maintain test pressure at the manifold gage throughout duration of test.
    - c. Test joints and fittings with electronic leak detector or by brushing a small amount of soap and glycerin solution over joints.
    - d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.
- B. Prepare test and inspection reports.

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### 3.7 SYSTEM CHARGING

- A. Charge system using the following procedures:
  1. Install core in filter dryers after leak test but before evacuation.
  2. Evacuate entire refrigerant system with a vacuum pump to 500 micrometers. If vacuum holds for 12 hours, system is ready for charging.
  3. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig.
  4. Charge system with a new filter-dryer core in charging line.

### 3.8 ADJUSTING

- A. Adjust thermostatic expansion valve to obtain proper evaporator superheat.
- B. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.
- C. Adjust set-point temperature of air-conditioning or chilled-water controllers to the system design temperature.
- D. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:
  1. Open shutoff valves in condenser water circuit.
  2. Verify that compressor oil level is correct.
  3. Open compressor suction and discharge valves.
  4. Open refrigerant valves except bypass valves that are used for other purposes.
  5. Check open compressor-motor alignment and verify lubrication for motors and bearings.
- E. Replace core of replaceable filter dryer after system has been adjusted and after design flow rates and pressures are established.

END OF SECTION 232300

## SECTION 232513 - 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 SUMMARY

- A. Section includes the following water treatment for closed-loop hydronic systems:
  - 1. Manual chemical-feed equipment.
  - 2. Chemicals.

#### 1.3 DEFINITIONS

- A. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.
- B. RO: Reverse osmosis.
- C. TSS: Total suspended solids are solid materials, including organic and inorganic, that are suspended in the water. These solids may include silt, plankton, and industrial wastes.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: Include rated capacities, operating characteristics, and furnished specialties and accessories for the following products:
  - 1. Bypass feeders.
  - 2. Water meters.
  - 3. Chemical test equipment.
  - 4. Chemical material safety data sheets.
- B. Shop Drawings: Pretreatment and chemical treatment equipment showing tanks, maintenance space required, and piping connections to hydronic systems.
  - 1. Include plans, elevations, sections, and attachment details.
  - 2. Include diagrams for power, signal, and control wiring.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Water Analysis Provider Qualifications: Verification of experience and capability of HVAC water-treatment service provider.
- B. Field quality-control reports.
- C. Other Informational Submittals:

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1. Water-Treatment Program: Written sequence of operation on an annual basis for the application equipment required to achieve water quality defined in "Performance Requirements" Article.
2. Water Analysis: Illustrate water quality available at Project site.

### 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For sensors, injection pumps, and controllers to include in emergency, operation, and maintenance manuals.

### 1.7 QUALITY ASSURANCE

- A. HVAC Water-Treatment Service Provider Qualifications: An experienced HVAC water-treatment service provider capable of analyzing water qualities, installing water-treatment equipment, and applying water treatment as specified in this Section.
- B. Contractor shall have a local office within 75 miles of the project site.

### 1.8 MAINTENANCE SERVICE

- A. Scope of Maintenance Service: Provide chemicals and service program to maintain water conditions required above to inhibit corrosion and scale formation for hydronic piping and equipment. Services and chemicals shall be provided for a period of one year from date of Substantial Completion and shall include the following:
  1. Initial water analysis and HVAC water-treatment recommendations.
  2. Startup assistance for Contractor to flush the systems, clean with detergents, and initially fill systems with required chemical treatment prior to operation.
  3. Periodic field service and consultation.
  4. Customer report charts and log sheets.
  5. Laboratory technical analysis.
  6. Analyses and reports of all chemical items concerning safety and compliance with government regulations.

### 1.9 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  1. Chemicals: Furnish quantity equal to 100 percent of amount initially installed.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. US Water

## SECTION 232513 - WATER TREATMENT FOR CLOSED-LOOP HYDRONIC SYSTEMS

### 2. Nalco

3. All other companies shall request pre-qualification and approval from the Owner and Engineer.

## 2.2 PERFORMANCE REQUIREMENTS

- A. Water quality for hydronic systems shall minimize corrosion, scale buildup, and biological growth for optimum efficiency of hydronic equipment without creating a hazard to operating personnel or the environment.
- B. Base HVAC water treatment on quality of water available at Project site, hydronic system equipment material characteristics and functional performance characteristics, operating personnel capabilities, and requirements and guidelines of authorities having jurisdiction.
- C. Closed hydronic systems, including chilled water, shall have the following water qualities:
  1. Meet state and local pollution standards, codes and regulations.
  2. pH: Maintain a value within 9.0 to 10.5.
  3. TSS: Maintain a maximum value of 10 ppm.
  4. Hardness: 0.0
  5. Iron: 0.0
  6. TDS: 1500 to 1700 PPM (as CaCO<sub>3</sub>)
  7. Silica: 60 PPM or less
  8. Copper: Per manufacturer's recommendations.
  9. Total Algae: 0.00 growth.
  10. Provide liquid biocide during initial fill.
  11. Microbiological Limits:
    - a. Total Aerobic Plate Count: Maintain a maximum value of 1000 organisms/mL.
    - b. Total Anaerobic Plate Count: Maintain a maximum value of 100 organisms/mL.
    - c. Nitrate Reducers: Maintain a maximum value of 100 organisms/mL.
    - d. Sulfate Reducers: Maintain a maximum value of zero organisms/mL.
    - e. Iron Bacteria: Maintain a maximum value of zero organisms/mL.

## 2.3 MANUAL CHEMICAL-FEED EQUIPMENT

- A. Bypass Feeders: Steel, with corrosion-resistant exterior coating, minimum 3-1/2-inch fill opening in the top, and NPS 3/4 bottom inlet and top side outlet. Quarter turn or threaded fill cap with gasket seal and diaphragm to lock the top on the feeder when exposed to system pressure in the vessel.
  1. Capacity: 5 gal..
  2. Minimum Working Pressure: 175 psig.
- B. Water Meter:
  1. AWWA C701, turbine-type, totalization meter.
  2. Body: Bronze.
  3. Minimum Working-Pressure Rating: 100 psig.
  4. Maximum Pressure Loss at Design Flow: 3 psig.
  5. Registration: Gallons or cubic feet.
  6. End Connections: Threaded.



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7. Control: Low-voltage signal capable of transmitting 1000 feet.
8. 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.

### 2.4 CHEMICALS

- A. Chemicals shall be as recommended by water-treatment system manufacturer that are compatible with piping system components and connected equipment and that can attain water quality specified in "Performance Requirements" Article.
- B. System Cleaner: Liquid alkaline compound with emulsifying agents and detergents to remove grease and petroleum products.
- C. Biocide: Chlorine release agents or microbiocides.
- D. Closed-Loop, Water Piping Chemicals: Sequestering agent to reduce deposits and adjust pH, corrosion inhibitors, and conductivity enhancers.

### 2.5 FILTRATION UNIT

- A. Filtration Unit: Stainless-steel housing and polypropylene filter with polypropylene core.
- B. Replaceable Filter Media: Compatible with antifreeze and water-treatment chemicals.
- C. Filter Media for Sediment Removal Service: Rated at 98 percent efficiency for 20-micrometer particulate.

## PART 3 - EXECUTION

### 3.1 WATER ANALYSIS

- A. Perform an analysis of supply water to determine quality of water available at Project site.

### 3.2 INSTALLATION

- A. Install chemical application equipment on concrete bases, level and plumb. Maintain manufacturer's recommended clearances. Arrange units so controls and devices that require servicing are accessible. Anchor chemical tanks and floor-mounting accessories to substrate.
- B. Install water testing equipment on wall near water chemical application equipment.
- C. Bypass Feeders: Install in closed hydronic systems, including chilled water, and equipped with the following:
  1. Install bypass feeder in a bypass circuit around circulating pumps unless otherwise indicated on Drawings.
  2. Install water meter in makeup-water supply.

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3. Install test-coupon assembly in bypass circuit around circulating pumps unless otherwise indicated on Drawings.
4. Install a gate or full-port ball isolation valves on inlet, outlet, and drain below the feeder inlet.
5. Install a swing check on the inlet after the isolation valve.

### 3.3 CONNECTIONS

- A. Where installing piping adjacent to equipment, allow space for service and maintenance.
- B. Make piping connections between HVAC water-treatment equipment and dissimilar-metal piping with dielectric fittings. Comply with requirements in Section 232116 "Hydronic Piping Specialties."
- C. Install shutoff valves on HVAC water-treatment equipment inlet and outlet. Metal general-duty valves are specified in Division 23 Sections.
- D. Comply with requirements in Section 221119 "Domestic Water Piping Specialties" for backflow preventers required in makeup-water connections to potable-water systems.
- E. Confirm applicable electrical requirements in electrical Sections for connecting electrical equipment.
- F. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- G. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

### 3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
  1. Inspect field-assembled components and equipment installation, including piping and electrical connections.
  2. Inspect piping and equipment to determine that systems and equipment have been cleaned, flushed, and filled with water, and are fully operational before introducing chemicals for water-treatment system.
  3. Place HVAC water-treatment system into operation and calibrate controls during the preliminary phase of hydronic systems' startup procedures.
  4. Do not enclose, cover, or put piping into operation until it is tested and satisfactory test results are achieved.
  5. Test for leaks and defects. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
  6. Leave uncovered and unconcealed new, altered, extended, and replaced water piping until it has been tested and approved. Expose work that has been covered or concealed before it has been tested and approved.
  7. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and

## SECTION 232513 - WATER TREATMENT FOR CLOSED-LOOP HYDRONIC SYSTEMS

allow test pressure to stand for four hours. Leaks and loss in test pressure constitute defects.

8. Repair leaks and defects with new materials and retest piping until no leaks exist.
- B. Equipment will be considered defective if it does not pass tests and inspections.
  - C. Prepare test and inspection reports.
  - D. At eight-week interval following Substantial Completion, perform separate water analyses on hydronic systems to show that chemical-feed systems are maintaining water quality within performance requirements specified in this Section. Submit written reports of water analysis advising Owner of changes necessary to adhere to "Performance Requirements" Article.
  - E. Comply with ASTM D 3370 and with the following standards:
    1. Silica: ASTM D 859.
    2. Acidity and Alkalinity: ASTM D 1067.
    3. Iron: ASTM D 1068.
    4. Water Hardness: ASTM D 1126.

### 3.5 ADJUSTING

- A. Occupancy Adjustments: Within 12 months of Substantial Completion, perform two separate water analyses to prove that systems are maintaining water quality within performance requirements specified in this Section. Perform analyses at least 60 days apart. Submit written reports of water analysis.

### 3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC water-treatment systems and equipment.

END OF SECTION 232513

## SECTION 232923 - VARIABLE FREQUENCY MOTOR CONTROLLERS

### 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 solid-state, PWM, VFDs for speed control of three-phase, squirrel-cage induction motors.
- B. Related Sections include the following:
  - 1. Division 26 Section "Electrical Power Monitoring and Control" for monitoring and control of motor circuits.
  - 2. Division 26 Section "Transient Voltage Suppression" for low-voltage power, control, and communication surge suppressors.

#### 1.3 DEFINITIONS

- A. BAS: Building Automation System.
- B. IGBT: Integrated gate bipolar transistor.
- C. LAN: Local area network.
- D. PID: Control action, proportional plus integral plus derivative.
- E. PWM: Pulse-width modulated.
- F. VFD: Variable frequency drive.

#### 1.4 REFERENCES

- A. ANSI/NEMA ICS 6 – Enclosures for industrial control systems.
- B. ANSI/UL 198C – High intensity capacity fuses; current limiting types.
- C. NEMA ICS 2 – Industrial control devices, controllers, and assemblies.
- D. NEMA KS 1 – Enclosed switches.
- E. NEMA PB 1.1 – Instructions for safe installation, operation, and maintenance of panelboards rated 600 volts or less.

## SECTION 232923 - VARIABLE FREQUENCY MOTOR CONTROLLERS

### 1.5 SUBMITTALS

- A. Product Data: For each type of VFD, provide dimensions; mounting arrangements; location for conduit entries; shipping and operating weights; and manufacturer's technical data on features, performance, electrical ratings, characteristics, and finishes.
- B. Shop Drawings: For each VFD.
  - 1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings. Include the following:
    - a. Each installed unit's type and details.
    - b. Nameplate legends.
    - c. Short-circuit current ratings of integrated unit.
  - 2. Wiring Diagrams: Power, signal, and control wiring for VFD. Provide schematic wiring diagram for each type of VFD.
- C. Manufacturer's field service report.
- D. Operation and Maintenance Data: For VFDs, all installed devices, and components to include in emergency, operation, and maintenance manuals. Include routine maintenance requirements for VFDs and all installed components

### 1.6 QUALITY ASSURANCE

- A. Source Limitations: Obtain VFDs of a single type through one source from a single manufacturer.
- B. 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.
- C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for VFDs, minimum clearances between VFDs, and adjacent surfaces and other items. Comply with indicated dimensions and clearances.
- D. Comply with NFPA 70.
- E. UL listed drive and UL-508 listed bypass/inverter assembly.

### 1.7 WARRANTY

- A. Written warranty, signed by manufacturer. Manufacturer's standard form in which manufacturer agrees to replace components of units that fail in materials or workmanship within specified warranty period. Manufacturer will provide all labor required for replacement of materials, equipment, controls, and any other portion of complete assembly, as required. A factory-trained employee of manufacturer shall perform warranty work.
  - 1. Warranty Period for VFD's: Manufacturer's standard, but not less than three years from date of Substantial Completion.

## SECTION 232923 - VARIABLE FREQUENCY MOTOR CONTROLLERS

2. Warranty period will commence from the date of manufacturer's startup.
- B. For the duration of the warranty, local manufacturer's representative must provide a response time of no more than 24 hours. Any failed VFD must be put back into automatic operation within this time period. Mere acknowledgement of a problem does not constitute an acceptable response.

### 1.8 SPARE PARTS

- A. Spare Fuses: Furnish three spare fuses for each type and rating installed.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. ABB.
  2. Yaskawa.
  3. Other manufacturers may be accepted only with prior approval of Engineer, and only if they meet all requirements of this specification. Provide request for substitution a minimum of 7 days prior to submission of bid.
- B. Specific models proposed must have a continuous and proven track record of no less than 3 years.

### 2.2 VARIABLE FREQUENCY DRIVES

- A. Description: NEMA ICS 2, IGBT, PWM, VFD; listed and labeled as a complete unit and arranged to provide variable speed of a NEMA MG 1, Design B, 3-phase, premium-efficiency induction motor by adjusting output voltage and frequency.
- B. Design and Rating: Match load type such as fans, blowers, and pumps; and type of connection used between motor and load such as direct or through a power-transmission connection.
- C. Output Rating: 3-phase; 6 to 60 Hz, with voltage proportional to frequency throughout voltage range.
- D. Unit Operating Requirements:
  1. Input ac voltage tolerance of 380 to 480 V, plus or minus 10 percent.
  2. Input frequency tolerance of 60 Hz, plus or minus 6 percent.
  3. Capable of driving full load, under the following conditions, without derating:
    - a. Ambient Temperature: 0 to 40 deg C.
    - b. Humidity: Less than 90 percent (non-condensing).
    - c. Altitude: 3300 feet (1000 m).

## SECTION 232923 - VARIABLE FREQUENCY MOTOR CONTROLLERS

4. Minimum Efficiency: 96 percent at 60 Hz, full load.
5. Minimum Displacement Primary-Side Power Factor: 97 percent.
6. Overload Capability: 1.10 times the base load current for 60 seconds at 40°C; 2.0 times the base load current for 3 seconds at 40°C.
7. Starting Torque: 100 percent of rated torque or as indicated.
8. Speed Regulation: Plus or minus 1 percent.
9. Isolated control interface to allow controller to follow control signal over an 11:1 speed range.
10. Continuous output current rating shall be no less than 100% of NEC motor amperage ratings.
11. Overload current capability of power cube at 40°C shall equal or exceed 200% of NEC motor amperage values for instantaneous trip, and 110% of NEC amperage for a minimum of sixty seconds, without damage to power cube.
12. Minimum 5% input impedance line reactor; comply with EN61000-3-2, or minimum 3% DC link reactor (also called inductive choke) connected to the DC bus between the rectifier and the PWM inverter.

### E. Power Quality Issues

1. VFD must be capable of operating satisfactorily when connected to a bus supplying other solid state power conversion equipment which may be causing up to 10% total harmonic distortion and commutation notches up to 36,500 volt-microseconds, and when other VFDs are operating from the same bus.
2. VFD shall generate less than 3% total harmonic distortion back to the incoming power line at the point of common connection with sensitive equipment. A harmonic analysis shall be submitted with the approval drawings to verify compliance with the latest version of IEEE-519 voltage and current distortion limits as shown in table 10.2 and 10.3 at the point of common coupling (the consumer-utility interface or primary side of the main distribution transformer).
3. The system shall not produce spikes on the incoming line.
4. Any inverter that generates sufficient electrical line noise to interfere with the operation of sensitive building equipment shall be field modified or replaced by the inverter supplier at no additional cost to the Owner.
5. Provide input line noise suppression with MOV's (metal oxide varistors) and snubber circuits to allow for operation on typical industrial or commercial power distribution systems. MOV's shall be provided across incoming line terminals and transistors to protect inverter from voltage surges and spikes.
6. The VFD shall not induce excessive power losses in motors. The worst case RMS motor line current measured at rated speed, torque, and voltage shall not exceed 1.05 times the rated RMS current for pure sine wave operation.
7. VFD must be capable of operating a motor satisfactorily with up to 300 feet of wiring between VFD and motor.

### F. Diodes: Bridge rated for 1600 volts.

### G. Internal Adjustability Capabilities:

1. Minimum Speed: 5 to 25 percent of maximum rpm.
2. Maximum Speed: 80 to 100 percent of maximum rpm.
3. Acceleration: 2 to a minimum of 22 seconds.
4. Deceleration: 2 to a minimum of 22 seconds.

## SECTION 232923 - VARIABLE FREQUENCY MOTOR CONTROLLERS

5. Current Limit: 50 to a minimum of 110 percent of maximum rating.
- H. Self-Protection and Reliability Features:
1. Input transient protection by means of surge suppressors.
  2. Snubber networks to protect against malfunction due to system voltage transients.
  3. Under- and overvoltage trips; inverter overtemperature, overload, and overcurrent trips.
  4. Motor Overload Relay: Adjustable and capable of NEMA 250, Class 20 performance.
  5. Notch filter to prevent operation of the controller-motor-load combination at a natural frequency of the combination.
  6. Instantaneous line-to-line and line-to-ground overcurrent trips.
  7. Loss-of-phase protection.
  8. Reverse-phase protection.
  9. Short-circuit protection.
  10. Motor overload.
  11. Motor over-temperature fault.
  12. Heat sink over temperature (Max. operating ambient: 104 degrees F)
  13. Protect solid state inverter devices by limiting output current to 110% of inverter rating, automatically prevent over-current trip due to momentary overload conditions.
- I. Automatic Reset and Restart: To attempt three restarts after controller fault or on return of power after an interruption and before shutting down for manual reset or fault correction. Bidirectional auto-speed search shall be capable of starting into rotating loads spinning in either direction and returning motor to set speed in proper direction, without damage to controller, motor, or load.
- J. Power-Interruption Protection: To prevent motor from re-energizing after a power interruption until motor has stopped.
- K. Torque Boost: Automatically vary starting and continuous torque to at least 1.5 times the minimum torque to insure high-starting torque and increased torque at slow speeds.
- L. Motor Temperature Compensation at Slow Speeds: Adjustable current fall-back based on output frequency for temperature protection of self-cooled fan-ventilated motors at slow speeds.
- M. Status Lights: Door-mounted LED indicators shall indicate the following conditions:
1. Power on.
  2. Run.
  3. Overvoltage.
  4. Line fault.
  5. Overcurrent.
  6. External fault.
- N. Panel-Mounted Operator Station: Start-stop and auto-manual selector switches with manual speed control potentiometer and elapsed time meter.
- O. Indicating Devices: Meters or digital readout devices and selector switch, mounted flush in controller door and connected to indicate the following controller parameters:
1. Output frequency (Hz).



## SECTION 232923 - VARIABLE FREQUENCY MOTOR CONTROLLERS

2. Motor speed (rpm).
3. Motor status (running, stop, fault).
4. Motor current (amperes).
5. Motor torque (percent).
6. Fault or alarming status (code).
7. PID feedback signal (percent).
8. DC-link voltage (VDC).
9. Set-point frequency (Hz).
10. Motor output voltage (V).

P. Control Signal Interface: Provide VFD with the following:

1. Provide communications devices as necessary to allow for connectivity to major automation systems.
2. VFD shall be provided with protocol information specific to Owner's BAS control manufacturer and shall be pre-configured at the factory to provide automatic communications, without the need for field programming, via a single twisted pair wire.
  - a. The VFD shall allow the DDC system to control the drive's digital and analog outputs and monitor all drive digital and analog inputs via the serial interface.
  - b. VFD is to support BACNet, LonWorks, and Modbus RTU.
  - c. Serial communications capabilities include, but are not limited to: run/stop control, speed set adjustment, proportional/integral or PID control adjustments, current limit and acceleration/deceleration time adjustments. The drive shall also have the capability of allowing the DDC system to monitor the following feedback signals: process variable, output speed/frequency, current, torque, power (KW), operating hours, kilowatt hours; relay outputs, and diagnostic warning and fault information.
3. Remote Signal Inputs: Capability to accept any of the following speed-setting input signals from the BMS or other control systems:
  - a. 0 to 10-V dc.
  - b. 0-20 or 4-20 mA.
  - c. Potentiometer using up/down digital inputs.
  - d. Fixed frequencies using digital inputs.
  - e. RS485.
  - f. Keypad display for local hand operation.
4. Remote Indication Interface: A minimum of 2 dry circuit relay outputs (120-V ac, 1 A) for remote indication of the following:
  - a. Motor running.
  - b. Set-point speed reached.
  - c. Fault and warning indication (over-temperature or over-current).
  - d. PID high or low speed limits reached.

Q. Manual Bypass: Arrange magnetic contactor to safely transfer motor between controller output and bypass controller circuit when motor is at zero speed. Controller-off-bypass selector switch sets mode, and indicator lights give indication of mode selected. Unit shall be capable of stable operation (starting, stopping, and running), with motor completely disconnected from controller (no load).

## SECTION 232923 - VARIABLE FREQUENCY MOTOR CONTROLLERS

- R. Isolating Switch: Non-load-break switch arranged to isolate VFD and permit safe troubleshooting and testing, both energized and de-energized, while motor is operating in bypass mode.
- S. Bypass Controller:
  - 1. NEMA ICS 2, full-voltage, non-reversing enclosed controller with across-the-line starting capability in manual-bypass mode. Provide motor overload protection under both modes of operation with control logic that allows common start-stop capability in either mode.
  - 2. Bypass section is to be located in a metal enclosure separate from the drive section, and shall be constructed in such a manner that the inverter can be removed for repair while still operating the motor in the "bypass" mode without exposing personnel to any electrical voltage. VFD shall have inverter input power disconnect with door interlocked handle (lock out type) arranged to isolate VFD and permit safe troubleshooting & testing of inverter in when energized and/or de-energized, while motor is operating in bypass mode.
  - 3. Manual bypass shall contain:
    - a. A molded case circuit breaker or non-fused disconnect switch with door interlocked handle (lock out type) that interrupts input power to both the bypass circuitry and the drive.
    - b. A thermal overload to provide protection of motor in the bypass mode.
    - c. A safety interlock circuit that disconnects power to the motor (regardless of the mode of operation—"inverter" or "bypass") in response to a signal from the thermal overload and/or external safety circuits.
    - d. Line voltage to 120/1 volt transformers, fused per NEC, to provide power to bypass control circuits. Transformer shall be sized to include additional 20VA capacity for use by EMS contractor. DC and/or solid-state bypass sources are not acceptable.
- T. Non-fused input disconnect switch.
- U. Where indicated, provide accessories for "Contactor Motor Selection with Bypass" that will allow the DDC system to remotely switch lead-lag motors.

### 2.3 ENCLOSURES

- A. NEMA 4XSS for any VFD located outdoors.
- B. NEMA 12, for all other VFDs located in unconditioned space (indoors).
- C. NEMA 1, for all other VFDs located in conditioned space (indoors).
- D. Metal inverter enclosure. Plastic and/or fiberglass enclosures are not acceptable.

### 2.4 FACTORY FINISHES

- A. Finish: Manufacturer's standard paint applied to factory-assembled and -tested VFDs before shipping.

## SECTION 232923 - VARIABLE FREQUENCY MOTOR CONTROLLERS

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine areas, surfaces, and substrates to receive VFDs for compliance with requirements, installation tolerances, and other conditions affecting performance.
- B. Examine roughing-in for conduit systems to verify actual locations of conduit connections before VFD installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 APPLICATIONS

- A. Select features of each VFD to coordinate with ratings and characteristics of supply circuit and motor; required control sequence; and duty cycle of motor, drive, and load.
- B. Select rating of controllers to suit motor controlled.

#### 3.3 INSTALLATION

- A. Anchor each VFD assembly to steel-channel sills arranged and sized according to manufacturer's written instructions. Attach by bolting. Level and grout sills flush with VFD mounting surface.
- B. Controller Fuses: Install fuses in each fusible switch. Comply with requirements in Division 16 Section "Fuses."
- C. Do not install incoming AC lines in same conduit as feeder lines to motor.
- D. Do not install wiring runs between VFD and motor longer than recommended by manufacturer.

#### 3.4 IDENTIFICATION

- A. Identify VFDs, components, and control wiring according to Division 16 Section "Basic Electrical Materials and Methods"

#### 3.5 CONNECTIONS

- A. Ground equipment.
- B. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

#### 3.6 FIELD QUALITY CONTROL

## SECTION 232923 - VARIABLE FREQUENCY MOTOR CONTROLLERS

- A. Prepare for acceptance tests as follows:
  - 1. Test insulation resistance for each VFD element, bus, component, connecting supply, feeder, and control circuit.
  - 2. Test continuity of each circuit.
- B. Testing: Perform the following field quality-control testing:
  - 1. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Sections 7.5, 7.6, and 7.16. Certify compliance with test parameters.
  - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- C. Test Reports: Prepare a written report to record the following:
  - 1. Test procedures used.
  - 2. Test results that comply with requirements.
  - 3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

### 3.7 STARTUP SERVICE

- A. Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including pretesting and adjusting VFDs, and perform startup service.
- B. Verify that electrical wiring installation complies with manufacturer's submittal and installation requirements in Division 16 Sections.
- C. Complete installation and startup checks according to manufacturer's written instructions.
- D. Upon successful completion of testing, submit written certification that drives are operating in accordance with Contract Documents, and within design operating limits of equipment. Notify Owner; include set points of adjustable devices, amperages recorded, and any other pertinent data. This information is to be included in the operation and maintenance manual.

### 3.8 ADJUSTING

- A. Set field-adjustable switches and circuit-breaker trip ranges.

### 3.9 CLEANING

- A. Clean VFDs internally, on completion of installation, according to manufacturer's written instructions. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

### 3.10 DEMONSTRATION

- A. Provide services of manufacturer trained employee(s) for minimum of three hours training. Demonstrate operation of controllers in the automatic, manual, and bypass modes.

END OF SECTION 23 29 23

## SECTION 233113 - 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, spiral-seam, round ducts and fittings.
3. Double-wall, round and flat-oval spiral-seam ducts and formed fittings.
4. Sheet metal materials.
5. Duct liner.
6. Sealants and gaskets.
7. Hangers and supports.
8. Kitchen hood exhaust grease duct, dishwasher hood duct.
9. Lab exhaust ducts.

##### B. Related Sections:

1. Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
2. Section 233300 "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.
3. Section 233813 "Commercial Kitchen Hoods".

#### 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.
- D. Duct system design, as indicated, has been used to select size and type of air-moving and -distribution equipment and other air system components. Changes to layout or configuration of duct system must be specifically approved in writing by Architect. Accompany requests for layout modifications with calculations showing that proposed layout will provide original design results without increasing system total pressure.

## SECTION 233113 - METAL DUCTS

- E. Kitchen exhaust duct shall be pre-fabricated, double wall grease duct according to this specification.

### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of the following products:
  - 1. Liners and adhesives.
  - 2. Sealants and gaskets.
  - 3. Fire-Stopping Materials.
- B. 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. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
  - 4. Elevation of top of ducts.
  - 5. Dimensions of main duct runs from building grid lines.
  - 6. Fittings.
  - 7. Reinforcement and spacing.
  - 8. Seam and joint construction.
  - 9. Penetrations through fire-rated and other partitions.
  - 10. Equipment installation based on equipment being used on Project.
  - 11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
  - 12. Hangers and supports, including methods for duct and building attachment and vibration isolation.
- C. 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.

## SECTION 233113 - METAL DUCTS

- 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 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 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."

## PART 2 - PRODUCTS

### 2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
- B. 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."
- C. 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."
- D. 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."

## SECTION 233113 - METAL DUCTS

### 2.2 SINGLE-WALL ROUND DUCTS AND FITTINGS

- A. Round, Spiral Lock-Seam Ducts.
- B. 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.
  - 1. Manufacturers:
    - a. Lindab Inc.
    - b. McGill AirFlow LLC.
    - c. SEMCO Incorporated.
    - d. Sheet Metal Connectors, Inc.
    - e. Spiral Manufacturing Co., Inc.
- 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).
- D. Duct Joints:
  - 1. Ducts up to 20 Inches in Diameter: Interior, center-beaded slip coupling, sealed before and after fastening, attached with sheet metal screws.
  - 2. Ducts 21 to 72 Inches in Diameter: Three-piece, gasketed, flanged joint consisting of two internal flanges with sealant and one external closure band with gasket.
  - 3. Round Ducts: Prefabricated connection system consisting of double-lipped, EPDM rubber gasket. Manufacture ducts according to connection system manufacturer's tolerances.
    - a. Manufacturers:
      - 1) Ductmate Industries, Inc.
      - 2) Lindab Inc.
- E. 90-Degree Tees and Laterals and Conical Tees: Fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," with metal thicknesses specified for longitudinal-seam straight ducts.
- F. Diverging-Flow Fittings: Fabricate with reduced entrance to branch taps and with no excess material projecting from fitting onto branch tap entrance.
- G. Fabricate elbows using die-formed, gored, pleated, or mitered construction. Unless elbow construction type is indicated, fabricate elbows as follows:
  - 1. Mitered-Elbow Radius and Number of Pieces: Welded construction complying with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," unless otherwise indicated.
  - 2. Round Mitered Elbows with Aerofoil Vanes: Welded construction with the following metal thickness for pressure classes from minus 2- to plus 2-inch wg:
    - a. Ducts 3 to 36 Inches in Diameter: 0.034 inch.
    - b. Ducts 37 to 50 Inches in Diameter: 0.040 inch.
  - 3. 90-Degree, 2-Piece, Mitered Elbows: Use only for supply systems or for material-handling Class A or B exhaust systems and only where space restrictions do not permit using radius elbows. Fabricate with single-thickness turning vanes.
  - 4. Round Elbows 8 Inches and Less in Diameter: Fabricate die-formed elbows for 45- and 90-degree elbows and pleated elbows for 30, 45, 60, and 90 degrees only. Fabricate



## SECTION 233113 - METAL DUCTS

nonstandard bend-angle configurations or nonstandard diameter elbows with gored construction.

5. Round Elbows 9 through 14 Inches in Diameter: Fabricate gored or pleated elbows for 30, 45, 60, and 90 degrees unless space restrictions require mitered elbows. Fabricate nonstandard bend-angle configurations or nonstandard diameter elbows with gored construction.
6. Round Elbows Larger than 14 Inches in Diameter and All Flat-Oval Elbows: Fabricate gored elbows unless space restrictions require mitered elbows.
7. Die-Formed Elbows for Sizes through 8 Inches in Diameter and All Pressures 0.040 inch thick with 2-piece welded construction.
8. Round Gored-Elbow Metal Thickness: Same as non-elbow fittings specified above.
9. Pleated Elbows for Sizes through 14 Inches in Diameter and Pressures through 10-Inch wg: 0.022 inch.

### 2.3 DOUBLE-WALL ROUND AND FLAT-OVAL DUCTS AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Lindab Inc.
  2. McGill AirFlow LLC.
  3. SEMCO Incorporated.
- B. Ducts: Prefabricated double-wall (insulated) ducts with an outer shell and an inner duct. Dimensions indicated are for inner ducts.
- 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 in 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."
  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."

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- E. Inner Duct: Minimum 0.028-inch solid sheet steel.
- F. Fittings: Fabricate double-wall (insulated) fittings with an outer shell and an inner duct.
  - 1. Solid Inner Ducts: Use the following sheet metal thicknesses:
    - a. Ducts 3 to 34 Inches in Diameter: 0.028 inch.
    - b. Ducts 35 to 58 Inches in Diameter: 0.034 inch.
    - c. Ducts 60 to 88 Inches in Diameter: 0.040 inch.
- G. 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: 0.26 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
  - 2. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
  - 3. Terminate insulation where double-wall duct connects to single-wall externally insulated duct, and reduce outer shell diameter to inner duct diameter.
  - 4. Coat insulation with antimicrobial coating.
  - 5. Cover insulation with polyester film complying with UL 181, Class 1.
  - 6. **Supply and Make-Up Air Ducts: 2 inches thick.**
  - 7. **Painted for indoor application. Coordinate final finish with architect.**

### 2.4 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.
  - 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 minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

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### 2.5 DUCT LINER

- A. Fibrous-Glass Duct Liner: Comply with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
1. Manufacturers:
    - a. Owens Corning's Aeroflex Plus Duct Liner or Equal.
  2. Materials: ASTM C 1071; surfaces exposed to airstream shall be coated to prevent erosion of glass fibers.
    - a. Maximum Thermal Conductivity:
    - b. Thickness: 1 inch for sound attenuation, and R8 for thermal insulation.
    - c. Thermal Conductivity (k-Value): 0.26 at 75 deg Fmean temperature.
    - d. Fire-Hazard Classification: Maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM E84.
    - e. Water-Based Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B. 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).
    - f. Mechanical Fasteners: Galvanized steel suitable for adhesive attachment, mechanical attachment, or welding attachment to duct without damaging liner when applied as recommended by manufacturer and without causing leakage in duct.
      - 1) Tensile Strength: Indefinitely sustain a 50-lb-tensile, dead-load test perpendicular to duct wall.
      - 2) Fastener Pin Length: As required for thickness of insulation and without projecting more than 1/8 inch into airstream.
      - 3) Adhesive for Attaching Mechanical Fasteners: Comply with fire-hazard classification of duct liner system.
  3. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.

### 2.6 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. Two-Part Tape Sealing System:
1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
  2. Tape Width: 4 inches.
  3. Sealant: Modified styrene acrylic.
  4. Water resistant.
  5. Mold and mildew resistant.
  6. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
  7. Service: Indoor and outdoor.

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8. Service Temperature: Minus 40 to plus 200 deg F.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
10. 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).
11. Sealant 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."

### C. 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.

### D. 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).
7. Sealant 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."

### E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

### F. Round Duct Joint O-Ring Seals:

1. Seal shall provide maximum 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.

## 2.7 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.

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- C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."
- D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
- E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.
- F. 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.
- G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- H. 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.

### 2.8 FIRE-STOPPING

- A. Fire-Resistant Sealant: Provide two-part, foamed-in-place, fire-stopping silicone sealant, one-part elastomeric sealant, formulated for use in a through-penetration fire-stop system for filling openings around duct penetrations through walls and floors, having fire-resistance ratings indicated as established by testing identical assemblies per ASTM E 814 by Underwriters Laboratory, Inc. or other testing and inspecting agency acceptable to authorities having jurisdiction.
- B. Products: Subject to compliance with requirements, products that may be incorporated in the Work are limited to, the following:
  - 1. "Dow Corning Fire Stop Foam"; Dow Corning Corp.
  - 2. "Dow Corning Fire Stop Sealant"; Dow Corning Corp.
  - 3. "3M Fire Barrier Caulk CP-25"; Electrical Products Div./3M.
- C. Seams and laps arranged on top of duct.

### 2.9 INSULATED, PRE-FABRICATED GREASE DUCT (KITCHEN HOOD EXHAUST DUCT)

- A. See Section 233533 Listed Kitchen Ventilation System Exhaust Ducts.

### 2.9 STAINLESS STEEL DUCT (DISHWASHER EXHAUST DUCT)

- A. Construction, installation and testing shall be per applicable codes.
- B. Dishwasher Hood Exhaust Ducts:
  - 1. Type 304, stainless steel with finish to match kitchen equipment and range hood.
  - 2. Rated for transportation of steam and heat laden vapors from commercial dishwashing operation.
  - 3. Weld and flange seams and joints. Seams and laps arranged on top of duct.

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4. Include all supports, roof penetrations, fan adapters, square-to-round transitions, hood connectors, drain fittings and expansion joints required to install duct.
5. Roof penetration pieces shall be UL listed products. Where roof is pitched (up to 12:12), roof penetration pieces shall be of the pitched type so that it is not necessary to provide a horizontal roof curb.
6. Comply with NFPA 96.

### 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 and flat-oval 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 Section 233300 "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."

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### 3.2 INSTALLATION 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.

### 3.3 DISHWASHER EXHAUST DUCTS, SPECIAL INSTALLATION REQUIREMENTS

- A. Install ducts to allow for thermal expansion through temperature range.
- B. Install ducts without dips or traps that may collect residues unless traps have continuous or automatic residue removal.
- C. Install access openings at each change in direction and at intervals defined by NFPA 96; locate on sides of duct a minimum of 1-1/2 inches from bottom; and fit with air-tight covers of same material as duct.

### 3.4 APPLICATION OF LINER IN RECTANGULAR DUCTS

- A. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
- B. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
- C. Butt transverse joints without gaps and coat joint with adhesive.
- D. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
- E. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and standard liner product dimensions make longitudinal joints necessary.
- F. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm.
- G. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.

## SECTION 233113 - METAL DUCTS

- H. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:
  - 1. Fan discharges.
  - 2. Intervals of lined duct preceding unlined duct.
  - 3. Upstream edges of transverse joints in ducts where air velocities are greater than 2500 fpm or where indicated.
- I. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

### 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."
- B. Seal ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible", and as defined below.
  - 1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
  - 2. All Ducts U.N.O: Seal Class A.
  - 3. Unconditioned Space, Return-Air Ducts: Seal Class B.
  - 4. Conditioned Space, Return-Air Ducts: Seal Class C.

### 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. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "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 intervals 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.



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### 3.7 CONNECTIONS

- A. Make connections to equipment with flexible connectors complying with Section 233300 "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 interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Division 9 Sections.

### 3.9 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Leakage Tests:
  - 1. **Comply with requirements for Leakage Class A for sealing all ducts.** Refer to SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.
  - 2. Test the following systems:
    - a. Supply, Return, Exhaust, Outdoor Ducts with a Pressure Class of 2-Inch wg or Higher: Test representative duct sections, selected by Architect from sections installed, totaling no less than 50 percent of total installed duct area for each designated pressure class.
    - b. Engineer will randomly designate two supply duct systems for testing in accordance with Section 4 of SMACNA HVAC Air Duct Leakage Test Manual, current edition. If leakage test results exceed SMACNA allowable leakage rates, then additional two systems shall be tested. Supply duct test section shall include main trunk line from the mechanical room to the farthest VAV box. For systems without VAV boxes, main trunk shall be determined on site
  - 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. Give seven days' advance notice for testing.
- C. Duct System Cleanliness Tests:
  - 1. Visually inspect duct system to ensure that no visible contaminants are present.
  - 2. Test sections of metal duct system, chosen randomly by Owner, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."
    - a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.

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- D. Duct system will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

### 3.10 DUCT CLEANING

- A. Clean new and existing duct system(s) before testing, adjusting, and balancing.
- B. Use service openings for entry and inspection.
  - 1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Section 233300 "Air Duct Accessories" for access panels and doors.
  - 2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
  - 3. Remove and reinstall ceiling to gain access during the cleaning process.
- C. Particulate Collection and Odor Control:
  - 1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
  - 2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.
- D. Clean the following components by removing surface contaminants and deposits:
  - 1. Air outlets and inlets (registers, grilles, and diffusers).
  - 2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
  - 3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
  - 4. Coils and related components.
  - 5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
  - 6. Supply-air ducts, dampers, actuators, and turning vanes.
  - 7. Dedicated exhaust and ventilation components and makeup air systems.
- E. Mechanical Cleaning Methodology:
  - 1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
  - 2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
  - 3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
  - 4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.

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5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
6. Provide drainage and cleanup for wash-down procedures.
7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents according to manufacturer's written instructions after removal of surface deposits and debris.

### 3.11 START UP

- A. Air Balance: Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

### 3.12 DUCT SCHEDULE

- A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:

#### A. Supply Ducts:

1. Ducts Connected to Fan Coil Units, and Terminal Units:
  - a. Pressure Class: Positive 2-inch wg.
  - b. Minimum SMACNA Seal Class: A
2. Ducts Connected to Constant-Volume Air-Handling Units, including DOAS
  - a. Pressure Class: Positive 3-inch wg
  - b. Minimum SMACNA Seal Class: A
3. Ducts Connected to Variable-Air-Volume Air-Handling Units:
  - a. Pressure Class: Positive 4-inch wg.
  - b. Minimum SMACNA Seal Class: A

#### B. Return Ducts:

1. Ducts Connected to Fan Coil Units, and Terminal Units
  - a. Pressure Class: Positive or negative 2-inch wg
  - b. Minimum SMACNA Seal Class: B.
2. Ducts Connected to Air-Handling Units
  - a. Pressure Class: Positive or negative 3-inch wg
  - b. Minimum SMACNA Seal Class: B

#### C. Exhaust Ducts:

1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:
  - a. Pressure Class: Negative 2-inch wg
  - b. Minimum SMACNA Seal Class: A
2. Ducts Connected to Dishwasher Hoods:
  - a. Type 304, stainless-steel sheet.
  - b. Welded seams and flanged joints with watertight EPDM gaskets.
  - c. Pressure Class: Positive or negative 2-inch wg
  - d. Minimum SMACNA Seal Class: Welded seams, joints, and penetrations.
  - e. SMACNA Leakage Class: 3.
3. Ducts Connected to Commercial Kitchen Hoods:

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- a. Duct shall be factory fabricated. See Div. 23 specifications.
4. Exhaust Ducts Connected to Fume Hoods, Bio Safety and Chemical Storage Cabinets:
  - a. Type 316L stainless-steel, minimum thickness 18 gage, pressure Class neg. 2"wg.
  - b. Minimum SMACNA Seal Class: Welded seams, joints, and penetrations. Ductwork shall have longitudinal butt ("solid") weld seams with butt weld joints.
  - c. Butt-weld all joints and fittings using Gas Tungsten Arc Welding ("GTAW" or "TIG").
  - d. Welding procedures shall meet the requirements of AWS D1.1.
  - e. Welds on exposed ductwork inside the building shall be ground and polished.
  - f. Duct sealant shall not be used to seal ductwork.
  - g. With Owner's approval, joints may be made with steel companion flange and PTFE gaskets.
  - h. Provide required transitions from duct to equipment and make equipment connections.
  - i. Welder procedure qualifications (WPQ) are required to perform the welding operations on all project welding procedure specifications (WPS) for TIG welding sheet metal. All welder certifications shall be maximum 2 years prior to date of awarding contract.
  - j. Install ducts with an upward grade in the direction of flow. Make the grade a minimum of 1/8 inch per foot. Low places in the duct that can collect moisture will not be allowed. Use eccentric reducers, with the flat on bottom, in ductwork to maintain slope.
  - k. All welds shall be cleaned with uncontaminated stainless-steel wire brush prior to inspection. Welds shall be visually inspected and meet the requirements of AWS D9.1 and SMACNA's The Managers' Guide for Welding.
5. Exhaust Ducts Connected to Laser Cutter, and other equipment specifically noted on the drawings:
  - a. Manufacturers: Subject to compliance with requirements, provide products by the following: Monoxivent Co.
  - b. Duct and Fittings:
    - 1) Thermoset FRP Resin: Comply with UL 181, Class 1, maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested by an NRTL according to ASTM E84.
    - 2) Inner Liner: FSK liner rated by an NRTL to comply with UL 181, Class 1.
    - 3) Round Duct: ASTM D2996, Type I, Grade 2, Class E, filament-wound duct, minimum 0.125-inch wall thickness, with tapered bell-and-spigot ends for adhesive joints or with plain ends with couplings.
    - 4) Round Fittings: Compression or spray-up/contact, molded of same material, pressure class, and joining method as duct.
    - 5) Rectangular Fittings: Minimum 0.125-inch thick, flat sheet with fiberglass roving and resin-reinforced joints and seams.
    - 6) Verify thickness with manufacturer for indoor and outdoor application and windspeeds.
  - c. Joining Materials: Roving and polyester resin.
  - d. Fabrication:
    - 1) Fabricate joints, seams, transitions, reinforcement, elbows, branch connections, and access doors and panels according to SMACNA's "Thermoset FRP Duct Construction Manual," Ch. 7, "Requirements."

## SECTION 233113 - METAL DUCTS

- 2) Fabricate 90-degree rectangular mitered elbows to include turning vanes, and 90-degree round elbows with a minimum of three segments for 12 inches and smaller and a minimum of five segments for 14 inches and larger.
  - e. Drains: Formed drain pockets with a minimum of NPS 1 threaded pipe connections.
  - f. Install thermoset FRP ducts and fittings to comply with SMACNA's "Thermoset FRP Duct Construction Manual."
- D. Outdoor-Air (Not Filtered, Heated, or Cooled) Ducts:
1. Ducts Connected to AHUs, Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units
    - a. Pressure Class: Positive or negative 2-inch wg
    - b. Minimum SMACNA Seal Class: A
- E. Double-Wall Duct Interstitial Insulation:
1. Supply Air Ducts: 2 inches thick, unless noted otherwise on drawings.
- F. Elbow Configuration:
1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Elbows."
    - a. Double Skin vaned elbows. See drawings.
  2. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-3, "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.
- 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 1000 fpm or Lower: 90-degree tap.
    - b. Velocity 1000 to 1500 fpm: Conical tap.
    - c. Velocity 1500 fpm or Higher: 45-degree lateral.

END OF SECTION 233113

## SECTION 233300 - 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. Backdraft and pressure relief dampers.
  - 2. Barometric relief dampers.
  - 3. Manual volume dampers.
  - 4. Control dampers.
  - 5. Fire dampers.
  - 6. Flange connectors.
  - 7. Turning vanes.
  - 8. Remote damper operators.
  - 9. Duct-mounted access doors.
  - 10. Flexible connectors.
  - 11. Flexible ducts.
  - 12. Duct accessory hardware.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.
  - 1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:
    - a. Special fittings.
    - b. Manual volume damper installations.
    - c. Control-damper installations.
    - d. Fire-damper, ceiling, and corridor damper installations, including sleeves; and duct-mounted access doors and remote damper operators.
    - e. Wiring Diagrams: For power, signal, and control wiring.

## SECTION 233300 - AIR DUCT ACCESSORIES

### 1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from Installers of the items involved.
- B. Source quality-control reports.

### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

### 1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Fusible Links: Furnish quantity equal to 10 percent of amount installed.

### 1.7 QUALITY ASSURANCE

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- B. Comply with AMCA 500-D testing for damper rating.

## PART 2 - PRODUCTS

### 2.1 ASSEMBLY DESCRIPTION

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- B. 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.

### 2.2 MATERIALS

- A. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
  - 1. Galvanized Coating Designation: G90.
  - 2. Exposed-Surface Finish: Mill phosphatized.

## SECTION 233300 - AIR DUCT ACCESSORIES

- B. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304.
- C. Aluminum Sheets: Comply with ASTM B 209, Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.
- D. Extruded Aluminum: Comply with ASTM B 221, Alloy 6063, Temper T6.
- E. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- F. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

### 2.3 BACKDRAFT AND PRESSURE RELIEF DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Greenheck Fan Corporation.
  - 2. Nailor Industries Inc.
  - 3. Pottorff.
  - 4. Ruskin Company.
- B. Description: Gravity balanced. Blades of maximum 6-inch width, with sealed edges, assembled in rattle-free manner, steel ball bearings, and axles.
- C. Frame: Hat-shaped, 0.05-inch-thick, galvanized sheet steel, with welded corners and mounting flange.
- D. Blades: Multiple single-piece blades, 0.050-inch-thick aluminum sheet with sealed edges.
- E. Blade Action: Parallel.
- F. Blade Seals: Neoprene, mechanically locked.
- G. Blade Axles:
  - 1. Material: Galvanized steel.
- H. Tie Bars and Brackets: Galvanized steel.
- I. Return Spring: Adjustable tension.
- J. Accessories:
  - 1. Adjustment device to permit setting for varying differential static pressure.
  - 2. Counterweights and spring-assist kits for vertical airflow installations.
  - 3. Electric actuators, where noted.
  - 4. Chain pulls.
  - 5. Screen Mounting: Front mounted in sleeve.



## SECTION 233300 - AIR DUCT ACCESSORIES

- a. Sleeve Thickness: 20 gage minimum.
- b. Sleeve Length: 6 inches minimum.
6. Screen Mounting: Rear mounted.
7. Screen Material: Stainless steel.
8. Screen Type: Bird.
9. 90-degree stops.

### 2.4 MANUAL VOLUME DAMPERS

#### A. Standard, Steel, Manual Volume Dampers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Flexmaster U.S.A., Inc.
  - b. McGill AirFlow LLC.
  - c. Nailor Industries Inc.
  - d. Pottorff.
  - e. Ruskin Company.
2. Standard leakage rating, with linkage outside airstream.
3. Suitable for horizontal or vertical applications.
4. Frames:
  - a. Frame: Hat-shaped, 0.094-inch-thick, galvanized sheet steel.
  - b. Mitered and welded corners.
  - c. Flanges for attaching to walls and flangeless frames for installing in ducts.
5. Blades:
  - a. Multiple or single blade.
  - b. Parallel- or opposed-blade design.
  - c. Stiffen damper blades for stability.
  - d. Galvanized-steel, 0.064 inch thick.
6. Blade Axles: Galvanized steel.
7. Tie Bars and Brackets: Galvanized steel.

#### B. Standard, Aluminum, Manual Volume Dampers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. McGill AirFlow LLC.
  - b. Nailor Industries Inc.
  - c. Pottorff.
  - d. Ruskin Company.

## SECTION 233300 - AIR DUCT ACCESSORIES

2. Standard leakage rating, with linkage outside airstream.
  3. Suitable for horizontal or vertical applications.
  4. Frames: Hat-shaped, 0.10-inch-thick, aluminum sheet channels; frames with flanges for attaching to walls and flangeless frames for installing in ducts.
  5. Blades:
    - a. Multiple or single blade.
    - b. Parallel- or opposed-blade design.
    - c. Stiffen damper blades for stability.
    - d. Roll-Formed Aluminum Blades: 0.10-inch-thick aluminum sheet.
    - e. Extruded-Aluminum Blades: 0.050-inch-thick extruded aluminum.
  6. Blade Axles: Galvanized steel.
  7. Tie Bars and Brackets: Aluminum.
- C. Low-Leakage, Steel, Manual Volume Dampers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Pottorff.
    - b. Ruskin Company.
  2. Comply with AMCA 500-D testing for damper rating.
  3. Low-leakage rating, with linkage outside airstream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.
  4. Suitable for horizontal or vertical applications.
  5. Frames:
    - a. Hat shaped.
    - b. 0.094-inch-thick, galvanized sheet steel.
    - c. Mitered and welded corners.
    - d. Flanges for attaching to walls and flangeless frames for installing in ducts.
  6. Blades:
    - a. Multiple or single blade.
    - b. Parallel- or opposed-blade design.
    - c. Stiffen damper blades for stability.
    - d. Galvanized, roll-formed steel, 0.064 inch thick.
  7. Blade Axles: Galvanized steel.
  8. Blade Seals: Neoprene.
  9. Tie Bars and Brackets: Galvanized steel.
  10. Accessories:
    - a. Include locking device to hold single-blade dampers in a fixed position without vibration.

## SECTION 233300 - AIR DUCT ACCESSORIES

### D. Low-Leakage, Aluminum, Manual Volume Dampers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Pottorff.
  - b. Ruskin Company.
2. Comply with AMCA 500-D testing for damper rating.
3. Low-leakage rating, with linkage outside airstream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.
4. Suitable for horizontal or vertical applications.
5. Frames: Hat-shaped, 0.10-inch-thick, aluminum sheet channels; frames with flanges for attaching to walls and flangeless frames for installing in ducts.
6. Blades:
  - a. Multiple or single blade.
  - b. Parallel- or opposed-blade design.
  - c. Roll-Formed Aluminum Blades: 0.10-inch-thick aluminum sheet.
  - d. Extruded-Aluminum Blades: 0.050-inch-thick extruded aluminum.
7. Blade Axles: Galvanized steel.
8. Blade Seals: Neoprene.
9. Tie Bars and Brackets: Aluminum.
10. Accessories:
  - a. Include locking device to hold single-blade dampers in a fixed position without vibration.

### E. Jackshaft:

1. Size: 1-inch diameter.
2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.

### F. Damper Hardware:

1. Zinc-plated, die-cast core with dial and handle made of 3/32-inch-thick zinc-plated steel, and a 3/4-inch hexagon locking nut.
2. Include center hole to suit damper operating-rod size.
3. Include elevated platform for insulated duct mounting.

## 2.5 CONTROL DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

## SECTION 233300 - AIR DUCT ACCESSORIES

1. [Greenheck Fan Corporation.](#)
  2. [Pottorff.](#)
  3. [Ruskin Company.](#)
  4. [Young Regulator Company.](#)
- B. Low-leakage rating, with linkage outside airstream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.
- C. Frames:
1. Hat shaped.
  2. 0.094-inch-thick, galvanized sheet steel.
  3. Mitered and welded corners.
- D. Blades:
1. Multiple blade with maximum blade width of 6 inches.
  2. Opposed-blade design.
  3. Galvanized-steel.
  4. 0.064 inch thick single skin.
  5. Blade Edging: Closed-cell neoprene.
  6. Blade Edging: Inflatable seal blade edging, or replaceable rubber seals.
- E. Blade Axles: 1/2-inch-diameter; galvanized steel; blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings.
1. Operating Temperature Range: From minus 40 to plus 200 deg F.
- F. Bearings:
1. Molded synthetic.
  2. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
  3. Thrust bearings at each end of every blade.

### 2.6 FIRE DAMPERS

- A. [Manufacturers:](#) Subject to compliance with requirements, provide products by one of the following:
1. [Greenheck Fan Corporation.](#)
  2. [Pottorff.](#)
  3. [Ruskin Company.](#)
- B. Type: Dynamic; rated and labeled according to UL 555 by an NRTL.
- C. Closing rating in ducts up to 4-inch wg static pressure class and minimum 2000-fpm velocity.
- D. Fire Rating: 1-1/2 hours.

## SECTION 233300 - AIR DUCT ACCESSORIES

- E. Frame: Curtain type with blades outside airstream; fabricated with roll-formed, 0.034-inch-thick galvanized steel; with mitered and interlocking corners.
- F. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.
  - 1. Minimum Thickness: 0.138 inch thick, as indicated, and of length to suit application.
  - 2. Exception: Omit sleeve where damper-frame width permits direct attachment of perimeter mounting angles on each side of wall or floor; thickness of damper frame must comply with sleeve requirements.
- G. Mounting Orientation: Vertical or horizontal as indicated.
- H. Blades: Roll-formed, interlocking, 0.034-inch-thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch-thick, galvanized-steel blade connectors.
- I. Horizontal Dampers: Include blade lock and stainless-steel closure spring.
- J. Heat-Responsive Device: Replaceable, 165 deg F rated, fusible links.

### 2.7 FLANGE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. [Ductmate Industries, Inc.](#)
  - 2. [Nexus PDQ.](#)
  - 3. [Ward Industries, Inc.](#)
- B. Description: Factory-fabricated, slide-on transverse flange connectors, gaskets, and components.
- C. Material: Galvanized steel.
- D. Gage and Shape: Match connecting ductwork.

### 2.8 TURNING VANES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. [Ductmate Industries, Inc.](#)
  - 2. [METALAIRE, Inc.](#)
  - 3. [SEMCO Incorporated.](#)
  - 4. [Ward Industries, Inc.](#)
- B. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
  - 1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.

## SECTION 233300 - AIR DUCT ACCESSORIES

- C. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 4-3, "Vaness and Vane Runners," and 4-4, "Vane Support in Elbows."
- D. Vane Construction: Double wall.

### 2.9 REMOTE DAMPER OPERATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Pottorff.
  - 2. Young Regulator Company.
- B. Description: Cable system designed for remote manual damper adjustment.
- C. Tubing: Brass.
- D. Cable: Stainless steel.
- E. Wall-Box Cover-Plate Material: Stainless steel.

### 2.10 DUCT-MOUNTED ACCESS DOORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Flexmaster U.S.A., Inc.
  - 2. Greenheck Fan Corporation.
  - 3. Pottorff.
- B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 7-2, "Duct Access Doors and Panels," and 7-3, "Access Doors - Round Duct."
  - 1. Door:
    - a. Double wall, rectangular.
    - b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
    - c. Vision panel.
    - d. Hinges and Latches: 1-by-1-inch butt or piano hinge and cam latches.
    - e. Fabricate doors airtight and suitable for duct pressure class.
  - 2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.

### 2.11 FLEXIBLE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

## SECTION 233300 - AIR DUCT ACCESSORIES

1. [Ductmate Industries, Inc.](#)
  2. [Duro Dyne Inc.](#)
  3. [Ward Industries, Inc.](#)
- B. Materials: Flame-retardant or noncombustible fabrics.
- C. Coatings and Adhesives: Comply with UL 181, Class 1.
- D. Metal-Edged Connectors: Factory fabricated with a fabric strip 5-3/4 inches wide attached to two strips of 2-3/4-inch-wide, 0.028-inch-thick, galvanized sheet steel or 0.032-inch-thick aluminum sheets. Provide metal compatible with connected ducts.
- E. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
1. Minimum Weight: 26 oz./sq. yd..
  2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
  3. Service Temperature: Minus 40 to plus 200 deg F.
- F. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.
1. Minimum Weight: 24 oz./sq. yd..
  2. Tensile Strength: 530 lbf/inch in the warp and 440 lbf/inch in the filling.
  3. Service Temperature: Minus 50 to plus 250 deg F.
- G. High-Temperature System, Flexible Connectors: Glass fabric coated with silicone rubber.
1. Minimum Weight: 16 oz./sq. yd..
  2. Tensile Strength: 285 lbf/inch in the warp and 185 lbf/inch in the filling.
  3. Service Temperature: Minus 67 to plus 500 deg F.
- H. High-Corrosive-Environment System, Flexible Connectors: Glass fabric with chemical-resistant coating.
1. Minimum Weight: 14 oz./sq. yd..
  2. Tensile Strength: 450 lbf/inch in the warp and 340 lbf/inch in the filling.
  3. Service Temperature: Minus 67 to plus 500 deg F.

### 2.12 FLEXIBLE DUCTS

- A. [Manufacturers](#): Subject to compliance with requirements, provide products by the following:
1. [Flexmaster U.S.A., Inc.](#)
  2. Thermaflex
- A. Where acoustical flexible duct is shown on drawings, provide Flexmaster Type 8M (or Thermaflex M-KE) UL 181 Class I Air Duct or equal.
- B. The duct shall be constructed of a CPE fabric supported by helical wound galvanized steel. The fabric shall be mechanically locked to the steel helix without the use of adhesives or chemicals.

SECTION 233300 - AIR DUCT ACCESSORIES

- C. The internal working pressure rating shall be at least 6" w.g. positive and 4" w.g. negative through 16" diameter, and 1" w.g. negative for 18" and 20" diameters, with a bursting pressure of at least 2 ½ time the working pressure.
- D. The duct shall be rated for a velocity of at least 4000 feet per minute.
- E. The duct must be suitable for continuous operation at a temperature range of -20° F to +250° F.
- F. Factory insulate the flexible duct with fiberglass insulation. The R-value shall be at least 8 at a mean temperature of 75° F.
- G. Cover the insulation with a fire retardant metalized vapor barrier jacket reinforced with crosshatched scrim having a permeance of not greater than 0.05 perms when tested in accordance with ASTM E96, Procedure.
- H. Sound attenuation Properties: Acoustical performance, when tested by an independent laboratory in accordance with the Air Diffusion Council's Flexible Air Duct Test Code FD 72-R1, Section 3.0, Sound Properties, shall be as follows:

<b>Octave Band</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>
<b>Hz.</b>	125	250	500	1000	2000	4000
<b>6" diameter</b>	7	31	40	38	40	27
<b>8" diameter</b>	13	29	36	35	38	22
<b>12" diameter</b>	21	28	29	33	26	12

- I. Flexible Duct Connectors:
  - 1. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action in sizes 3 through 18 inches, to suit duct size.

2.13 DUCT ACCESSORY HARDWARE

- A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.
- B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.



## SECTION 233300 - AIR DUCT ACCESSORIES

- B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.
- C. Install backdraft dampers (control dampers for fans 2,000CFM and larger) at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.
- D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger 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.
- E. Set dampers to fully open position before testing, adjusting, and balancing.
- F. Install test holes at fan inlets and outlets and elsewhere as indicated.
- G. Install fire and smoke dampers according to UL listing.
- H. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
  - 1. On both sides of duct coils.
  - 2. Upstream from duct filters.
  - 3. At outdoor-air intakes and mixed-air plenums.
  - 4. At drain pans and seals.
  - 5. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
  - 6. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
  - 7. At each change in direction and at maximum 50-foot spacing.
  - 8. Upstream from turning vanes.
  - 9. Upstream or downstream from duct silencers.
  - 10. Control devices requiring inspection.
  - 11. Elsewhere as indicated.
- I. Install access doors with swing against duct static pressure.
- J. Access Door Sizes:
  - 1. One-Hand or Inspection Access: 8 by 5 inches.
  - 2. Two-Hand Access: 12 by 6 inches.
  - 3. Head and Hand Access: 18 by 10 inches.
  - 4. Head and Shoulders Access: 21 by 14 inches.
  - 5. Body Access: 25 by 14 inches.
  - 6. Body plus Ladder Access: 25 by 17 inches.

## SECTION 233300 - AIR DUCT ACCESSORIES

- K. Label access doors according to Section 230553 "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.
- L. Install flexible connectors to connect ducts to equipment.
- M. For fans developing static pressures of 5-inch wg and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.
- N. Connect terminal units to supply ducts directly, and for fan powered boxes with maximum 12-inch lengths of flexible duct. Do not use flexible ducts to change directions.
- O. Connect flexible ducts to metal ducts with stainless steel draw bands.
- P. Install duct test holes where required for testing and balancing purposes.

### 3.2 FIELD QUALITY CONTROL

- A. Tests and Inspections:
  - 1. Operate dampers to verify full range of movement.
  - 2. Inspect locations of access doors and verify that purpose of access door can be performed.
  - 3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
  - 4. Inspect turning vanes for proper and secure installation.
  - 5. Operate remote damper operators to verify full range of movement of operator and damper.

END OF SECTION 233300

## SECTION 233423 - HVAC POWER VENTILATORS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  1. Ceiling-mounted ventilators.
  2. Centrifugal roof ventilators.
  3. Up-blast centrifugal roof ventilator and make up supply air fan (kitchen ventilation system).
  4. In-line fans.
  5. Ceiling fans
  6. Industrial Material Handler Fan for Laser Cutter

#### 1.3 PERFORMANCE REQUIREMENTS

- A. Project Altitude: Base fan-performance ratings on sea level.
- B. Operating Limits: Classify according to AMCA 99.
- C. Delegated Design: Design roof curbs to comply with **wind** performance requirements, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- D. Wind-Restraint Performance rated for basic Wind Speed: Rated for project location.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Also include the following:
  1. Certified fan performance curves with system operating conditions indicated.
  2. Certified fan sound-power ratings.
  3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
  4. Material thickness and finishes, including color charts.
  5. Dampers, including housings, linkages, and operators.
  6. Fan speed controllers.
  7. Roof curbs.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
  1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

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2. Wiring Diagrams: For power, signal, and control wiring.
- C. Delegated-Design Submittal: For unit hangars and supports indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
1. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
  2. Design Calculations: Calculate requirements for selecting vibration isolators and for designing vibration isolation bases.
  3. Wind Restraints and Certification.
- D. Manufacturer Wind Loading Qualification Certification: Submit certification that specified equipment will withstand wind forces identified in "Performance Requirements" Article, Division 7 and in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculations.
  2. Dimensioned Outline Drawings of Equipment Unit: Identify center of wind force 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.

### 1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
1. Framing and support members relative to duct penetrations.
  2. Ceiling suspension assembly members.
  3. Size and location of initial access modules for acoustical tile.
  4. Ceiling-mounted items including light fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
  5. Roof framing and support members relative to duct penetrations.
- B. Certified Compliance Statement and shop drawings from a licensed PE for IBC and TDI.
1. Sealed shop drawings showing installation instructions and attachment of equipment to curb, and curb to structure. Include quantity and type of restraining brackets/clips, screws, spacing, etc.
  2. As a separate attachment provide sealed IBC and TDI compliant calculations for curbs and attachment.
- C. Field quality-control reports.

### 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For power ventilators to include in emergency, operation, and maintenance manuals.

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### 1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Belts: One set for each belt-driven unit.

### 1.8 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. AMCA Compliance: Fans shall have AMCA-Certified performance ratings and shall bear the AMCA-Certified Ratings Seal.
- C. UL Standards: Power ventilators shall comply with UL 705. Power ventilators for use for restaurant kitchen exhaust shall also comply with UL 762.
- D. International Building Code and TDI Compliance: Licensed Professional Engineer shall certify that the listed items are designed for and will withstand wind speed for the location of the project, per the relevant edition of International Building Code, ASCE Std 7, Texas Department of Insurance requirements.
  - 1. Equipment curb/attachment for exterior and roof mounted equipment such as fans.
  - 2. Attachment of equipment to curb/pad.
  - 3. Attachment of curb/pad to building structure.

### 1.9 COORDINATION

- A. Coordinate size and location of structural-steel support members.
- B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 7 Section "Roof Accessories."

### 1.10 WARRANTY

- A. General Warranty: The special warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.
- B. Special Warranty: A written warranty, executed by Contractor and signed by manufacturer, agreeing to replace components that fail in materials and workmanship within the specified warranty period, provided manufacturer's written instructions for installation, operation, and maintenance have been followed.
  - 1. Warranty Period: One (1) year parts and labor for fan and motor, including all components, from date of Substantial Completion.

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### 1.11 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Belts: One set for each belt-driven unit.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. HVAC Power Ventilators: subject to compliance with requirements, provide products by one of the following:
  - 1. Loren Cook Company.
  - 2. Greenheck Fan Corp.
  - 3. New York Blower Company (The).
  - 4. Penn Ventilation.

### 2.2 CEILING-MOUNTED VENTILATORS

- A. Description: Centrifugal fans designed for installing in ceiling or wall or for concealed in-line applications.
- B. Housing: Steel, lined with acoustical insulation.
- C. Fan Wheel: Centrifugal forward curved type, injection molded of polypropylene resin for smaller fans, galvanized steel for larger fans.
- D. Grille: Manufacturer's standard **Aluminum**, louvered grille with flange on intake and thumbscrew attachment to fan housing.
- E. Electrical Requirements: Junction box for electrical connection on housing and receptacle for motor plug-in.
- F. Accessories:
  - 1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
  - 2. Manual Starter Switch: Single-pole rocker switch assembly with cover and pilot light.
  - 3. Factory mounted disconnect
  - 4. Stainless steel insect screen
  - 5. Isolation: Rubber-in-shear vibration isolators.
  - 6. Aluminum backdraft damper
  - 7. Vibration isolator kit
  - 8. Time-Delay Switch: See schedules for switch coordination.
  - 9. See schedules for other options.

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### 2.3 IN-LINE CENTRIFUGAL AND MIXED FLOW INLINE FANS

- A. Description: In-line, centrifugal fans consisting of housing, wheel, outlet guide vanes, fan shaft, bearings, motor and disconnect switch, drive assembly, mounting brackets, and accessories.
- B. Housing: Split, spun aluminum with aluminum straightening vanes, inlet and outlet flanges, and support bracket adaptable to floor, side wall, or ceiling mounting.
- C. Direct-Driven Units: Motor encased in housing outside of airstream, factory wired to disconnect switch located on outside of fan housing.
- D. Belt-Driven Units: Motor mounted on adjustable base, with adjustable sheaves, enclosure around belts within fan housing, and lubricating tubes from fan bearings extended to outside of fan housing.
- E. Fan Wheels: Aluminum, airfoil blades welded to aluminum hub.
- F. Accessories:
  - 1. Volume-Control Damper: Manually operated with quadrant lock, located in fan outlet.
  - 2. Companion Flanges: For inlet and outlet duct connections.
  - 3. 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.
  - 4. Motor and Drive Cover (Belt Guard): Epoxy-coated steel.
  - 5. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit. **See schedules.**
  - 6. Motorized Dampers: Parallel-blade dampers mounted in curb base with electric actuator; wired to close when fan stops.
  - 7. See schedules for other options.

### 2.4 IN-LINE CENTRIFUGAL FANS

- A. Description: In-line mounted, centrifugal fans that are UL 705 listed, AMCA certified.
- B. Housing: 20 gauge galvanized steel and acoustically insulated. Blower and motor assembly mounted on 14 ga. reinforced channel, resiliently mounted fan. Inlet and outlet duct flanges, reinforced aluminum dampers with continuous aluminum hinge rods and brass bushings.
- C. Wheels: twin DWDI centrifugal forward curved type, galvanized steel, balanced in accordance with AMCA Std 204-96 Balance Quality and Vibration Levels for Fans.
- D. Motor: Totally enclosed with permanently lubricated bearing and built-in thermal overload protection.
- E. Accessories:
  - 1. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired.
  - 2. For two speed exhaust fans in science laboratories, do NOT include integral disconnect switch. This will be provided by electrical. See schedules.
  - 3. See schedules for other options.

## SECTION 233423 - HVAC POWER VENTILATORS

### 2.5 SPARK RESISTANT FANS

- A. For fume hood application, provide spark resistant fan per schedules.

### 2.6 INDUSTRIAL MATERIAL HANDLER FAN

- A. Similar to Cook IMH fans as scheduled on the drawings.
- B. Construction features:
  1. Heavy duty, capable of being re-lubricated, self-aligning bearings, rated for 200,000 hours average life
  2. All steel components coated with electrostatically applied baked polyester power coating
  3. Integral adjustable motor mounting plate
  4. Dynamically balanced wheels
  5. Static resistant belts
  6. Pre-punched mounting holes
  7. Lifting lugs
  8. Corrosion resistant fasteners
  9. Backward inclined blades in a backplate wheel with a conical shroud
- C. Accessories and Options:
  1. Premium efficiency fan motors
  2. Disconnect
  3. Flanged outlets
  4. Isolation rails
  5. Extended lube lines
  6. Spare belt set
  7. Spring type vibration isolators
  8. Discharge shutter

### 2.7 CENTRIFUGAL ROOF VENTILATORS

- A. Description: Direct- or belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, curb base, and accessories.
- B. Housing: Removable, **spun-aluminum, dome top and outlet baffle**; square, one-piece, aluminum base with venturi inlet cone.
  1. Upblast Units: Provide spun-aluminum discharge baffle to direct discharge air upward, with rain and snow drains **and grease collector**.
  2. Hinged Subbase: Galvanized-steel hinged arrangement permitting service and maintenance.
- C. Fan Wheels: Aluminum hub and wheel with backward-inclined blades.
- D. Belt-Driven Drive Assembly: Resiliently mounted to housing, with the following features:
  1. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
  2. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
  3. Pulleys: Cast-iron, adjustable-pitch motor pulley.
  4. Fan and motor isolated from exhaust airstream.



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- E. Accessories:
  - 1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
  - 2. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted **inside** fan housing, factory wired through an internal aluminum conduit.
  - 3. Bird Screens: Removable, 1/2-inch mesh, stainless steel.
  - 4. Dampers: Counterbalanced, parallel-blade, backdraft dampers mounted in curb base; factory set to close when fan stops.
  - 5. Motorized Dampers for airflow 2000CFM and larger: Parallel-blade dampers mounted in curb base with electric actuator; wired to close when fan stops.
  - 6. Explosion proof motors and spark resistant fans where indicated.
- F. Roof Curbs: Galvanized steel; mitered and welded corners; 1-1/2-inch- thick, rigid, fiberglass insulation adhered to inside walls; and 1-1/2-inch wood nailer. Size as required to suit roof opening and fan base.

### 2.8 CEILING FANS

- A. Description:
  - 1. Variable speed control fan with mounting hardware.
  - 2. TUV certified, UL Standard 507.
  - 3. Mounting system: Formed metal design using low-carbon steel, powder coated for corrosion resistance with stainless steel mounting bolts. Round, extruded aluminum tube fan extension with forward-reverse controls and fan status indicator lights visible from floor.
  - 4. Hub: Zinc plated steel.
  - 5. Safety cable (3/16" diameter, 7x19 stranded galvanized steel, pre-loaded and tested to 3200 lbf) for additional means of securing fan assembly to building structure.
  - 6. Wall controls: Low-voltage remote wall control, mounted in standard electrical box, rotary dial, LED lights showing faults. Communication with standard CAT 5 or higher Ethernet cable. [Provide optional RF remote wall control with capacity touch display with wireless communication with fan drive and controller.](#) Coordinate with Architect.
- B. Airfoil system:
  - 1. 8 high volume, low speed airfoils of precision extruded anodized aluminum alloy, connected to the hub and interlocked with stainless steel retainers, bolts and lock washers.
  - 2. Equipped with 8 upswept airfoil tips designed to redirect outward airflow downward for efficiency. Winglets shall be high strength polymer attached with SS screws.
- C. Motor:
  - 1. Permanent magnet brushless motor, capable of modulating between 0-100% speed without gearbox.
  - 2. Motor shall be non-ventilated, heat-sink design.
- D. Controls:
  - 1. Fan controller shall be incorporated into the fan assembly, factory programmed to minimize starting and breaking torques, equipped with simple diagnostics, LED lights to identify and relay faults in system.

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- E. Warranty:
  - 1. 10 year warranty on motor, drive and controller.
  - 2. Lifetime warranty on blades, hub, and mounting system.
- F. Coordinate with supplier for installation details related to miscellaneous structural metal work and electrical wiring and controls.
- G. Start up and training services by factory authorized personnel.
- H. Refer to schedules and plans.

### 2.9 COMMERCIAL KITCHEN VENTILATION SYSTEMS:

- A. Provide a complete packaged ventilation system with all necessary components to include: up-blast exhaust fan, make-up air supply fan, and master control panel with disconnect switch.
- B. See below.

### 2.10 UP-BLAST CENTRIFUGAL EXHAUST VENTILATOR

- A. Construction: Bolted and welded construction utilizing corrosion resistant fasteners. Spun aluminum structural components constructed of minimum 16-gauge marine alloy aluminum, bolted to a rigid aluminum support structure. The aluminum base shall have a one piece inlet spinning and continuously welded curb cap corners for maximum leak protection. The wind-band shall have a rolled bead for added strength. A two piece top cap shall have quick release latches to provide access into the motor compartment. An external wiring compartment with 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. These Components shall be enclosed in a weather-tight compartment, separated from the exhaust airstream. A 1-inch thick, three-pound density foil backed heat shield shall be utilized to protect the motor and drive components from excessive heat. Unit shall bear an engraved aluminum nameplate and shall be shipped in ISTA certified transit-tested packaging.
- B. Wheel: Wheel shall be centrifugal backward inclined, constructed of 100% 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.
- C. Motor: Motor shall be heavy duty type with permanently lubricated sealed ball bearings and furnished at the specified voltage, phase and enclosure. Provide pre-wired disconnect switch.
- D. 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 housing selected for a minimum L50 life in excess of 200,000 hours at maximum cataloged operating speed.
- E. Belts and Drives: Belts shall be oil and heat resistant, non-static type. Drives shall be precision machined cast iron type, keyed and securely attached to the wheel and motor shafts. Drive shall

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be sized for 150% of the installed motor horsepower. The variable pitch motor drive must be factory set to the specified fan RPM.

- F. Provide Cook Grease Terminator, vented curb extension, and hinged base per NFPA-96.
- G. Roof Curbs: Mechanical contractor to coordinate dimensions and location with roofing contractor and Div. 7 specifications for tie-downs.
- H. Accessories: See schedules.

### 2.11 ROOF MOUNTED, FILTERED KITCHEN AIR SUPPLY FAN

- A. Description: Side intake, roof mounted, belt driven, centrifugal filtered supply air fan, mounted on roof curb, with extended intake vent, motor and disconnect switch, drive assembly, mounting kits, and accessories.
- B. Certifications: Manufactured at an ISO 9001 certified facility, listed by Underwriters Laboratories (UL 705). Fan shall bear the AMCA certified ratings seal for sound and air performance.
- C. Construction: Bolted construction utilizing corrosion resistant fasteners. Housing minimum 18 gauge galvanized steel bolted to a minimum 16 gauge steel fan base with prepunched mounting holes. Unit shall be provided with an insulated top cover and 1" washable permanent aluminum filter. Internal blower and motor assembly shall be mounted on rubber vibration isolators. Unit shall bear an engraved aluminum nameplate. Nameplate shall indicate design CFM, static pressure, and maximum fan RPM. Unit shipped in ISTA certified transit tested packaging.
- D. Fan Wheel: Wheel shall be DWDI, centrifugal forward curved type, constructed of painted steel. Wheel shall be balanced in accordance with AMCA Standard 204-96, Balance Quality and Vibration Levels for Fans.
- E. Motor: Motor shall be heavy duty type with permanently lubricated sealed ball bearings and furnished at the specified voltage, phase and enclosure. Rated for VFD duty.
- F. 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 pillow block cast iron housing selected for a minimum L50 life in excess of 200,000 hours at maximum cataloged operating speed.
- G. Drive: Belts shall be oil and heat resistant, non-static type. Drives shall be precision machined cast iron type, keyed and securely attached to the wheel and motor shafts. Drives shall be sized for 150% of the installed motor horsepower. The variable pitch motor drive must be factory set to the specified fan RPM.
- H. Accessories:
  - 1. Motorized backdraft damper.
  - 2. Permanent Filters: One-inch, washable aluminum type, easily removable for cleaning.
  - 3. [Dedicated roof curb](#) for exhaust and supply air fans, as indicated.
  - 4. Ecoat or Lorenized coating on all exposed vent hood and fan cabinets.
  - 5. See schedules.

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### 2.12 ROOF MOUNTED EQUIPMENT

- A. [Wind Restraints: Metal brackets compatible with the curb and casing, painted to match RTU, used to anchor unit to the curb, and designed for loads at Project site.](#)
- B. Ecoat or Lorenized coating on all exposed fans, vent hoods and fan cabinets

### 2.13 MOTORS

- A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
  - 1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
- B. Enclosure Type: Totally enclosed, fan cooled.

### 2.14 SOURCE QUALITY CONTROL

- A. Certify sound-power level ratings according to AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.
- B. Certify fan performance ratings, including flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests according to AMCA 210, "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating." Label fans with the AMCA-Certified Ratings Seal.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install power ventilators level and plumb.
- B. Secure roof-mounting fans to roof curbs with cadmium-plated hardware. Refer to Division 7 Section "Roof Accessories" for installation of roof curbs.
- C. Ceiling Units: Suspend units from structure; use steel wire or metal straps.
- D. Support suspended units from structure using threaded steel rods and spring hangers having a static deflection of 1 inch. Vibration-control devices are specified in Section 230548.13 "Vibration Controls for HVAC."
- E. Install units with clearances for service and maintenance.
- F. Label units according to requirements specified in Section 230553 "Identification for HVAC Piping and Equipment."

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- G. Coordinate installation of kitchen ventilation fan systems with commercial kitchen ventilation hoods and duct systems. Install in accordance with manufacturer's instructions.
  - 1. Comply with all codes regarding the type of insulation required between the ventilation systems, wall and/or ceiling combustible material.
  - 2. Kitchen hood shall be hung level and lined up with roof exhaust openings.

### 3.2 CONNECTIONS

- A. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Section 233300 "Air Duct Accessories."
- B. Install ducts adjacent to power ventilators to allow service and maintenance.
- C. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

### 3.3 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
  - 1. Verify that shipping, blocking, and bracing are removed.
  - 2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
  - 3. Verify that cleaning and adjusting are complete.
  - 4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
  - 5. Adjust belt tension.
  - 6. Adjust damper linkages for proper damper operation.
  - 7. Verify lubrication for bearings and other moving parts.
  - 8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
  - 9. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
  - 10. Shut unit down and reconnect automatic temperature-control operators.
  - 11. Remove and replace malfunctioning units and retest as specified above.
- B. Starting Procedures:
  - 1. Energize motor and adjust fan to indicated rpm.
  - 2. Measure and record motor voltage and amperage.
- C. 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.

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- D. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

### 3.4 ADJUSTING

- A. Adjust damper linkages for proper damper operation.
- B. Adjust belt tension.
- C. Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.
- D. Replace fan and motor pulleys as required to achieve design airflow.
- E. Lubricate bearings.

### 3.5 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain power ventilators.
  - 1. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining equipment and schedules.
  - 2. Review data in maintenance manuals. Refer to Division 1 Section "Operation and Maintenance Data."
  - 3. Schedule training with Owner, through Architect, with at least seven days' advance notice.

END OF SECTION 233423

## SECTION 233533 - LISTED KITCHEN VENTILATION SYSTEM EXHAUST 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. Listed grease ducts.
2. Access doors.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for listed grease ducts.

- B. Shop Drawings: For listed grease ducts.

1. Include plans, elevations, sections, and attachment details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Detail fabrication and assembly of hangers and seismic restraints.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

#### 1.5 QUALITY ASSURANCE

- A. 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 D9.1/D9.1M, "Sheet Metal Welding Code," for shop and field welding of joints and seams in listed grease ducts and field-fabricated grease ducts.

## SECTION 233533 - LISTED KITCHEN VENTILATION SYSTEM EXHAUST DUCTS

### PART 2 - PRODUCTS

#### 2.1 LISTED GREASE DUCTS

- A. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
1. [Metal-Fab, Inc.](#)
  2. [Selkirk Corporation.](#)
  3. Jeremias
- B. Description: Factory-fabricated, -listed, and -labeled, double-wall ducts tested according to UL 1978 and rated for 500 deg F continuously, or 2000 deg F for 30 minutes; with positive or negative duct pressure and complying with NFPA 211.
1. [For use with Type I kitchen hoods, as described in NFPA-96, for the transportation of air and grease-laden vapors from commercial cooking operations.](#)
- C. Construction: Inner shell and outer jacket separated by at least a 1-inch annular space filled with high-temperature, ceramic-fiber insulation.
1. Inner Shell: ASTM A 666, Type 430 stainless steel.
    - a. 0.036" thick for diameters 6" through 36"
  2. Outer Jacket: Aluminized steel where concealed. Stainless steel where exposed.
    - a. 0.024" thick aluminized steel for sizes 6" through 24"
  3. [Inner and outer walls connected by means of spacer clips, which maintain the concentricity of the annular space and allow unobstructed differential thermal expansion of the inner and outer walls.](#)
- D. Gaskets and Flanges: Ensure that gaskets and sealing materials are rated at 1500 deg F minimum. All inner pipe joints shall be held together by means of formed Vee bands and sealed with P080 Grease Duct Sealant.
- E. Hood Connectors: Constructed from same material as grease duct with internal or external continuously welded or brazed joints.
- F. Accessories: Tees, elbows, increasers, terminations, adjustable roof flashings, storm collars, support assemblies, thimbles, firestop spacers, and fasteners; fabricated from similar materials and designs as vent-pipe straight sections; all listed for same assembly. Include unique components required to comply with NFPA 96 including cleanouts, transitions, adapters, and drain fittings.
1. [Include all supports, roof penetrations, fan adapters, square-to-round transitions, hood connectors, drain fittings and expansion joints required to install insulated grease duct.](#)
  2. [Roof penetration pieces shall be UL listed products of the grease duct manufacturer. Where roof is pitched \(up to 12:12\), roof penetration pieces shall be of the pitched type so that it is not necessary to provide a horizontal roof curb.](#)
- G. Grease Duct Supports: Construct duct bracing and supports from non-combustible material.



## SECTION 233533 - LISTED KITCHEN VENTILATION SYSTEM EXHAUST DUCTS

1. Design bracing and supports to carry static and seismic loads within stress limitations of the International Building Code. If applicable, coordinate 3<sup>rd</sup> party support for seismic loads.
2. Ensure that bolts, screws, rivets and other mechanical fasteners do not penetrate duct walls.

### H. Comply with

1. ASTM E 2336: Duct wall assembly tested and listed to 2 inches clearance to combustibles for 6 inch diameter, 3 inches clearance to combustibles for 8 to 18 inch diameters, and 4 inches clearance to combustibles for 20 to 24 inch diameters.
2. ASTM E119 Fire Engulfment Test, ASTM E814 2-hour Fire Stop Test: Grease duct shall conform to requirements.
3. Listed by the following agencies with the associated listed reports: UL 1978 (File MH8251) - Grease Ducts for Restaurant Cooking Appliances.

## 2.2 ACCESS DOORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. 3M.
2. Acudor Products, Inc.
3. Ductmate Industries, Inc.
4. CaptivAire

- B. Description: Factory-fabricated, -listed, and -labeled, double-wall maintenance access doors tested according to UL 1978 and rated for 500 deg F continuously, or 2000 deg F for 30 minutes; with positive or negative duct pressure and complying with NFPA 211.

1. Door Label: Mark door with uppercase lettering as follows: "ACCESS PANEL. DO NOT OBSTRUCT."

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Coordinate installation of roof curbs, equipment supports, and roof penetrations. Comply with requirements in Section 077200 "Roof Accessories."
- B. Coordinate connections to kitchen exhaust hoods with requirements in Section 233813 "Commercial-Kitchen Hoods."

## SECTION 233533 - LISTED KITCHEN VENTILATION SYSTEM EXHAUST DUCTS

- C. Coordinate connections to exhaust fans with requirements in Division 23 Sections.
- D. Coordinate firestopping where grease ducts penetrate fire separations with requirements in Section 078413 "Penetration Firestopping."
- E. Comply with minimum clearances from combustibles and minimum termination heights according to product listing or NFPA 211 and UL 2221, whichever is most stringent.
- F. Install airtight maintenance access doors where indicated.
- G. Seal between sections of grease exhaust ducts according to manufacturer's written installation instructions, using sealants recommended by manufacturer.
- H. Connections: Make grease duct connections according to the International Mechanical Code.
  - 1. Grease duct to exhaust fan connections: Connect grease ducts to inlet side of fan using flanges, gaskets, and bolts.
  - 2. Grease duct to hood connections:
    - a. Make grease duct to hood joints connections using internal or external continuously welded or brazed joints.
    - b. Make watertight grease duct to hood joints connections using flanges, gaskets, and bolts.
- I. Support ducts at intervals recommended by manufacturer to support weight of ducts and accessories, without applying loading on kitchen hoods.
  - 1. Securely attach supports and bracing to structure.
- J. Grease Duct Enclosures: Comply with requirements of the International Building Code and ASTM E 2336.
- K. Coordinate fire-rated enclosure construction with Section 092116.23 "Gypsum Board Shaft Wall Assemblies."
- L. Repair damage to adjacent materials caused by listed kitchen ventilation system exhaust ducts installation.

### 3.3 FIELD QUALITY CONTROL

- A. Perform air leakage test in presence of Owner before concealment of any portion of the grease duct system.
  - 1. Notify Owner a minimum of 7 days before test is performed.

END OF SECTION 233533

## SECTION 233600 - 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: Shutoff, single-duct air terminal units.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of air terminal unit.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for air terminal units.
  - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: For air terminal units.
  - 1. Include plans, elevations, sections, and mounting details.
  - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 3. Include diagrams for power, signal, and control wiring.
  - 4. Hangers and supports, including methods for duct and building attachment and vibration isolation.
- C. Delegated-Design Submittal:
  - 1. Materials, fabrication, assembly, and spacing of hangers and supports.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. 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.
- B. Field quality-control reports.

## SECTION 233600 - AIR TERMINAL UNITS

### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For air terminal units to include in emergency, operation, and maintenance manuals.
  - 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
    - a. Instructions for resetting minimum and maximum air volumes.
    - b. Instructions for adjusting software set points.

### 1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

## PART 2 - PRODUCTS

### 2.1 SYSTEM DESCRIPTION

- 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. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."
- C. ASHRAE Compliance: Applicable requirements in ASHRAE/IES 90.1, "Section 6 - Heating, Ventilating, and Air Conditioning."

### 2.2 SHUTOFF, SINGLE-DUCT AIR TERMINAL UNITS

- A. Manufacturers:
  - 1. Price.
  - 2. Trane Co. (The); Worldwide Applied Systems Group.
  - 3. Titus.
  - 4. Krueger.
- B. Configuration: Volume-damper assembly inside unit casing with control components inside a protective metal shroud.
- C. Casing: 22 gage thick galvanized steel, single wall.
  - 1. Casing Liner: Provide 1" thick insulation of fiberglass or all-natural fiber complying with NFPA 90A. The liner shall have a foil scrim barrier to prevent air and moisture from coming into contact with the insulation. Insulation shall be equal to Titus Eco-shield with foil. Closed cell/open cell foam liners are not acceptable.
  - 2. Air Inlet: Round stub connection or S-slip and drive connections for duct attachment.
  - 3. Air Outlet: S-slip and drive connections, size matching inlet size.

## SECTION 233600 - AIR TERMINAL UNITS

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.
- A. Regulator Assembly: Extruded-aluminum or galvanized-steel components; key damper blades onto shaft with nylon-fitted pivot points located inside unit casing.
1. Automatic Flow-Control Assembly: Combined spring rates shall be matched for each volume-regulator size with machined dashpot for stable operation.
  2. Factory-calibrated and field-adjustable assembly with shaft extension for connection to externally mounted control actuator.
- B. Volume Damper: Galvanized steel with peripheral gasket and self-lubricating bearings.
1. Maximum Damper Leakage: AHRI 880 rated, 2 percent of nominal airflow at 3-inch wg inlet static pressure.
  2. Damper Position: Normally open.
- C. Attenuator Section: 22 gage sheet.
1. Provide a sound attenuator section between the damper assembly and electric heating section.
  2. Attenuator Section Liner: Insulate per casing insulation requirements, the entire terminal unit including heating and sound attenuator sections.
  3. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- D. Electric Heating Coil: Slip-in-type, open-coil design with integral control box factory wired and installed. Include the following features:
1. Primary automatic reset thermal cutout and secondary manual reset thermal cutout.
  2. Nickel chrome 80/20 heating elements.
  3. Proportional electronic airflow sensor for proof of flow, independent of duct static pressure. Shall adjust heater capacity per available airflow.
  4. Integral door interlock type disconnect switch.
  5. Stages of heat that respond to DDC signal.
  6. Magnetic contactor for each step of control (for three-phase coils).
  7. Line terminal block.
- E. Control devices shall be compatible with temperature controls system specified in Section 230923 "Direct Digital Control (DDC) System for HVAC."
1. Electronic Damper Actuator: 24 V, powered open, spring return.
  2. Provide controls transformer.

### 2.3 SOURCE QUALITY CONTROL

- A. Factory Tests: Test assembled air terminal units according to AHRI 880.
1. Label each air terminal unit with plan number, nominal airflow, maximum and minimum factory-set airflows, coil type, and AHRI certification seal.

## SECTION 233600 - AIR TERMINAL UNITS

### PART 3 - EXECUTION

#### 3.1 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 5, "Hangers and Supports" and with Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
- B. Building Attachments: Concrete inserts, 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.

#### 3.2 TERMINAL UNIT 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 wall-mounted thermostats.

#### 3.3 CONNECTIONS

- A. Where installing piping adjacent to air terminal unit, allow space for service and maintenance.
- B. Comply with requirements in Section 233113 "Metal Ducts" for connecting ducts to air terminal units.
- C. 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.

## SECTION 233600 - AIR TERMINAL UNITS

### 3.5 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
  - 1. After installing air terminal units and after electrical circuitry has been energized, test for compliance with requirements.
  - 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
  - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Air terminal unit will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

### 3.6 STARTUP SERVICE

- A. Engage a factory-authorized service representative to 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. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air terminal units.

END OF SECTION 233600

## SECTION 233713 - 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 grilles, registers, diffusers, and other air devices
- B. Related Sections:
  - 1. Section 089116 "Operable Wall Louvers" and Section 089119 "Fixed Louvers" for fixed and adjustable louvers and wall vents, whether or not they are connected to ducts.
  - 2. Section 233300 "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.

#### 1.3 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 Initial Selection: For diffusers, registers, and grilles with factory-applied color finishes.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. 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. Method of attaching hangers to building structure.
  - 3. Size and location of initial access modules for acoustical tile.
  - 4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
  - 5. Duct access panels.
- B. Source quality-control reports.



## SECTION 233713 - DIFFUSERS, REGISTERS, AND GRILLES

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Subject to compliance with requirements, provide products by one of the manufacturers specified:
  - 1. Price Industries.
  - 2. Titus.

#### 2.2 AIR DEVICES

- A. Rectangular and Square Ceiling Grilles, Registers, Diffusers: See schedules for material, finish, size, pattern, damper type, and accessories.
- B. Fire rated air devices: Plans indicate a "fire damper" designation on diffusers that need a fire rated air device. Coordinate with plans.

#### 2.3 INSULATION

- A. All cold surfaces that are susceptible to condensation shall be insulated.
- B. Insulation may be provided by manufacturer or by installing Contractor. Coordinate with installing Contractor.

#### 2.4 SOURCE QUALITY CONTROL

- A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. 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.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 INSTALLATION

- A. Install diffusers, registers, and grilles level and plumb.
- B. 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

## SECTION 233713 - DIFFUSERS, REGISTERS, AND GRILLES

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.

- C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

### 3.3 ADJUSTING

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 233713

## SECTION 233813 - COMMERCIAL-KITCHEN HOODS

### 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 Type I and Type II commercial-kitchen hoods.
- B. Related Requirements:
  - 1. Section 233533 "Listed Kitchen Ventilation System Exhaust Ducts" for fire-rated ducts connecting to kitchen hoods.

#### 1.3 DEFINITIONS

- A. Listed Hood: A hood, factory fabricated and tested for compliance with UL 710 by a testing agency acceptable to authorities having jurisdiction.
- B. Standard Hood: A hood, usually field fabricated, that complies with design, construction, and performance criteria of applicable national and local codes.
- C. Type I Hood: A hood designed for grease exhaust applications.
- D. Type II Hood: A hood designed for heat and steam removal and for other nongrease applications.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For the following:
  - 1. Standard hoods.
  - 2. Filters/baffles.
  - 3. Fire-suppression systems.
  - 4. Lighting fixtures.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer.
  - 1. Shop Drawing Scale: 1/4 inch = 1 foot.
  - 2. Show plan view, elevation view, sections, roughing-in dimensions, service requirements, duct connection sizes, and attachments to other work.
  - 3. Show cooking equipment plan and elevation to confirm minimum code-required overhang.

## SECTION 233813 - COMMERCIAL-KITCHEN HOODS

4. Indicate performance, exhaust and makeup air airflow, and pressure loss at actual Project-site elevation.
5. Show water-supply and drain piping connections.
6. Show control cabinets.
7. Show fire-protection cylinders, piping, actuation devices, and manual control devices.
8. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
9. Include diagrams for power, signal, and control wiring.
10. Duct Connections: Detail connections between ducts and hoods, including access doors and panels.
11. Piping Diagrams: Detail fire-suppression piping and components and differentiate between manufacturer-installed and field-installed piping. Include roughing-in requirements for drain connections. Show cooking equipment plan and elevation to illustrate fire-suppression nozzle locations.
  - a. Piping Diagram Scale: 1/4 inch = 1 foot.

### 1.5 INFORMATIONAL SUBMITTALS

- A. 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. Coordination Drawing Scale: 1/4 inch = 1 foot.
  2. Suspended ceiling assembly components.
  3. Structural members to which equipment will be attached.
  4. Roof framing and support members for duct penetrations.
  5. Items penetrating finished ceiling including the following:
    - a. Lighting fixtures.
    - b. Air outlets and inlets.
    - c. Speakers.
    - d. Sprinklers.
    - e. Access panels.
    - f. Moldings on hoods and accessory equipment.
- B. Welding certificates.
- C. Field quality-control reports.

### 1.6 QUALITY ASSURANCE

- A. Engineering Responsibility: Preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.
- B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D 1.1M, "Structural Welding Code - Steel," for hangers and supports; and AWS D9.1/D9.1M, "Sheet Metal Welding Code," for joint and seam welding.

## SECTION 233813 - COMMERCIAL-KITCHEN HOODS

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

#### 2.2 HOOD MATERIALS

- A. Stainless-Steel Sheet: ASTM A 666, Type 430.
  - 1. Minimum Thickness: Double wall, 20 gauge.
  - 2. Finish: Comply with SSINA's "Finishes for Stainless Steel" for recommendations for applying and designating finishes.
    - a. Finish shall be free from tool and die marks and stretch lines and shall have uniform, directionally textured, polished finish indicated, free of cross scratches. Grain shall run with long dimension of each piece.
  - 3. Concealed Stainless-Steel Surfaces: ASTM A 480/A 480M, No. 2B finish (bright, cold-rolled, unpolished finish).
  - 4. Exposed Surfaces: ASTM A 480/A 480M, No. 3 or 4 finish (intermediate polished surface).
  - 5. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
- B. Sealant: ASTM C 920; Type S, Grade NS, Class 25, Use NT. Elastomeric sealant shall be NSF certified for commercial-kitchen hood application. Sealants, when cured and washed, shall comply with requirements in 21 CFR 177.2600, for use in areas that come in contact with food.
  - 1. Color: As selected by Architect from manufacturer's standard options.
  - 2. Backer Rod: Closed-cell polyethylene, in diameter larger than joint width.
- C. Sound Dampening: NSF-certified, non-absorbent, hard-drying, sound-deadening compound for permanent adhesion to metal in minimum 1/8-inch thickness that does not chip, flake, or blister.
- D. Gaskets: NSF certified for end-use application indicated; of resilient rubber, neoprene, or PVC that is nontoxic, stable, odorless, nonabsorbent, and unaffected by exposure to foods and cleaning compounds, and that passes testing according to UL 710.

#### 2.3 GENERAL HOOD FABRICATION REQUIREMENTS

- A. Welding: Use welding rod of same composition as metal being welded. Use methods that minimize distortion and develop strength and corrosion resistance of base metal. Make ductile welds free of mechanical imperfections such as gas holes, pits, or cracks.
  - 1. Welded Butt Joints: Full-penetration welds for full-joint length. Make joints flat, continuous, and homogenous with sheet metal without relying on straps under seams, filling in with solder, or spot welding.

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2. Grind exposed welded joints flush with adjoining material and polish to match adjoining surfaces.
  3. Where fasteners are welded to underside of equipment, finish reverse side of weld smooth and flush.
  4. Coat concealed stainless-steel welded joints with metallic-based paint to prevent corrosion.
  5. After zinc-coated steel is welded, clean welds and abraded areas and apply SSPC-Paint 20, high-zinc-dust-content, galvanizing repair paint to comply with ASTM A 780/A 780M.
- B. For metal butt joints, comply with SMACNA's "Kitchen Ventilation Systems & Food Service Equipment Guidelines."
- C. Where stainless steel is joined to a dissimilar metal, use stainless-steel welding material or fastening devices.
- D. Form metal with break bends that are not flaky, scaly, or cracked in appearance; where breaks mar uniform surface appearance of material, remove marks by grinding, polishing, and finishing.
- E. Sheared Metal Edges: Finish free of burrs, fins, and irregular projections.
- F. In food zones, as defined in NSF, fabricate surfaces free from exposed fasteners.
- G. Cap exposed fastener threads, including those inside cabinets, with stainless-steel lock washers and stainless-steel cap (acorn) nuts.
- H. Fabricate pipe slots on equipment with turned-up edges sized to accommodate service and utility lines and mechanical connections.
- I. Fabricate enclosures, including panels, housings, and skirts, to conceal service lines, operating components, and mechanical and electrical devices including those inside cabinets unless otherwise indicated.
- J. Fabricate equipment edges and backsplashes according to SMACNA's "Kitchen Ventilation Systems & Food Service Equipment Guidelines."
- K. Fabricate enclosure panels to ceiling and wall as follows:
1. Fabricate panels on all exposed side(s) with same material as hood, and extend from ceiling to top of hood canopy and from canopy to wall.
  2. Wall Offset Spacer: Minimum of 3 inches.
  3. Wall Shelves and Overshelves: Fabricate according to SMACNA's "Kitchen Ventilation Systems & Food Service Equipment Guidelines," with minimum 0.0625-inch-thick, stainless-steel shelf tops.

### 2.4 TYPE I EXHAUST HOOD FABRICATION

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

## SECTION 233813 - COMMERCIAL-KITCHEN HOODS

1. [Captive-Aire Systems](#).
  2. [Grease Master](#).
  3. [Greenheck Fan Corporation](#).
- B. Weld all joints exposed to grease with continuous welds, and make filters/baffles or grease extractors and makeup air diffusers easily accessible for cleaning.
1. Fabricate hoods according to NSF 2, "Food Equipment."
  2. Hoods shall be listed and labeled, according to UL 710, by a testing agency acceptable to authorities having jurisdiction.
  3. Hoods shall be designed, fabricated, and installed according to NFPA 96.
  4. Include access panels as required for access to fire dampers and fusible links.
  5. Duct Collars: Minimum 0.0598-inch-thick steel at least 3 inches long, continuously welded to top of hood and at corners. Fabricate a collar with a 0.5-inch-wide duct flange.
  6. Duct-Collar Fire Dampers (if needed): Collar and damper shall comply with UL 710 testing and listing required for the entire hood.
    - a. Collar: Minimum 0.0598-inch-thick stainless steel, at least 3 inches long, continuously welded to top of hood and at corners. Fabricate a collar with a minimum 0.5-inch-wide duct flange.
    - b. Blades: Minimum 0.1046-inch-thick stainless steel, counterbalanced to remain closed after actuation.
    - c. Blade Pivot and Spring: Stainless steel.
    - d. Fusible Link: Replaceable, 212 deg F rated.
  7. Makeup Air Fire Dampers: Labeled, according to UL 555, by a testing agency acceptable to authorities having jurisdiction.
    - a. Fire Rating: 1-1/2 hours.
    - b. Frame: SMACNA with blades in airstream; fabricated with roll-formed, stainless steel; with mitered and interlocking corners.
    - c. Blades: Roll-formed, interlocking or folded, minimum 0.034-inch-thick, galvanized-steel sheet.
    - d. Horizontal Dampers: Include a blade lock and stainless-steel closure spring.
    - e. Firestat or Replaceable Fusible Link
- C. Hood Configuration: Exhaust and makeup air.
1. Makeup air shall be introduced through laminar-flow-type, perforated stainless steel panels on front of hood canopy.
- D. Hood Style: Wall-mounted canopy, or as scheduled.
- E. Filters/Baffles: Removable, aluminum. Exposed surfaces shall be pitched to drain to collection cup. Filters/baffles must be listed and meet UL Standard 1046. Mesh filters are NOT allowed to be used as listed grease filter/baffles. Filters/baffles shall be tested according to UL 1046, "Safety for Grease Filters for Exhaust Ducts," by an NRTL acceptable to authorities having jurisdiction.
- A. Lighting Fixtures: U.L. [LED](#) fixtures and globes shall be installed and pre-wired to a junction box. The light fixtures shall be installed with a maximum of 4'0" spacing on center. Light switches shall be mounted on front panel of hood canopy.

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- B. Light switches shall be mounted on front panel of hood canopy.
  - 1. Lighting Fixtures: [LED](#), UL listed for commercial hoods.
- C. Hood Controls: Wall-mounting control cabinet, fabricated of stainless steel.
  - 1. Exhaust Fan: On-off switches shall start and stop the exhaust fan. Interlock exhaust fan with makeup air supply fan to operate simultaneously. Interlock exhaust fan with fire-suppression system to operate fan(s) during fire-suppression-agent release and to remain in operation until manually stopped. Include red pilot light to indicate fan operation. Include spare terminals for fire alarm, and wiring to start fan with fire alarm.
- D. Capacities and Characteristics: See construction schedules.

### 2.5 TYPE II EXHAUST HOOD FABRICATION

- A. [Manufacturers](#): Subject to compliance with requirements, provide products by one of the following:
  - 1. [Captive-Aire Systems](#).
  - 2. [Grease Master](#).
  - 3. [Greenheck Fan Corporation](#).
- B. Fabricate hoods according to NSF 2, "Food Equipment."
- C. Fabricate hoods to comply with SMACNA's "HVAC Duct Construction Standards: Metal and Flexible."
- D. Hood Configuration: Exhaust only.
- E. Hood Type: Heat and vapor removal.
- F. Hood Style: Wall-mounted canopy or as indicated.
- G. Condensate Hood Baffles for Type 1 Hoods: Removable, stainless-steel baffles to drain into a hood drain trough, and stainless-steel drain piping.
- H. Lighting Fixtures: U.L. listed LED fixtures and lamps with lenses sealed vapor tight. Wiring shall be installed in stainless-steel conduit on hood exterior. Number and location of fixtures shall provide a minimum of 70 fc at 30 inches above finished floor.
  - 1. Light switches shall be mounted on front panel of hood canopy.
  - 2. Lighting Fixtures: LED, UL listed for use in commercial hoods.
- I. Capacities and Characteristics: See construction documents.

### 2.6 WET-CHEMICAL FIRE-SUPPRESSION SYSTEM

- A. [Manufacturers](#): Subject to compliance with requirements, provide products by one of the following:



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1. Ansul Incorporated; a Tyco International Ltd. Company.
  2. Approved NFPA 96 equal.
  3. CaptiveAire TANK FS UL300 Fire Suppression System.
- B. Description: Engineered distribution piping designed for automatic detection and release or manual release of fire-suppression agent by hood operator. Fire-suppression system shall be listed and labeled for complying with NFPA 17A, "Wet Chemical Extinguishing Systems," by a qualified testing agency acceptable to authorities having jurisdiction.
1. Steel Pipe, NPS 2 and Smaller: ASTM A 53/A 53M, Type S, Grade A, Schedule 40, plain ends.
  2. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300.
  3. Piping, fusible links and release mechanism, tank containing the suppression agent, and controls shall be factory installed. Controls shall be in stainless-steel control cabinet mounted on hood or wall. Furnish manual pull station for wall mounting. Exposed piping shall be covered with chrome-plated aluminum tubing. Exposed fittings shall be chrome plated.
  4. Liquid Extinguishing Agent: Noncorrosive, low-pH liquid.
  5. Furnish electric-operated gas shutoff valve with clearly marked open and closed indicator for field installation.
  6. Fire-suppression system controls shall be integrated with controls for fans, lights, and fuel supply and located in a single cabinet for each group of hoods immediately adjacent.
  7. Wiring shall have color-coded, numbered terminal blocks and grounding bar. Spare terminals for fire alarm, optional wiring to start fan with fire alarm, red pilot light to indicate fan operation, and control switches shall all be factory wired in control cabinet with relays or starters. Include spare terminals for fire alarm, and wiring to start fan with fire alarm.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for piping systems to verify actual locations of piping connections before equipment installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Coordinate equipment layout and installation with adjacent Work, including lighting fixtures, HVAC equipment, plumbing, and fire-suppression system components.
- B. Complete field assembly of hoods where required.
  1. Make closed butt and contact joints that do not require filler.

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2. Grind field welds on stainless-steel equipment smooth, and polish to match adjacent finish. Comply with welding requirements in "General Hood Fabrication Requirements" Article.
- C. Install hoods and associated services with clearances and access for maintaining, cleaning, and servicing hoods, filters/baffles, grease extractor, and fire-suppression systems according to manufacturer's written instructions and requirements of authorities having jurisdiction.
- D. Make cutouts in hoods where required to run service lines and to make final connections, and seal openings according to UL 1978.
- E. Securely anchor and attach items and accessories to walls, floors, or bases with stainless-steel fasteners unless otherwise indicated.
- F. Install hoods to operate free from vibration.
- G. Install trim strips and similar items requiring fasteners in a bed of sealant. Fasten with stainless-steel fasteners at 48 inches o.c. maximum.
- H. Install sealant in joints between equipment and abutting surfaces with continuous joint backing unless otherwise indicated. Provide airtight, watertight, vermin-proof, sanitary joints.
- I. Install lamps, with maximum recommended wattage, in equipment with integral lighting.
- J. Set initial temperatures, and calibrate sensors.
- K. Set field-adjustable switches.

### 3.3 CONNECTIONS

- A. Where installing piping adjacent to hoods, allow space for service and maintenance.
- B. Connect ducts according to requirements in Section 233300 "Air Duct Accessories." Install flexible connectors on makeup air supply duct. Weld exhaust-duct connections with continuous liquidtight joint.
- C. Install fire-suppression piping for remote-mounted suppression systems according to NFPA 17A, "Wet Chemical Extinguishing Systems."

### 3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
  1. Test each equipment item for proper operation. Repair or replace equipment that is defective, including units that operate below required capacity or that operate with excessive noise or vibration.
  2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

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3. Test water, drain, gas, and liquid-carrying components for leaks. Repair or replace leaking components.
  4. Perform hood performance tests required by authorities having jurisdiction.
  5. Perform fire-suppression system performance tests required by authorities having jurisdiction.
- B. Commercial-kitchen hoods will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

### 3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain commercial-kitchen hoods.

END OF SECTION 233813

## SECTION 236423 - SCROLL WATER CHILLERS

### 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: Packaged, air-cooled, electric-motor-driven, scroll water chillers.

#### 1.3 DEFINITIONS

- A. 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.
- B. DDC: Direct digital control.
- 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 506/110 and referenced to ARI standard rating conditions.
- E. kW/Ton: The ratio of total power input of the chiller in kilowatts to the net refrigerating capacity in tons 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 506/110 and intended for operating conditions other than the ARI standard rating conditions.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: Include refrigerant, rated capacities, operating characteristics, furnished specialties, and accessories.
  - 1. Performance at ARI standard conditions and at conditions indicated.
  - 2. Performance at ARI standard unloading conditions.
  - 3. Minimum evaporator flow rate.
  - 4. Refrigerant capacity of water chiller.
  - 5. Oil capacity of water chiller.
  - 6. Fluid capacity of evaporator.
  - 7. Characteristics of safety relief valves.
  - 8. Minimum entering condenser-air temperature

## SECTION 236423 - SCROLL WATER CHILLERS

9. Performance at varying capacity with constant design entering condenser-air temperature. Repeat performance at varying capacity for different entering condenser-air temperatures from design to minimum in 10 deg F increments.
- B. Shop Drawings: Complete set of manufacturer's prints of water chiller assemblies, control panels, sections and elevations, and unit isolation. Include the following:
1. Assembled unit dimensions.
  2. Weight and load distribution.
  3. Required clearances for maintenance and operation.
  4. Size and location of piping and wiring connections.
  5. Wiring Diagrams: For power, signal, and control wiring.

### 1.5 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.
  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 test reports.
- D. Startup service reports.
- E. Warranty: Sample of special warranty.

### 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For each water chiller to include in emergency, operation, and maintenance manuals.

### 1.7 QUALITY ASSURANCE

- A. ARI Certification: Certify chiller according to ARI 590 certification program.
- B. ARI Rating: Rate water chiller performance according to requirements in ARI 506/110, "Water Chilling Packages Using the Vapor Compression Cycle."
- C. ASHRAE Compliance: ASHRAE 15 for safety code for mechanical refrigeration.
- D. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

## SECTION 236423 - SCROLL WATER CHILLERS

- E. ASME Compliance: Fabricate and stamp water chiller heat exchangers to comply with ASME Boiler and Pressure Vessel Code.
- F. Comply with NFPA 70.

### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Ship water chillers from the factory fully charged with refrigerant and filled with oil.
- B. Package water chiller for export shipping.

### 1.9 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

### 1.10 WARRANTY

- A. The special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of Contract Documents.
- B. Special Warranty: Submit a written warranty signed by chiller manufacturer and Installer agreeing to furnish parts for compressor and motor failures within special warranty period.
  - 1. Warranties shall include coverage for complete assembly including materials, labor, and refrigerant.
  - 2. Delivery date will not be used as a basis for start of warranty period. Warranty period shall commence from date of chiller start-up. Provide Owner and Engineer with copy of field technician's start-up report, and with written notice of commencement of warranty period.
  - 3. Related Damages and Losses: 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.
  - 4. Reinstatement of Warranty: When Work covered by a warranty has failed and been corrected by replacement or rebuilding, reinstate the warranty by written endorsement. The reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation.
  - 5. Replacement Cost: 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 or rebuilding defective Work regardless of whether the Owner has benefited from use of the Work through a portion of its anticipated useful service life.
  - 6. Rejection of Warranties: The Owner reserves the right to reject warranties and to limit selections to products with warranties not in conflict with requirements of the Contract Documents.

## SECTION 236423 - SCROLL WATER CHILLERS

- C. Submit a written warranty signed by chiller manufacturer and Installer agreeing to furnish parts for compressor and motor failures within special warranty period.
  - 1. Warranty Period: Manufacturer's warranty, not less than FIVE YEARS (bumper-to-bumper) for entire chiller and pump package, including parts, and labor as provided by manufacturer, and replacement of refrigerant.

### PART 2 - PRODUCTS

#### 2.1 PACKAGED AIR-COOLED WATER CHILLERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Trane
  - 2. Carrier
  - 3. JCI / York.
  - 4. Daikin
- B. Description: Factory-assembled and run-tested water chiller complete with base and frame, condenser casing, compressors, compressor motors and motor controllers, evaporator, condenser coils, condenser fans and motors, electrical power, controls, and accessories.
- C. Cabinet:
  - 1. Base: Galvanized-steel base extending the perimeter of water chiller. Secure frame, compressors, and evaporator to base to provide a single-piece unit.
  - 2. Frame: Rigid galvanized-steel frame secured to base and designed to support cabinet, condenser, control panel, and other chiller components not directly supported from base.
  - 3. Casing: Galvanized steel.
  - 4. Finish: Coat base, frame, and casing with a corrosion-resistant coating capable of withstanding a 500-hour salt-spray test according to ASTM B 117.
  - 5. Sound-reduction package consisting of the following:
    - a. Acoustic enclosure around compressors.
    - b. Reduced-speed fans with acoustic treatment.
    - c. Designed to reduce sound level without affecting performance.
  - 6. Security Package: Provide security grilles with fasteners for additional protection of compressors, evaporator, and condenser coils. Grilles shall be coated for corrosion resistance and shall be removable for service access.
- D. Compressors:
  - 1. Description: Positive-displacement direct drive with hermetically sealed casing.
  - 2. Each compressor provided with suction and discharge service valves, crankcase oil heater, and suction strainer.
  - 3. Operating Speed: Nominal 3600 rpm for 60-Hz applications.
  - 4. Capacity Control: On-off compressor cycling.

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5. Oil Lubrication System: Automatic pump with strainer, sight glass, filling connection, filter with magnetic plug, and initial oil charge.
  6. Vibration Isolation: Mount individual compressors on vibration isolators.
- E. Compressor Motors:
1. Hermetically sealed and cooled by refrigerant suction gas.
  2. High-torque, two-pole induction type with inherent thermal-overload protection on each phase.
- F. Compressor Motor Controllers:
1. Across the Line: NEMA ICS 2, Class A, full voltage, nonreversing.
- G. Refrigeration:
1. Refrigerant: R-410a. Classified as Safety Group A1 according to ASHRAE 34.
  2. Refrigerant Compatibility: Parts exposed to refrigerants shall be fully compatible with refrigerants, and pressure components shall be rated for refrigerant pressures.
  3. Refrigerant Circuit: Each circuit shall include a electronic-expansion valve, refrigerant charging connections, a hot-gas muffler, compressor suction and discharge shutoff valves, a liquid-line shutoff valve, a replaceable-core filter-dryer, a sight glass with moisture indicator, a liquid-line solenoid valve, and an insulated suction line.
  4. Refrigerant Isolation: Factory install positive shutoff isolation valves in the compressor discharge line and the refrigerant liquid-line to allow the isolation and storage of the refrigerant charge in the chiller condenser.
- H. Evaporator:
1. Brazed-plate or shell-and-tube design, as indicated.
  2. Shell and Tube:
    - a. Description: Direct-expansion, shell-and-tube design with fluid flowing through the shell and refrigerant flowing through the tubes within the shell.
    - b. Code Compliance: Tested and stamped according to ASME Boiler and Pressure Vessel Code.
    - c. Shell Material: Carbon steel.
    - d. Shell Heads: Removable carbon-steel heads with multipass baffles designed to ensure positive oil return and located at each end of the tube bundle.
    - e. Shell Nozzles: Fluid nozzles located along the side of the shell and terminated with mechanical-coupling end connections for connection to field piping.
    - f. Tube Construction: Individually replaceable copper tubes with enhanced fin design, expanded into tube sheets.
    - g. Chiller shall be capable of starting up with 95°F entering fluid temperature to the evaporator. Maximum water temperature that can be circulated with the Chiller not operating is 125°F.
  3. Brazed Plate:
    - a. Direct-expansion, single-pass, brazed-plate design.
    - b. Type 316 stainless-steel construction.



## SECTION 236423 - SCROLL WATER CHILLERS

- c. Code Compliance: Tested and stamped according to ASME Boiler and Pressure Vessel Code.
- d. Fluid Nozzles: Terminate with mechanical-coupling end connections for connection to field piping.

### I. Air-Cooled Condenser:

- 1. Plate-fin coil with integral subcooling on each circuit, rated at 450 psig.
  - a. Construct coils of copper tubes mechanically bonded to aluminum fins.
  - b. All Aluminum Microchannel may be submitted as a voluntary alternate. Provide a 10-year condenser coil warranty against leaks. Extended warranty shall include equipment, materials, refrigerant, and labor.
  - c. Hail Protection: Provide condenser coils with steel louvers, baffles, or hoods painted to match the chiller to protect against hail damage. Wire mesh type is not acceptable.
  - d. Coat coils with a baked epoxy corrosion-resistant coating after fabrication. Black-fin coating is not acceptable. Coil shall have minimum salt spray rating of 6,000+ hours when rated IAW ASTM-B117.
  - e. Chiller shall be capable of starting and running at outdoor ambient temperatures from 32°F to 115°F.
- 2. Fans: Direct-drive propeller type with statically and dynamically balanced fan blades, arranged for vertical air discharge.
- 3. Fan Motors: Totally enclosed air over (TEAO) enclosure, with permanently lubricated bearings, and having built-in overcurrent- and thermal-overload protection.
- 4. Fan Guards: Steel safety guards with corrosion-resistant coating.

### J. Electrical Power:

- 1. Factory-installed and -wired switches, motor controllers, transformers, and other electrical devices necessary shall provide a single-point field power connection to water chiller.
- 2. House in a unit-mounted, NEMA 250, enclosure with hinged access door with lock and key or padlock and key.
- 3. Wiring shall be numbered and color-coded to match wiring diagram.
- 4. Install factory wiring outside of an enclosure in a raceway.
- 5. Field power interface shall be to heavy-duty, nonfused disconnect switch, provided by Div. 26.
- 6. Provide branch power circuit to each motor and to controls with one of the following disconnecting means:
  - a. Motor-circuit protector (circuit breaker) with field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.
- 7. Provide each motor with overcurrent protection.
- 8. Overload relay sized according to UL 1995, or an integral component of water chiller control microprocessor.
- 9. Phase-Failure and Undervoltage: Solid-state sensing with adjustable settings.
- 10. Transformer: Unit-mounted transformer with primary and secondary fuses and sized with enough capacity to operate electrical load plus spare capacity.

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- a. Power unit-mounted controls.
11. Control Relays: Auxiliary and adjustable time-delay relays.
  12. Indicate the following for water chiller electrical power supply:
    - a. Current, phase to phase, for all three phases.
    - b. Voltage, phase to phase and phase to neutral for all three phases.
    - c. Three-phase real power (kilowatts).
    - d. Three-phase reactive power (kilovolt amperes reactive).
    - e. Power factor.
    - f. Running log of total power versus time (kilowatt hours).
    - g. Fault log, with time and date of each.
- K. Controls:
1. Stand-alone, microprocessor based.
  2. Enclosure: Share enclosure with electrical power devices or provide a separate enclosure of matching construction.
  3. Operator Interface: Keypad or pressure-sensitive touch screen. Multiple-character, backlit, liquid-crystal display or light-emitting diodes. Display the following:
    - a. Date and time.
    - b. Operating or alarm status.
    - c. Operating hours.
    - d. Outside-air temperature if required for chilled-water reset.
    - e. Temperature and pressure of operating set points.
    - f. Entering and leaving temperatures of chilled water.
    - g. Refrigerant pressures in evaporator and condenser.
    - h. Saturation temperature in evaporator and condenser.
    - i. No cooling load condition.
    - j. Elapsed time meter (compressor run status).
    - k. Pump status.
    - l. Antirecycling timer status.
    - m. Percent of maximum motor amperage.
    - n. Current-limit set point.
    - o. Number of compressor starts.
  4. Control Functions:
    - a. Manual or automatic startup and shutdown time schedule.
    - b. Entering and leaving chilled-water temperatures, control set points, and motor load limit. Chilled-water leaving temperature shall be reset based on input from the BAS system.
    - c. Current limit and demand limit.
    - d. External water chiller emergency stop.
    - e. Antirecycling timer.
  5. Manual-Reset Safety Controls: The following conditions shall shut down water chiller and require manual reset:
    - a. Low evaporator pressure or high condenser pressure.

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- b. Low chilled-water temperature.
  - c. Refrigerant high pressure.
  - d. High or low oil pressure.
  - e. High oil temperature.
  - f. Loss of chilled-water flow.
  - g. Control device failure.
6. Interface with DDC System for HVAC: DDC shall provide hardwired control points to monitor, control, and display water chiller status and alarms. In addition, provide BACnet gateway communications device allowing for chiller operating parameters and alarms with descriptions to be monitored via direct digital control system. Coordinate interface with DDC Contractor.
- a. Hardwired points: As a minimum, the system shall allow the following parameters to be monitored or controlled.
    - 1) Leaving chilled water temperature.
    - 2) Entering chilled water temperature.
    - 3) Percent running load amps on motor.
    - 4) Chiller compressor status.
    - 5) Proof of chilled water flow.
    - 6) Alarm status.
    - 7) Chiller enable / disable.
    - 8) Chilled water temperature setpoint.
    - 9) Demand limit setpoint.
    - 10) Chiller % load.
    - 11) Hot gas bypass status, if required
  - b. BACnet points: As a minimum, the system shall allow the following parameters to be monitored.
    - 1) Alarm status and descriptions.
    - 2) Refrigerant temperatures (each circuit): saturation temp, suction temp
    - 3) Refrigerant pressure (each circuit): condensing, evaporating
    - 4) Compressor run time (each)
    - 5) And 10 other points that will be determined at a later date.
- L. Insulation:
- 1. Material: Closed-cell, flexible elastomeric, thermal insulation complying with ASTM C 534, Type I, for tubular materials and Type II, for sheet materials.
  - 2. Thickness: 1-1/2 inches minimum, rated for installation in hot humid climate.
  - 3. Factory-applied insulation over cold surfaces of water chiller components.
    - a. Adhesive: As recommended by insulation manufacturer and applied to 100 percent of insulation contact surface. Seal seams and joints.
  - 4. Apply protective coating to exposed surfaces of insulation.
- M. Factory-Installed Dual Pump Package
- 1. The pump package shall be factory mounted and wired on the chiller. The chiller controller shall provide a pump start/stop signal when operation is required. The package shall be equipped with:

## SECTION 236423 - SCROLL WATER CHILLERS

- a. Pump package includes two high head pumps. Designed with one redundant pump, the chiller shall control both pumps through a lead/lag and failure/recovery functionality.
- b. Pump package shall also be equipped with:
  - 1) "Y" type inlet stainless-steel strainer and combination suction guide, a disposable fine-mesh strainer for start-up, and stabilizing outlet vanes.
  - 2) Butterfly shut off valves at inlet and outlet
  - 3) Expansion Tank, heat traced for freeze protection
  - 4) Drain valve
  - 5) Inverter
  - 6) Swing split flapper check valves
  - 7) Factory power and control wiring from the chiller to the pump package control panel
  - 8) Flow switch mounted and wired
  - 9) Interconnecting schedule 40 piping with Victaulic couplings
  - 10) Insulation of all cold surfaces
  - 11) Two factory installed water PT ports with pressure gauges

### N. Accessories:

1. Factory-installed, thermal dispersion chilled-water flow switches.
2. Individual compressor suction and discharge pressure gages with shutoff valves for each refrigeration circuit.
3. Factory-furnished neoprene or spring isolators for field installation.
4. [Integral dual pumps, with VFDs, check valve, isolation valves, and other accessories. See pump specifications.](#)

### O. Capacities and Characteristics: See schedules.

## 2.2 SOURCE QUALITY CONTROL

- A. Perform [standard](#) functional test of water chillers before shipping.
- B. For water chillers located outdoors, rate sound power level according to ARI 370 procedure.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Before water chiller installation, examine roughing-in for equipment support, anchor-bolt sizes and locations, piping, and electrical connections to verify actual locations, sizes, and other conditions affecting water chiller performance, maintenance, and operations.
  1. Water chiller locations indicated on Drawings are approximate. Determine exact locations before roughing-in for piping and electrical connections.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

## SECTION 236423 - SCROLL WATER CHILLERS

### 3.2 WATER CHILLER INSTALLATION

- A. Install water chillers on support structure indicated.
- B. Equipment Mounting:
  - 1. Install water chillers on cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
  - 2. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."
  - 3. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
  - 4. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
  - 5. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 6. Install anchor bolts to elevations required for proper attachment to supported equipment.
- C. Maintain manufacturer's recommended clearances for service and maintenance.
- D. Charge water chiller with refrigerant if not factory charged and fill with oil if not factory installed.
- E. Install separate devices furnished by manufacturer and not factory installed.

### 3.3 CONNECTIONS

- A. Comply with requirements in Section 232113 "Hydronic Piping" and Section 232116 Hydronic Piping Specialties." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to chiller to allow service and maintenance.
- C. Evaporator Fluid Connections: Connect to evaporator inlet with shutoff valve, strainer, flexible connector, thermometer, and plugged tee with pressure gage. Connect to evaporator outlet with shutoff valve, balancing valve, flexible connector, flow switch, thermometer, plugged tee with pressure gage, and drain connection with valve. Make connections to water chiller with a union, flange, or mechanical coupling.
- D. Connect each drain connection with a union and drain pipe and extend pipe, full size of connection, to floor drain. Provide a shutoff valve at each connection if required.
- E. Connect wiring and ground water chillers according to Division 26 Specifications.
- F. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

## SECTION 236423 - SCROLL WATER CHILLERS

### 3.4 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
- B. Inspect field-assembled components, equipment installation, and piping and electrical connections for proper assemblies, installations, and connections.
- C. Complete installation and startup checks according to manufacturer's written instructions and perform the following:
  - 1. Verify that refrigerant charge is sufficient and water chiller has been leak tested.
  - 2. Verify that pumps are installed and functional.
  - 3. Verify that thermometers and gages are installed.
  - 4. Operate water chiller for run-in period.
  - 5. Check bearing lubrication and oil levels.
  - 6. Verify that refrigerant pressure relief device for chillers installed indoors is vented outside.
  - 7. Verify proper motor rotation.
  - 8. Verify static deflection of vibration isolators, including deflection during water chiller startup and shutdown.
  - 9. Verify and record performance of chilled-water flow and low-temperature interlocks.
  - 10. Verify and record performance of water chiller protection devices.
  - 11. Test and adjust controls and safeties. Replace damaged or malfunctioning controls and equipment.
- D. Prepare a written startup report that records results of tests and inspections.

### 3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain water chillers. Video record the training sessions.

### 3.6 INSPECTION SERVICES

- A. Engage a qualified manufacturer's service technician to perform chiller inspections at time intervals specified below.
  - 1. Coordinate inspection time with Owner at least 5 working days prior to inspection. Schedule inspection at Owner's convenience.
  - 2. Manufacturer's field technician must check in with Owner prior to beginning inspection. Review with Owner chiller logs and operational issues for problems and trends.
  - 3. Manufacturer's field technician must check out with Owner after inspection.
- B. Quarterly inspections: Manufacturer shall provide comprehensive inspection service of chiller at approximately three, six, and nine months after Substantial Completion. Quarterly inspections shall include, as a minimum, the following services:
  - 1. Check the general operation of the unit.
  - 2. Log the operating temperatures, pressures, voltages, and amperages.

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3. Check the operation of the control circuit.
  4. Check the operation of the motor and starter.
  5. Analyze the recorded data. Compare the data to the original design conditions.
  6. Review operating procedures with operating personnel.
  7. Provide a written report of completed work, operating log, and indicate any uncorrected deficiencies detected.
- C. End of First Year inspection: Manufacturer shall provide comprehensive inspection service of chiller at approximately twelve months after Substantial Completion. Inspection shall include, as a minimum, the following services:
1. General Assembly
    - a. Leak-test the chiller and report the leak check results.
    - b. Repair minor leaks as required (e.g. valve packing, flare nuts).
    - c. Calculate refrigerant loss rate and report to customer.
    - d. Visually inspect condenser tubes for cleanliness.
  2. Controls and Safeties
    - a. Inspect the control panel for cleanliness.
    - b. Inspect wiring and connections for tightness and signs of overheating and discoloration.
    - c. Verify all settings in the electronic control panel.
    - d. Test the low oil pressure safety device. Calibrate and record setting.
    - e. Test the high motor temperature safety device. Calibrate and record setting.
    - f. Test the operation of the chilled water pump starter auxiliary contacts.
    - g. Verify the setting of the current control device.
  3. Lubrication System
    - a. Pull oil sample for spectroscopic analysis.
    - b. Test the oil for acid content and discoloration. Make recommendations to the customer based on the results of the test.
    - c. Change the oil filter.
    - d. Verify the operation of the oil heater. Measure amps and volts and compare the readings with the watt rating of the heater.
  4. Motor and Starter
    - a. Clean the starter and cabinet.
    - b. Inspect wiring and connections for tightness and signs of overheating and discoloration.
    - c. Check tightness of motor terminal connections.
    - d. Check condition of the contacts for wear and pitting.
    - e. Check contactors for free and smooth operation.
    - f. Check the mechanical linkages for wear, security and clearances.
    - g. Meg the motor and record the readings.
    - h. Verify the operation of the electrical interlocks.
    - i. Measure voltage and record. Voltage should be nominal voltage  $\pm 10\%$ .

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- D. Provide all services, equipment, and materials required to remedy manufacturing or operational deficiencies found. Arrange for subsequent visit(s) if required. If routine maintenance is required, provide a report with recommendations to the Owner.

END OF SECTION 236423



## SECTION 237313 - MODULAR INDOOR CENTRAL-STATION AIR-HANDLING UNITS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes full 2" double wall, modular air-handling units with coils in the following configurations: Variable-air-volume, chilled water air-handling units in single path and dual path configurations.

#### 1.3 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Casing panels shall be self-supporting and capable of withstanding 150 percent of internal static pressures indicated, without panel joints exceeding a deflection of  $L/240$  where "L" is the unsupported span length within completed casings.

#### 1.4 SUBMITTALS

- A. Product Data: For each air-handling unit indicated.
  - 1. Unit dimensions and weight.
  - 2. Cabinet material, metal thickness, finishes, insulation, and accessories.
  - 3. Fans:
    - a. AMCA 210 certified fan-performance curves with system operating conditions indicated.
    - b. AMCA 301 certified fan-sound power ratings.
    - c. Fan construction and accessories.
    - d. Motor ratings, electrical characteristics, and motor accessories.
  - 4. Certified coil-performance ratings with system operating conditions indicated.
  - 5. Dampers, including housings, linkages, and operators.
  - 6. Filters with performance characteristics.
- B. Coordination Drawings: Floor plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  - 1. Mechanical-room layout and relationships between components and adjacent structural and mechanical elements.
  - 2. Support location, type, and weight.
  - 3. Field measurements.

## SECTION 237313 - MODULAR INDOOR CENTRAL-STATION AIR-HANDLING UNITS

- C. Source quality-control reports.
- D. Field quality-control reports.
- E. Operation and Maintenance Data: For air-handling units to include in emergency, operation, and maintenance manuals.

### 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 62.1-2004, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
- E. ASHRAE/IESNA 90.1-2004 Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004, Section 6 - "Heating, Ventilating, and Air-Conditioning."
- F. Comply with NFPA 70.

### 1.6 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.
- B. Coordinate base size with condensate drain connection opening and requirements for condensate drain trap size.
- C. Coordinate side of coil connections and access doors. Coordinate exact dimensions of custom openings for supply, return and fresh air. Coordinate dimensional limitations.
- D. Since spatial constraints are an important consideration, coordinate site conditions, space availability for equipment, maintenance and NEC clearances, etc., prior to submitting bids.

### 1.7 WARRANTY

- A. General Warranty: The special warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.
- B. Special Warranty: A written warranty, executed by Contractor and signed by manufacturer, agreeing to replace components that fail in materials and workmanship within the specified

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warranty period, provided manufacturer's written instructions for installation, operation, and maintenance have been followed.

1. Warranty Period: One year parts and labor from date of Substantial Completion. Fan and fan motor to have 5-year parts warranty from date of shipment. Labor warranty shall be from installing contractor.

### 1.8 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.
  1. Filters: One set for each air-handling unit.
  2. Fan Belts: One set for each air-handling unit fan.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Carrier; Div. of United Technologies Corp.
  2. Daikin Applied.
  3. Johnson Controls (York)
  4. Trane.

### 2.2 GENERAL REQUIREMENTS

- A. Manufacturer shall clearly define any exceptions made to plans and specifications. Mechanical Contractor is responsible for expenses that occur due to exceptions made.
- B. Carefully coordinate with Electrical, Mechanical, and Controls Contractors for items of work that required close integration.
- C. Units shall be delivered prewired, bearing an approved label with all of the necessary identification marks, electrical data, and any necessary cautions as required by the National Electrical Code.
- D. The entire unit shall be covered with a protective covering from time of shipment at factory until installed with structure protecting indoor air handling units. If at any time the protective covering is removed before installation, the equipment shall be thoroughly cleaned, internally and externally.
- E. Unit shall be factory assembled central station air handler with a fan, motor and drive assembly, chilled water and hot water coils, access section, combination filter-mixing box section, control dampers and accessories, as indicated on schedules and details.

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- F. All unit sections shall be supplied with longitudinal 16-gage or heavier, galvanized steel structural perimeter base rails to serve as housekeeping rails when unit is installed. The manufacturer at the factory shall install base rails. Perimeter lifting brackets shall be provided on each section. Slings of units in place of lifting brackets is not acceptable.
- G. Units shall ship in the fewest number of sections to meet project requirements. All section shall be individually flanged and gasketed to allow easy assembly and disassembly.

### 2.3 UNIT CASINGS

- A. General Fabrication Requirements for Casings: Formed and reinforced double-wall insulated panels, fabricated to allow removal for access to internal parts and components, with joints between sections sealed. Units shall be weatherproofed and equipped for installation indoors or outdoors as scheduled.
  - 1. Unit shall be constructed not to deflect more than  $L/240$  at any point on the exterior liner and air leakage shall not exceed leak class 6 ( $CL = 6$ ) per ASHRAE 111 at specified casing pressure, where maximum casing leakage ( $\text{cfm}/100 \text{ ft}^2$  of casing surface area) =  $CL \times P^{0.65}$ , subject to factory or field testing.
  - 2. Outside Casing: G90 galvanized steel, **22 gauge** thick. Panels shall be designed to withstand Federal Test Method Standard No. 141 500-hour salt-spray test.
  - 3. Inside Casing: Type 304 stainless steel, **22 gauge** thick, including **coil casing, bulkheads, mounting supports, and inner liner.**
  - 4. Joints: All walls, roofs, and joints shall be of formed construction, with at least two breaks at each joint. Joints shall be secured by sheet metal screws or pop rivets. Wall and floor joints shall be broken in and roof joints broken out (exposed) for rigidity. All joints shall be caulked with a water resistant sealant.
  - 5. Base Rail: Casings shall be supported on formed galvanized steel channel or structural channel supports, designed and welded or bolted for low deflections. Base rail shall be continuous, with flanged connections at shipping splits. Mounting feet are not acceptable. Integral lifting lugs shall be provided for hoisting.
  - 6. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.
  - 7. Casing panel inner liners must not extend to the exterior of the unit or contact the exterior frame. A mid-span, no-through-metal, internal thermal break shall be provided for all unit casing panels
- B. Casing Insulation and Adhesive:
  - 1. Materials: 2" thick nominal 3 lb/cu.ft. density acoustic insulation; Thermal Conductivity (k-Value): **0.26 at 75 deg F** mean temperature. R-13 or higher.
  - 2. Fire-Hazard Classification: Maximum flame-spread index of 25 and smoke-developed index of 50, when tested according to ASTM C 411.
  - 3. Liner Adhesive: Comply with NFPA 90A or NFPA 90B and ASTM C 916.
  - 4. Location and Application: Encased between outside and inside casing.
- C. Inspection and Access Panels and Access Doors: Access doors large enough for easy access to accommodate periodic maintenance and inspection. Same materials and finishes as cabinet, complete with hinges, latches, handles, and gaskets. Provide access panels and doors in the following locations:

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1. Location: Access doors to fans and motors, filters, dampers and operators, coil section inspection and access section, electrical control panels, and as specified on unit drawings
2. Construction: Provide an extruded aluminum perimeter frame with steel sheets front and back (sheets shall match cabinet construction) and pressure inject with 2.2 lbs/cu.ft. of polyurethane foam to create a seamless rigid 2" double wall door with an insulating value of R13.
3. Thermal Resistance: Doors shall be designed with thermal break construction.
4. Gaskets: Design press fitted into the frame slots for easy field replacement.
5. Hardware: Each door is complete with a minimum of two stainless steel hinges and two lever lock handles.
6. Access Panels: Lift out access panels either bolted or secured with two or more cam-lock fasteners must be provided in locations where non-regular access is required.
7. Access doors downstream of all the return air coil section shall be a minimum of 18" wide, full size up to the height of the unit not to exceed 72" tall.

D. Condensate Drain Pans: Formed sections of **stainless-steel** sheet complying with requirements in ASHRAE 62. Fabricate IAQ drain pans with slopes in three planes to collect condensate from cooling coils (including coil piping connections and return bends) and humidifiers when units are operating at maximum catalogued face velocity across cooling coil. To prevent moisture carryover, extend drain pan a minimum of 6" (preferably 12") past the leaving face of the cooling coil. Unit drain pan shall be a minimum of 3" deep to permit cleaning and inspection.

1. Double-Wall Construction (full 2" thick): Fill space between walls with NFPA 90A compliant insulation and seal moisture tight.
2. Drain Connections: One end of pan. Coordinate with drawing.
3. Units with stacked coils shall have a stainless steel intermediate drain pan with drop tubes to main pan to collect condensate from top coil.

E. Base Rail: Unit shall have a minimum 6" tall continuous base rail bolted or welded to the unit frame. Mounting feet are not acceptable.

### 2.4 FAN SECTION

A. Fan-Section Construction: Plenum, airfoil, or forward curve type fan, wheel, fan shaft, bearings, motor, drive assembly, and support structure and equipped with formed-steel channel base for integral mounting of fan, motor, and casing panels. Mount fan with spring vibration isolation, a minimum of 2" deflection. Direct-driven centrifugal fans consisting of housing where specifically shown. Motor, fan bearings, and drive assembly shall be located inside the fan plenum to minimize bearing wear and to allow for internal vibration isolation of the fan-motor assembly.

B. Centrifugal Fan Housings: Formed- and reinforced-steel panels to form curved scroll housings with shaped cutoff and spun-metal inlet bell.

1. Bracing: Steel angle or channel supports for mounting and supporting fan scroll, wheel, motor, and accessories.
2. Horizontal-Flanged, Split Housing: Bolted construction.
3. Housing for Supply Fan: Attach housing to fan-section casing with metal-edged flexible duct connector, or a vibration absorbent discharge seal.

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4. Flexible Connector: Factory fabricated with a fabric strip **5-3/4 inches** wide attached to 2 strips of **2-3/4-inch-** wide, **0.028-inch-** thick, galvanized-steel sheet or **0.032-inch-** thick aluminum sheets; select metal compatible with casing.
  - a. Flexible Connector Fabric: Glass fabric, double coated with neoprene. Fabrics, coatings, and adhesives shall comply with UL 181, Class 1.
    - 1) Fabric Minimum Weight: **26 oz./sq. yd.**
    - 2) Fabric Tensile Strength: **480 lbf/inch** in the warp and **360 lbf/inch** in the filling.
    - 3) Fabric Service Temperature: **Minus 40 to plus 200 deg F.**
- C. Fan and Drive Assemblies: Statically and dynamically balanced and designed for continuous operation at maximum-rated fan speed and motor horsepower.
  1. Shafts: Designed for continuous operation at maximum-rated fan speed and motor horsepower, and with field-adjustable alignment.
    - a. Turned, ground, and polished hot-rolled steel with keyway. Ship with a protective coating of lubricating oil.
    - b. Designed to operate at no more than 70 percent of first critical speed at top of fan's speed range.
- D. Airfoil, Centrifugal Fan Wheels: Smooth-curved inlet flange, backplate, and hollow die-formed airfoil-shaped blades continuously welded at tip flange and backplate; cast-iron or cast-steel hub riveted to backplate and fastened to shaft with set screws.
- E. Grease-Lubricated Shaft Bearings: Self-aligning, pillow-block-type, ball or roller bearings with adapter mount and two-piece, cast-iron housing.
  1. Ball-Bearing Rating Life: ABMA 9, L<sub>10</sub> of 120,000 hours.
  2. Roller-Bearing Rating Life: ABMA 11, L<sub>10</sub> of 120,000 hours.
- F. Belt Drives (where specified): Factory mounted, with final alignment and belt adjustment made after installation and with 1.5 service factor based on fan motor.
  1. Pulleys: Cast iron or cast steel with split, tapered bushing; dynamically balanced at factory.
  2. Motor Pulleys: Adjustable pitch for use with 5-hp motors and smaller; fixed pitch for use with motors larger than 5 hp. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions.
  3. Belts: Oil resistant, nonsparking, and nonstatic; matched for multiple belt drives.
  4. Belt Guards: Comply with requirements specified by OSHA and fabricate according to SMACNA's "HVAC Duct Construction Standards"; **0.1046-inch-** thick, **3/4-inch** diamond-mesh wire screen, welded to steel angle frame; prime coated.
  5. Motor Mount: Adjustable for belt tensioning.
- G. Vibration Control: Vertical spring type isolators with leveling bolts, bridge bearing waffled pads with minimum 2 inch static deflection and side snubbers designed to achieve high isolation efficiency. Fans (other than plug fans) shall be attached to the discharge panel by a polyvinyl chloride coated polyester woven fabric, with a sealed double locking fabric to metal connection.

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### H. Fan-Section Source Quality Control:

1. Sound Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Fans shall bear AMCA-certified sound ratings seal.
2. Factory test fan performance for flow rate, pressure, power, air density, rotation speed, and efficiency. Establish ratings according to AMCA 210, "Laboratory Methods of Testing Fans for Rating."

## 2.5 MOTORS

- A. General: Refer to Division 23 Section for general requirements for motors.
- B. Torque Characteristics: Sufficient to accelerate driven loads satisfactorily.
- C. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range.
- D. Totally Enclosed Fan Cooled (TEFC), premium efficiency (E+3) type, NEMA Design B, inverter rated for Variable Speed Drive application, of size and electrical characteristics as shown on equipment schedule.
- E. Temperature Rating: 50 deg C maximum temperature rise at 40 deg C ambient for continuous duty at full load (Class A Insulation).
- F. Service Factor: 1.15 for polyphase motors and 1.35 for single-phase motors.
- G. Motor Construction: NEMA MG 1, general purpose, continuous duty, Design B mounted on adjustable base.
- H. Bearings: The following features are required:
  1. Ball or roller bearings with inner and outer shaft seals.
  2. Grease lubricated. Provide grease lines for motor and shaft lubrication, extended to a common mounting on access side of fan.
  3. Designed to resist thrust loading where belt or other drives produce lateral or axial thrust in motor.
- I. Overload Protection: Built-in, automatically resetting, thermal-overload protection.
- J. Noise Rating: Quiet.
- K. Efficiency: Premium efficiency.
- L. Suitable for use with variable speed drives.
- M. Nameplate: Indicate ratings, characteristics, construction, special features, and full identification of manufacturer.

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- N. Starters, Electrical Devices, and Wiring: Electrical devices and connections are specified in Division 26 Sections.

### 2.6 COIL SECTION

- A. Coil Sections: Common or individual, insulated, stainless-steel casings for cooling coils. Design and construct to facilitate removal and replacement of coil for maintenance and to ensure full airflow through coils.
- B. Water Coils: Circuited to provide adequate tube velocities to meet design requirements. Internal turbulators are not acceptable. Continuous circuit coil fabricated according to ARI 410.
  - 1. Piping Connections: Threaded, on same end.
  - 2. Tubes: **5/8" outer diameter copper tubes, minimum .020" thick tubes and u-bends.**
  - 3. Fins: Rippled for maximum heat transfer.
    - a. Coils: Aluminum fins.
  - 4. Fin and Tube Joint: Mechanical bond by mechanical expansion of tubes.
  - 5. Headers: Seamless copper tube with brazed joints, prime coated.
  - 6. Frames: **Type 304 stainless steel**, 16 gauge thick.
  - 7. Mounting racks and bulkhead: Stainless steel.
  - 8. Ratings: Design tested and rated according to ASHRAE 33 and ARI 410.
    - a. Working-Pressure Ratings: **200 psig, 325 deg F.**
  - 9. Source Quality Control: Test to **300 psig** underwater.
- C. Coil casing shall be **Type 304** stainless steel.
- D. Auxiliary Drain: Return bends and headers of coils shall be fully concealed within the air-handling unit. Provide auxiliary drain pan complete with drain connection at headered end of cooling coils. Exterior header covers will not be acceptable.
- E. Coil Removal: Coils shall be removable from the unit at the header end, unless shown otherwise on drawings.
- F. Drain and Vent: All water coils shall be equipped with a capped vent tapping at the top of the return header, and a capped drain tapping at the bottom of the supply header.
- G. Supply and return line connections shall be clearly labeled on the outside of the unit.

### 2.7 AIR FILTRATION

- A. General Requirements for Air Filtration Section: Shall be a part of the combination filter mixing box section. See sections below.
  - 1. Comply with NFPA 90A.
  - 2. Provide minimum arrestance according to ASHRAE 52.1, and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.
  - 3. Provide filter holding frames shall be constructed of extruded aluminum or galvanized steel for increased rigidity arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side or lifted out from access plenum.



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4. Return air stream: Each filter section shall be designed and constructed to house a 2-inch-thick pre-filter and a 4-inch thick pleated after filter.
5. Outside air stream: Each filter section shall be designed and constructed to house a 2-inch-thick filter.

### B. Extended-Surface, Nonsupported-Media Filters:

1. Factory-fabricated, dry, extended-surface, self-supporting type.
2. Arrestance (ASHRAE 52.1): 85 (pre-filter) and **95 (after filter)**.
3. MERV (ASHRAE 52.2): 8 (pre-filter) and 13 (after filter) for return air stream, MERV 8 for outside air stream.
4. Media: Fibrous material **with antimicrobial agent** constructed so individual pleats are maintained in tapered form by flexible internal supports under rated-airflow conditions.
5. Filter-Media Frame: **Galvanized steel for MERV 8 replaceable pad filters.** Disposable or filter header for MERV 13 filters
6. Mounting Frames: Welded, galvanized steel, with gaskets and fasteners, suitable for bolting together into built-up filter banks.

## 2.8 DAMPERS

- A. General Requirements for Dampers: Leakage rate, according to AMCA 500, "Laboratory Methods for Testing Dampers for Rating,".
- B. All Dampers: Ultra-low leak (ULL), double-skin, airfoil-blade galvanized-steel dampers with compressible jamb seals and extruded-vinyl blade edge seals, in opposed-blade arrangement with steel operating rods rotating in stainless-steel sleeve bearings mounted in a single galvanized-steel frame, and with operating rods connected with a common linkage. Leakage rate shall not exceed 3.7 cfm/sq. ft. at 1-inch wg and 8 cfm/sq. ft. at 4-inch wg.
- C. Mixing boxes and filter-mixing boxes shall have parallel blades. All mixing boxes and filter mixing boxes shall have access doors as specified.
- D. Coordinate damper actuators on damper shafts with controls.
- E. Damper Operators: Comply with requirements in Division 23 Section "Instrumentation and Control for HVAC."
- F. Combination Filter and Mixing Section:
  1. Cabinet support members shall hold ~~2-inch~~-thick, pleated, flat, permanent or throwaway filters. See Filter section above.
  2. Support: Permanent re-usable galvanized metal enclosing filter grid-frame for MERV 8 pre-filters.

## 2.9 ACCESSORIES

- A. See schedules.

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- B. Provide support kit for mounting the outside air section to the return air section. Provide interface between upper and lower sections in the common mixing plenum. Provide factory cut openings for exact match without the need for field modifications.

### 2.10 CONTROLS

- A. Air handler controls shall be achieved through dedicated DDC programmable control modules as specified in Section 230900. Each AHU shall have a dedicated controller capable of achieving control sequences in stand-alone mode.
- B. AHU manufacturer shall coordinate with work of Section 230900 to ensure DDC system can fully interact with the AHU without compromising any of the system safeties or warranties.

### 2.11 SOURCE QUALITY CONTROL

- A. Fan Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Fans shall bear AMCA-certified sound ratings seal.
- B. Fan Performance Rating: Factory test fan performance for airflow, pressure, power, air density, rotation speed, and efficiency. Rate performance according to AMCA 210, "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating."
- C. Water Coils: Factory tested to 300 psig according to ARI 410 and ASHRAE 33.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine casing insulation materials and filter media before air-handling unit installation. Reject insulation materials and filter media that are wet, moisture damaged, or mold damaged.
- C. Examine roughing-in for hydronic or refrigerant, and condensate drainage piping systems and electrical services to verify actual locations of connections before installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.
- E. Contractors providing units other than those used as the basis of design will assume all responsibility for changes required to accommodate units proposed.
- F. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting installation of air handling units.

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### 3.2 INSTALLATION

- A. Equipment Mounting: Install air-handling units on concrete bases **using elastomeric pads**. Secure units to anchor bolts installed in concrete bases. Comply with requirements for concrete bases specified in Division 03 Sections.
- B. Arrange installation of units to provide access space around air-handling units for service and maintenance.
- C. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction and testing, with new, clean filters.

### 3.3 CONNECTIONS

- A. Comply with requirements for piping specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to air-handling unit to allow service and maintenance.
- C. Connect piping to air-handling units mounted on vibration isolators with flexible connectors.
- D. Connect condensate drain pans using line size, Type M copper tubing. Extend to nearest equipment or floor drain. Construct deep trap at connection to drain pan and install cleanouts at changes in direction. Insulate condensate lines.
- E. **Hydronic Piping**: Comply with applicable requirements in Division 23 Section "Hydronic Piping." and Section 232116 Hydronic Piping Specialties." Connect to supply and return coil tapplings with shutoff or balancing valve and union or flange at each connection.
- F. Connect duct to air-handling units with flexible connections. Comply with requirements in Division 23 Section "Air Duct Accessories." Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connections.
- G. Electrical: Comply with applicable requirements in Division 26 Sections for power wiring, switches, and motor controls.
- H. Ground equipment according to Division 26 Section "Grounding and Bonding."
- I. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

### 3.4 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.
  - 1. Inspect field assembly of components and installation of central-station air-handling units including piping, ductwork, and electrical connections.
  - 2. Prepare a written report on findings and recommended corrective actions.

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### B. Tests and Inspections:

1. Leak Test: After installation, test coils and connections for leaks.
2. Fan Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Air-handling unit or components will be considered defective if unit or components do not pass tests and inspections.

D. Prepare test and inspection reports.

### 3.5 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 outdoor- and return-air mixing dampers open and close, and maintain minimum outdoor-air setting.
7. Comb coil fins for parallel orientation.
8. Verify that proper thermal-overload protection is installed for electric coils.
9. Install new, clean filters.
10. 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.

C. Refer to Division 23 Section "Testing, Adjusting, and Balancing" for modular indoor air-handling system testing, adjusting, and balancing.

### 3.6 ADJUSTING

A. Adjust damper linkages for proper damper operation.

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- B. Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for air-handling system testing, adjusting, and balancing.

### 3.7 CLEANING

- A. Clean modular indoor air-handling 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 air-handling unit and air-distribution systems and after completing startup service, clean air-handling units internally to remove foreign material and construction dirt and dust. Clean fan wheels, cabinets, dampers, coils, and filter housings, and install new, clean filters.

### 3.8 DEMONSTRATION

- A. **Train** Owner's maintenance personnel to adjust, operate, and maintain air-handling units.

END OF SECTION 237313

## SECTION 238126 - SPLIT-SYSTEM AIR-CONDITIONERS

### 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 split-system air-conditioning **units** consisting of separate evaporator-fan and compressor-condenser components.

#### 1.3 PERFORMANCE REQUIREMENTS

- A. **Delegated Design:** Design ACCU supports to comply with **wind** performance requirements, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. **Wind-Restraint Performance** rated for basic Wind Speed: Rated for Brownsville, Texas.

#### 1.4 SUBMITTALS

- A. **Product Data:** Include rated capacities, operating characteristics, and furnished specialties and accessories. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.
- B. **Shop Drawings:** Include plans, elevations, sections, details, and attachments to other work.
  - 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.
- C. **Manufacturer Wind Loading Qualification Certification:** Submit certification that specified equipment will withstand wind forces identified in "Performance Requirements" Article, Division 7 and in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
  - 1. **Basis for Certification:** Indicate whether withstand certification is based on actual test of assembled components or on calculations.
  - 2. **Dimensioned Outline Drawings of Equipment Unit:** Identify center of wind force 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. **Field quality-control reports.**

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- E. Operation and Maintenance Data: For split-system air-conditioning units to include in emergency, operation, and maintenance manuals.
- F. Warranty: Sample of special warranty.
- G. Certified Compliance Statement and shop drawings from a licensed PE for IBC and TDI.
  - 1. Sealed shop drawings showing installation instructions and attachment of equipment to curb, and curb to structure. Include quantity and type of restraining brackets/clips, screws, spacing, etc.
  - 2. As a separate attachment provide sealed IBC and TDI compliant calculations for curbs and attachment.

### 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. ASHRAE Compliance:
  - 1. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Standard for Refrigeration Systems."
  - 2. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2004, Section 4 - "Outdoor Air Quality," Section 5 - "Systems and Equipment," Section 6 - "Procedures," and Section 7 - "Construction and System Start-Up."
- C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004.
- D. International Building Code and TDI Compliance: Licensed Professional Engineer shall certify that the listed items are designed for and will withstand wind speed for the location of the project, per the relevant edition of International Building Code, ASCE Std 7, Texas Department of Insurance requirements.
  - 1. Equipment curb/attachment for exterior and roof mounted equipment such as RTUs, ACCU, fans.
  - 2. Attachment of equipment to curb/pad.
  - 3. Attachment of curb/pad to building structure.

### 1.6 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork are specified in Division 03 Section "Cast-in-Place Concrete."

### 1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of split-system air-conditioning units that fail in materials or workmanship within specified warranty period. Warranty period to commence from the date of equipment start-up.

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1. Warranty Period:
  - a. For Compressor: **Five** year(s) from date of Substantial Completion.
  - b. For Parts and Labor: **One** year(s) from date of Substantial Completion.

### 1.8 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.
  1. Filters: **One** set for each air-handling unit.
  2. Fan Belts: **One** set for each air-handling unit fan.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Trane.
  2. Carrier Corporation; Home Comfort and HVAC Building & Industrial Systems.
  3. Daikin
  4. JCI/York
  5. Lennox International Inc.

### 2.2 INDOOR UNITS **5 TONS** OR LESS

- A. Vertical, Evaporator-Fan Components: An assembly including cabinet, filter, chassis, coil, drain pan, fan, and motor in blow-through configuration with direct-expansion cooling coil, and electric heating coil, where scheduled.
- B. Cabinet: Covers and access panels shall be manufactured of 20 gauge pre-painted, galvanized sheet metal. Cabinet walls shall have insulated panels, fabricated to allow removal for access to internal parts and components. Units shall be designed and equipped for installation indoors.
- C. Chassis: Unit structural members shall be manufactured of 16 gauge pre-painted, galvanized sheet metal. Removable panels for servicing, and insulation on back of panel.
  1. Insulation: Standard insulation or minimum 1", whichever is greater.
- D. Refrigerant Coil: Copper **or aluminum** tube, with mechanically bonded aluminum fins, complying with ARI 210/240, and with thermal-expansion valve.
- E. Reheat Coil: **If scheduled**, unit shall include a hot gas reheat coil with a modulating reheat control valve and an electronic controller. The valve position shall be controlled to provide a specific supply air temperature setpoint that is set on the control board or sent to the control board by a remote 0-10 Vdc signal.



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- F. Electric Coil: **If scheduled**, helical, nickel-chrome, resistance-wire heating elements with refractory ceramic support bushings; automatic-reset thermal cutout; built-in magnetic contactors; manual-reset thermal cutout; airflow proving device; and one-time fuses in terminal box for over-current protection.
- G. Fan Motors: Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."
  - 1. Special Motor Features: Multi-tapped, multi-speed with internal thermal protection and permanent lubrication.
  - 2. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."
  - 3. Enclosure Type: Totally enclosed, fan cooled, **or open drip proof**.
  - 4. NEMA Premium (TM) efficient motors as defined in NEMA MG 1.
  - 5. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 26 Sections.
  - 6. Mount unit-mounted disconnect switches on unit.
- H. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.
- I. Condensate Drain Pans:
  - 1. Fabricated with slope in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and humidifiers, and to direct water toward drain connection.
    - 1) Length: Extend drain pan downstream from leaving face to comply with ASHRAE 62.1-2004.
    - 2) Depth: A minimum of **1 inch** deep.
  - b. Stainless-steel sheet or non-corrosive plastic, insulated.
  - c. Drain Connection: Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on one end of pan.
- 2. Air Filtration Section:
  - a. General Requirements for Air Filtration Section:
    - 1) Comply with NFPA 90A.
    - 2) Minimum Arrestance: According to ASHRAE 52.1 and MERV according to ASHRAE 52.2.
    - 3) Filter-Holding Frames: Arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side or lifted out from access plenum.
  - b. Filters:
    - 1) Factory-fabricated, viscous-coated, flat-panel type.
    - 2) Thickness: **2 inches**.
    - 3) Merv according to ASHRAE 52.2: 8.

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- 4) Media: Interlaced glass fibers sprayed with nonflammable adhesive and antimicrobial agent.
- 5) Frame: Galvanized steel, with metal grid on outlet side, steel rod grid on inlet side, and hinged; with pull and retaining handles.

### 2.3 OUTDOOR UNITS (5 TONS OR LESS)

#### A. Air-Cooled, Compressor-Condenser Components:

1. Casing: Corrosion free pre-painted steel cabinet, finished with baked enamel, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.
2. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation device. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.
  - a. Compressor Type: Scroll, mounted on rubber mounts for vibration isolation.
  - b. Two-stage (where scheduled) compressor motor with manual-reset high-pressure switch and automatic-reset low-pressure switch.
  - c. Refrigerant Charge: **R-407C** or **R-410A**.
  - d. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and liquid subcooler. Comply with ARI 210/240.
  - e. Internal excessive current and temperature protection.
3. Fan: Aluminum-propeller type, directly connected to motor.
4. Motor: Permanently lubricated, with integral thermal-overload protection.

### 2.4 ACCESSORIES

#### A. Controls: Coordinate with BAS specifications.

1. Temperature controllers for split system AC unit must be BACnet compatible so that Building Automation System can read compressor status, fan status, fan command, discharge air temperature, temperature setpoint, and space temperature directly via BACnet from controller.
2. Lock out local controllers from local temperature setpoint adjustment; temperature setpoints are to be adjustable only via Building Automation System central operator station.

#### B. Other:

1. Direct driven ECM fan motor, and with built in dehumidification sequence, option for indoor units, where scheduled.
2. Low Ambient Controller: Cycles condenser fan to permit operation down to **35 deg F** with time-delay relay to bypass low-pressure switch.
3. Package with refrigerant circuit suction and discharge gauges, and service valves.
4. Automatic-reset timer to prevent rapid cycling of compressor.
5. Site glass, filter-dryer.
6. High-Pressure Switch: Automatic-reset switch cycles compressor off on high refrigerant pressure.
7. Low-Pressure Switch: Automatic-reset switch cycles compressor off on low refrigerant pressure.

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8. Thermostatic expansion valve to match with existing Evaporator Coil, if existing is incompatible.
  9. Time-Delay Relay: Continues operation of evaporator fan after compressor shuts off.
  10. Evaporator defrost controller.
  11. Liquid line solenoid valves, electric unloaders, factory/field installed accumulators to accomplish stages of unloading.
  12. See drawing schedules.
- C. Unit Casing: Galvanized steel, finished with paint finish capable of withstanding at least 1000 hours when tested in salt spray atmosphere (ASTM B 117- 95 test procedure); with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Mount service valves, fittings, and gage ports on exterior of casing.
1. Condenser coil louvered hail guard to protect coil from physical damage.
  2. Condenser coil coating: epoxy coat or Energy Guard
  3. **Wind Restraints: Metal brackets compatible with the curb and casing, painted to match RTU, used to anchor unit to the curb, and designed for loads at Project site.**

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install units level and plumb.
- B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.
- C. Install ground-mounted, compressor-condenser components on **4-inch-** thick, reinforced concrete base that is **4 inches** larger, on each side, than unit. Concrete, reinforcement, and formwork are specified in Division 03 Section "Cast-in-Place Concrete." Coordinate anchor installation with concrete base.
- D. Install and connect refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.
- E. Provide auxiliary drain pans with float switches to disable fans. Provide drain piping with stop valves from pans to floor drains.

### 3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where piping is installed adjacent to unit, allow space for service and maintenance of unit.
- C. Duct Connections: Duct installation requirements are specified in Division 15 Section "Metal Ducts." Drawings indicate the general arrangement of ducts. Connect supply and return ducts

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to split-system air-conditioning units with flexible duct connectors. Flexible duct connectors are specified in Division 15 Section "Duct Accessories."

- D. Ground equipment according to Division 16 Section "Grounding and Bonding."
- E. Electrical Connections: Comply with requirements in Division 16 Sections for power wiring, switches, and motor controls.

### 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. Tests and Inspections:
  - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
  - 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
  - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Remove and replace malfunctioning units and retest as specified above.
- D. Prepare test and inspection reports.

### 3.4 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
- B. Verify that air-conditioning units are installed and connected according to manufacturer's written instructions and the Contract Documents.
  - 1. Verify that shipping, blocking, and bracing are removed.
  - 2. 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.
  - 3. Verify proper motor rotation direction, free fan wheel rotation, and smooth bearing operations. Reconnect fan drive system, align belts, and install belt guards.
  - 4. Verify that bearings, pulleys, belts, and other moving parts are lubricated with factory-recommended lubricants.
  - 5. Verify that outdoor- and return-air mixing dampers open and close, and maintain minimum outdoor-air setting.
  - 6. Comb coil fins for parallel orientation.
  - 7. Verify that proper thermal-overload protection is installed for electric coils.
  - 8. Install new, clean filters.
  - 9. Verify that manual and automatic volume control and fire and smoke dampers in connected

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10. 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.
  11. Measure and record motor electrical values for voltage and amperage.
- C. Verify that electrical wiring installation complies with manufacturer's submittal and installation requirements in Division 26 Sections.
  - D. Complete installation and startup checks according to manufacturer's written instructions.
  - E. After startup service and performance test, change filters.
  - F. Manually operate dampers from fully closed to fully open position and record fan performance.

### 3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 238126

## SECTION 260010 - SUMMARY OF ELECTRICAL WORK

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1 Specification Sections and other Division 26 Specification Sections, apply to this Section.

#### 1.2 WORK COVERED BY CONTRACT DOCUMENTS

- A. The following Summary of Work is intended as an aid to achieve an understanding of the various elements of work included in the project, as is not intended to be all-inclusive. Detailed descriptions of work and requirements are given in drawings and specifications.

- B. Scope of Work:

1. General: The “[UTRGV/Edinburg C.I.S.D. Collegiate High School](#)” consists of new two-story building, approximate 60,000 s.f. This building will generally be operated from 7:00am to 10:00pm. (Monday through Friday) with occasional after hours and weekends use.
2. Electrical: Provide all materials and labor associated with complete operational electrical distribution system. Major items of work include, but are not limited to:
  - (a) Electrical service:
    - (i) Provide a new underground electrical service; it shall consist of underground electrical raceways and concrete pad for Utility furnished transformer.
    - (ii) Utility company shall provide medium voltage conductors and pad mounted transformer.
  - (b) Interior and Exterior Lighting systems: shall consist of LED type, see light fixture schedule and specifications.
  - (c) Lighting controls (switches, occupancy sensors, daylight sensors, etc.): provide as noted on plans specifications. In some cases, they will be ceiling mounted and others wall mounted. It’s the intent for them to be wired to automatically control the luminaires in their respective areas.
  - (d) Power systems: Provide miscellaneous duplex receptacles, isolated ground receptacles for computer terminals, duplex receptacles for flat screens connections, and power for food service, H.V.A.C. and plumbing equipment.
  - (e) Fire Alarm System:
    - (i) Provide an addressable control panel with voice evacuation, manual and automatic initiation devices. Monitoring and interfacing with elevator, fire sprinkle tamper and flow switches. Indicating devices shall also be provided to comply with TDLR.
    - (ii) Fully coordinate with the Elevator Contractor for the Fire Alarm interfacing.

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- (iii) Fully coordinate with the food service contractor for the kitchen hood fire suppression interfacing.
- (f) Voice and Data Communication Cabling Equipment: Provide rough-ins only. Cabling, connectors, patch panels, racks, etc. by owner.
- (g) Multimedia system: Provide rough ins for multimedia outlets and projectors. Connectors, cabling and outlets by owner.
- (h) School Intercom System: Provide speakers and call-in switches in classrooms and offices. Hallways and building exterior walls with speakers to transmit general announcements.
- (i) Cafetorium Integrated Audio Video Sound System: Provide speakers, microphones, interface owner provided projector, interface projector screens, multimedia outlet, microphone stands, data connectors, and wiring. See specifications.
- (j) Lecture Hall Integrated Audio Video Sound System: Provide speakers, microphones, interface owner provided projector, interface projector screens, multimedia outlet, microphone stands, data connectors, and wiring. See specifications.
- (k) Intrusion and Access control System:
  - (i) Campus Access: Provide power to vehicle and pedestrian gates, reception area entrance door electric strikes and intercom and camera at vehicle gates entrances.
  - (ii) Lobby Access: Provide card readers, release buttons, software programming and equipment including power to secured doors, power supplies and raceways for wiring. Electric strikes and electrified hardware provide by door hardware sub-contractor.
  - (iii) Building Intrusion Detection System: It shall consist of a control panel, keypads, glass break sensors, motion detectors and magnetic contacts as noted on drawings.
  - (iv) CCTV Cameras: Provide rough ins only. Cameras, connectors, cabling, etc. provided by owner.
- (l) Commissioning: Provide for the lighting equipment and lighting controls as required per IECC 2015.

### 1.3 ALLOWANCES

- A. Electrical: See Division 1 for electrical allowances.

### 1.4 COORDINATION

- B. All electrical work shall be done under sub-contract to a General Contractor, who ultimately responsible for the entire project. Electrical Contractor shall coordinate all work through General Contractor, even in areas where only electrical work is to take place.
- C. All questions, requests for information, submittals, and correspondence from the Electrical Contractor shall be submitted via the General Contractor, who will forward to the Architect, who will then forward to the Engineer.
- D. Electrical Contractor shall not make any changes to design without written authorization from the Engineer. If changes are requested by the Owner, Architect, General Contractor, Suppliers,

## SECTION 260010 - SUMMARY OF ELECTRICAL WORK

Manufacturers, or any others, Contractor should issue a written RFI for response by the Engineer.

- E. Electrical Contractor shall issue seven (7) days written notice prior to any activities that require the presence of the Engineer at the job-site. This applies to all inspections required by specifications, and particularly to those where work will be covered (underground raceways, electrical raceways above ceiling).
- F. Cooperate fully with other contractors so that work under those contracts may be carried out smoothly, without interfering with or delaying work under this Contract.
- G. Fully coordinate with Mechanical Contractor for providing power to HVAC systems and plumbing equipment.
- H. Fully coordinate with HVAC controls contractor for Lab controller interface with Lab Fans.
- I. Fully coordinate with the Plumbing and Millwork contractors for the science lab equipment installation.
- J. Fully coordinate with the Elevator Contractor for the elevator equipment installation.
- K. Fully coordinate with the Food Service Contractor for the equipment installation.
- L. Issue written notification of the following tasks and allow five (5) days for Engineer to respond and schedule an inspection as required:
  - 1. Upon completion of underground raceways installation and prior to covering up.
  - 2. Upon completion of installing all raceways, labeling all j-boxes and prior to suspended ceiling installation.
  - 3. Upon completion of pulling all wiring, making all terminations, labeling and color-coding wires at the panelboards/switchboards and prior to installing their covers.
  - 4. When ready to request manufacturer's start-up of each piece of equipment.
  - 5. When ready to conduct complete Fire Alarm, and Intrusion Detection demonstration.
  - 6. When ready for Substantial Completion Inspection.
  - 7. When ready for Final Inspection.
- M. Failure to issue written notification may result in work having to be redone to allow for proper inspection. It is this contractor's responsibility to make sure Engineer receives notification.

### 1.5 UTILITIES

- 1. Coordinate with power, water, telephone, cable and gas utilities to locate all utilities prior to digging in any area.
- 2. Obtain any approvals required from utilities to relocate utilities.
- 3. Cost of relocating or bypassing utilities indicated on drawings shall be included in Base Bid.
- 4. Coordinate with utility for electrical service. Base bid shall include all costs associated with service connection, including permit fees.

### 1.6 CONTRACTOR USE OF PREMISES

- A. Use of the Site: Limit use of the premises to work in areas indicated. Confine operations to areas within contract limits indicated. Do not disturb portions of the site beyond the areas in which the Work is indicated.
  - 1. Owner Occupancy: Allow for Owner occupancy and use by the public.



## SECTION 260010 - SUMMARY OF ELECTRICAL WORK

2. Driveways and Entrances: Keep driveways and entrances serving the premises, clear and available to the Owner, the Owner's employees, and emergency vehicles at all time. Do not use these areas for parking or storage of materials. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.
- B. Site Safety: Take every precaution to ensure the site does not present a threat to the safety of occupants and/or workers. Minimal safety requirements include, but are not limited to the following:
  1. Temporary fencing around construction areas.
  2. Yellow caution tape and construction barricades along open trenches during the day. Trenches shall be covered at night and warning lights provided on construction barricades.
  3. Temporary fencing around equipment while site work is in progress.
- C. Work shall take place with minimal disruption to Owner's operations in areas surrounding the job site.

### 1.7 SUBMITTALS -Special Requirements

- A. Manufacturer's standard dimensioned drawings, performance and product data shall be edited to delete reference to equipment, features, or information, which is not applicable to the equipment being supplied for this project. Including Bill or List of Materials.
- B. Faxes and copies of faxes are not acceptable.
- C. Electrical Submittals shall be submitted electronically. **Please organize the files as noted below** (PDF format - searchable). Files would need to be properly identified (cover letter, stamped, etc.) from the general contractor.

#### 1. Miscellaneous Electrical – Submittal #1

- a. 260519 Low-Voltage Electrical Power Conductors and Cables
- b. 260526 Grounding and Bonding for Electrical Systems
- c. 260529 Hangers and Supports for Electrical Systems
- d. 260533 Raceways and Boxes for Electrical Systems
- e. 260553 Identification for Electrical Systems
- f. 260544 Sleeves and Sleeve Seals for Electrical Raceways and Cabling
- g. 262726 Wiring Devices
- h. 260850 Hand Dryer

#### 2. Electrical Gear Submittal #2

- a. 262200 Low Voltage Transformers
- b. 262416 Panelboards
- c. 262813 Fuses
- d. 262816 Enclosed Switches and Circuit Breakers
- e. 262913 Enclosed Controllers
- f. 264313 Surge Protection for Low-Voltage Electrical Power Circuit
- g. 266659 Laboratory Safety Device System

#### 3. Electrical Studies Submittal #3

- a. 260572 Overcurrent Protective Device Short-Circuit Study
- b. 260574 Arch Flash Study

## SECTION 260010 - SUMMARY OF ELECTRICAL WORK

4. Light Fixtures **Submittal #4**
    - a. 265116 Interior Lighting
    - b. 265219 Emergency and Exit Lighting
    - c. 265613 Lighting Poles and Standards
    - d. 265621 Exterior Lighting
    - e. 260924 Lighting Controls
  5. Special Systems: **Submittal #5**
    - a. 267210 Fire Alarm System
    - b. 267230 School Intercom
    - c. 267260 Cafetorium Integrated Sound System
    - d. 267240 Intrusion and Access Control System
  6. Electrical Commissioning **Submittal #6**
    - a. 260800 Commissioning for Electrical Systems
- E. Individual submittals shall not be reviewed until a complete package is received.
- F. Allow two weeks for initial submittal review by Engineer, from the day it is received at the Engineer's office.
- G. Allow one week for review of resubmittals by Engineer.
- H. All submittal review comments shall be forwarded by Engineer to Architect, who will then distribute as per Division 1.
- 1.8 SCHEDULE OF VALUES -Special Requirements
- A. Electrical Contractor shall submit a Schedule of Values reflecting the total value of Electrical Work in the Contract and broken down into the following items as a minimum, with a line item for Materials/Equipment and another for Labor.

### ELECTRICAL

1. Electrical gear.
2. Electrical coordination and arch flash study.
3. Interior raceways including wiring.
4. Interior Light fixtures
5. Exterior light fixtures
6. Wiring devices.
7. Fire alarm system
8. School intercom
9. Cafetorium Integrated Audio and Video System.
10. Intrusion and Access Control System
11. Commissioning
12. Allowances.
13. Miscellaneous.
14. Administrative and project management.

### 1.9 CODE COMPLIANCE:

The design for this project is based on:

1. Occupational Safety and Health Act (OSHA)
2. National Electric Code (NEC)

SECTION 260010 - SUMMARY OF ELECTRICAL WORK

3. National Fire Code
4. International Building Code
5. UL 916
6. Local ordinances

END OF SECTION 260010

## SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

### 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. Building wires and cables rated 600 V and less.
  - 2. Connectors, splices, and terminations rated 600 V and less.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Field quality-control reports.

#### 1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member Company of NETA or an NRTL.

### PART 2 - PRODUCTS

#### 2.1 CONDUCTORS AND CABLES

- A. Manufacturer:
  - 1. Senator Wire & Cable Company.
  - 2. Southwire Company.
  - 3. Encore Wire
- B. Copper Conductors: Comply with NEMA WC 70/ICEA S-95-658.
- C. Conductor Insulation: Comply with NEMA WC 70/ICEA S-95-658 for Type THHN/THWN-2, Type XHHW-2 and Type SO.

## SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

- D. Multiconductor Cable: Comply with UL 1569 and NEMA WC 70/ICEA S-95-658 for metal-clad cable, Type MC and Type SO with ground wire.

### 2.2 CONNECTORS AND SPLICES

- A. Manufacturers:
  - 1. AFC Cable Systems, Inc.
  - 2. AMP Incorporated/Tyco International.
  - 3. Hubbell/Anderson.
  - 4. O-Z/Gedney; EGS Electrical Group LLC.
  - 5. 3M Company; Electrical Products Division.
- B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

### 2.3 SYSTEM DESCRIPTION

- 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. Comply with NFPA 70.

## PART 3 - EXECUTION

### 3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger, except VFC cable, which shall be extra flexible stranded.

### 3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Exposed Feeders: Type THHN/THWN-2, single conductors in raceway.
- B. Feeders Concealed in Ceilings, Walls and Partitions: Type THHN/THWN-2, single conductors in raceway.
- C. Feeders Concealed in Concrete, below Slabs-on-Grade, and underground: Type THHN/THWN-2, single conductors in raceway.
- D. Exposed Branch Circuits: Type THHN/THWN-2, single conductors in raceway.
- E. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN-2, single conductors in raceway.

## SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

- F. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and underground: Type THHN/THWN-2, single conductors in raceway.

### 3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.
- B. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.
- C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, which will not damage cables or raceway.
- E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- F. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."

### 3.4 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
  - 1. Use oxide inhibitor in each splice, termination, and tap for aluminum conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

### 3.5 IDENTIFICATION

- A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."
- B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

## SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

### 3.6 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

### 3.7 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Section 078413 "Penetration Firestopping."

### 3.8 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
  - 1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.
  - 2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
  - 3. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each splice in conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner. Correct deficiencies determined during the scan.
    - a. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each splice 11 months after date of Substantial Completion.
    - b. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
    - c. Record of Infrared Scanning: Prepare a certified report that identifies splices checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
- B. Test and Inspection Reports: Prepare a written report to record the following:
  - 1. Procedures used.
  - 2. Results that comply with requirements.
  - 3. Results that do not comply with requirements and corrective action taken to achieve compliance with requirements.
- C. Cables will be considered defective if they do not pass tests and inspections.

END OF SECTION 260519

## SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section includes grounding and bonding systems and equipment.
- B. Section includes grounding and bonding systems and equipment, plus the following special applications:
  - 1. Underground distribution grounding.
  - 2. Ground bonding common with lightning protection system.
  - 3. Foundation steel electrodes.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. As-Built Data: Plans showing dimensioned as-built locations of grounding features specified in "Field Quality Control" Article, including the following:
  - 1. Ground rods.
  - 2. Ground rings.
  - 3. Grounding arrangements and connections for separately derived systems.
- B. Field quality-control reports.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals.
  - 1. In addition to items specified in Section "Operation and Maintenance Data," include the following:
    - a. Instructions for periodic testing and inspection of grounding features at ground rings and grounding connections for separately derived systems based on and NFPA 70B.



## SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

### 1.6 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. Comply with UL 467 for grounding and bonding materials and equipment.

## PART 2 - PRODUCTS

### 2.1 CONDUCTORS

- A. Insulated Conductors: tinned-copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
  - 1. Solid Conductors: ASTM B 3.
  - 2. Stranded Conductors: ASTM B 8.
  - 3. Tinned Conductors: ASTM B 33.
  - 4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
  - 5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
  - 6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
  - 7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
- C. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inches in cross section, with 9/32-inch holes spaced 1-1/8 inches apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V and shall be Lexan or PVC, impulse tested at 5000 V.

### 2.2 CONNECTORS

- A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.
- B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy.
- C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.
- D. Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless **exothermic**-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

### 2.3 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad; 3/4 inch by 10 feet.

## SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

### PART 3 - EXECUTION

#### 3.1 APPLICATIONS

- A. Conductors: Install solid conductor for No. 10 AWG and smaller, and stranded conductors for No. 8 AWG and larger unless otherwise indicated.
- B. Underground Grounding Conductors: Install bare tinned copper conductor, No. 2/0 AWG minimum.
  - 1. Bury at least 24 inches below grade.
  - 2. Duct-Bank Grounding Conductor: Bury 12 inches above duct bank when indicated as part of duct-bank installation.
- C. Isolated Grounding Conductors: Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.
- D. Grounding Bus: Install in electrical equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
  - 1. Install bus horizontally, on insulated spacers 2 inches minimum from wall, 6 inches above finished floor unless otherwise indicated.
  - 2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.
- E. Conductor Terminations and Connections:
  - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
  - 2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
  - 3. Connections to Ground Rods at Test Wells: Bolted connectors.
  - 4. Connections to Structural Steel: Welded connectors.

#### 3.2 GROUNDING AT THE SERVICE

- A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses.

#### 3.3 GROUNDING SEPARATELY DERIVED SYSTEMS

- A. Generator: Install grounding electrode(s) at the generator location. The electrode shall be connected to the equipment grounding conductor and to the frame of the generator.

#### 3.4 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

- A. Comply with IEEE C2 grounding requirements.

## SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

- B. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches above to 6 inches below concrete. Seal floor opening with waterproof, nonshrink grout.
- C. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields according to written instructions by manufacturer of splicing and termination kits.
- D. Pad-Mounted Transformers and Switches: Install two ground rods and ground ring around the pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Install tinned-copper conductor not less than No. 2 AWG for ground ring and for taps to equipment grounding terminals. Bury ground ring not less than 6 inches from the foundation.

### 3.5 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
  - 1. Feeders and branch circuits.
  - 2. Lighting circuits.
  - 3. Receptacle circuits.
  - 4. Single-phase motor and appliance branch circuits.
  - 5. Three-phase motor and appliance branch circuits.
  - 6. Flexible raceway runs.
  - 7. Metal-clad cable runs.
  - 8. Busway Supply Circuits: Install insulated equipment grounding conductor from grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.
  - 9. X-Ray Equipment Circuits: Install insulated equipment grounding conductor in circuits supplying x-ray equipment.
- C. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.
- D. Water Heater and Heat-Tracing Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.

## SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

- E. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.
- F. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.
- G. Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.
- H. Metallic Fences: Comply with requirements of IEEE C2.
  - 1. Grounding Conductor: Bare, tinned copper, not less than No. 3 AWG.
  - 2. Gates: Shall be bonded to the grounding conductor with a flexible bonding jumper.
  - 3. Barbed Wire: Strands shall be bonded to the grounding conductor.

### 3.6 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Ground Bonding Common with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.
- C. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade unless otherwise indicated.
  - 1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
  - 2. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.
- D. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
  - 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.

## SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.

### E. Grounding and Bonding for Piping:

1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

### F. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install **tinned** bonding jumper to bond across flexible duct connections to achieve continuity.

### G. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet apart.

### H. Ground Ring: Install a grounding conductor, electrically connected to each building structure ground rod and to each indicated item, extending around the perimeter of building.

1. Install tinned-copper conductor not less than No. 2/0 AWG for ground ring and for taps to building steel.
2. Bury ground ring not less than 24 inches from building's foundation.

## 3.7 FIELD QUALITY CONTROL

### A. Tests and Inspections:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, at individual ground rods. Make tests at ground rods before any conductors are connected.
  - a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.

## SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

- b. Perform tests by fall-of-potential method according to IEEE 81.
  4. Prepare dimensioned Drawings locating each, ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
- B. Grounding system will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.
- D. Report measured ground resistances that exceed the following values:
1. Power and Lighting Equipment or System with Capacity of 500 kVA and less: 10 ohms.
  2. Power and Lighting Equipment or System with Capacity of 500 to 1000 kVA: 5 ohms.
  3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
  4. Power Distribution Units or Panelboards Serving Electronic Equipment: 3 ohm(s).
  5. Manhole Grounds: 10 ohms.
- E. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION 260526

## SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Hangers and supports for electrical equipment and systems.
  - 2. Construction requirements for concrete bases.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:
    - a. Hangers.
    - b. Steel slotted support systems.
    - c. Nonmetallic support systems.
    - d. Trapeze hangers.
    - e. Clamps.
    - f. Turnbuckles.
    - g. Sockets.
    - h. Eye nuts.
    - i. Saddles.
    - j. Brackets.
  - 2. Include rated capacities and furnished specialties and accessories.
- B. Shop Drawings: For fabrication and installation details for electrical hangers and support systems.
  - 1. Trapeze hangers. Include product data for components.
  - 2. Steel slotted-channel systems.
  - 3. Nonmetallic slotted-channel systems.
  - 4. Equipment supports.

## SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

### 1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  - 1. Suspended ceiling components.
  - 2. Structural members to which hangers and supports will be attached.
  - 3. Size and location of initial access modules for acoustical tile.
  - 4. Items penetrating finished ceiling, including the following:
    - a. Lighting fixtures.
    - b. Air outlets and inlets.
    - c. Speakers.
    - d. Sprinklers.
    - e. Access panels.
    - f. Projectors.
- B. Welding certificates.

### 1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
  - 1. AWS D1.1/D1.1M.
  - 2. AWS D1.2/D1.2M.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Flame Rating: Class 1.
  - 2. Self-extinguishing according to ASTM D 635.

### 2.2 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Comply with MFMA-4 factory-fabricated components for field assembly.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Allied Tube & Conduit.
    - b. Cooper B-Line, Inc.; a division of Cooper Industries.
    - c. ERICO International Corporation.
    - d. GS Metals Corp.



## SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

- e. Thomas & Betts Corporation.
  - f. Unistrut; Tyco International, Ltd.
  - g. Wesanco, Inc.
2. Material: Plain steel.
  3. Channel Width: 1-1/4 inches.
  4. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
  5. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
  6. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
  7. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
  8. Channel Dimensions: Selected for applicable load criteria.
- B. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- C. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be made of malleable iron.
- D. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M steel plates, shapes, and bars; black and galvanized.
- E. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
    - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - 1) Hilti Inc.
      - 2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
      - 3) MKT Fastening, LLC.
      - 4) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.
  2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
    - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - 1) Cooper B-Line, Inc.; a division of Cooper Industries.
      - 2) Empire Tool and Manufacturing Co., Inc.
      - 3) Hilti Inc.
      - 4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
      - 5) MKT Fastening, LLC

## SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

3. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.
  - a. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
  - b. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
  - c. Toggle Bolts: All-steel springhead type.
  - d. Hanger Rods: Threaded steel.
  - e. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
  - f. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
  - g. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
  - h. Toggle Bolts: All-steel springhead type.
  - i. Hanger Rods: Threaded steel

### 2.3 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
- B. Materials: Comply with requirements in Section 055000 "Metal Fabrications" for steel shapes and plates.

## PART 3 - EXECUTION

### 3.1 APPLICATION

- A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems unless requirements in this Section are stricter.
- B. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."
- C. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMTs and RMCs as scheduled in NECA 1, where its Table 1 lists maximum spacings that are less than those stated in] NFPA 70. Minimum rod size shall be 1/4 inch in diameter.
- D. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
  1. Secure raceways and cables to these supports with two-bolt conduit clamps.
- E. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

## SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

### 3.2 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this article.
- B. Raceway Support Methods: In addition to methods described in NECA 1, EMTs, and RMCs may be supported by openings through structure members, according to NFPA 70.
- C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.
- D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
  - 1. To Wood: Fasten with lag screws or through bolts.
  - 2. To New Concrete: Bolt to concrete inserts.
  - 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
  - 4. To Existing Concrete: Expansion anchor fasteners.
  - 5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
  - 6. To Steel: Spring-tension clamps.
  - 7. To Light Steel: Sheet metal screws.
  - 8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.
- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

### 3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Comply with installation requirements in Architectural Section "Metal Fabrications" for site-fabricated metal supports.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- C. Field Welding: Comply with AWS D1.1/D1.1M.

## SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

### 3.4 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.
- B. Use 3000-psi, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Sections "Cast-in-Place Concrete" or "Miscellaneous Cast-in-Place Concrete."
- C. Anchor equipment to concrete base as follows:
  - 1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 2. Install anchor bolts to elevations required for proper attachment to supported equipment.
  - 3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

### 3.5 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
  - 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
- B. Touchup: Comply with requirements in Sections "Exterior Painting", "Interior Painting" and "High-Performance Coatings" for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 260529

## SECTION 260533 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Metal conduits, tubing, and fittings.
  - 2. Nonmetal conduits, tubing, and fittings.
  - 3. Metal wireways and auxiliary gutters.
  - 4. Nonmetal wireways and auxiliary gutters.
  - 5. Surface raceways.
  - 6. Boxes, enclosures, and cabinets.
  - 7. Handholes and boxes for exterior underground cabling.

#### 1.3 DEFINITIONS

- A. GRC: Galvanized rigid steel conduit.
- B. IMC: Intermediate metal conduit.
- C. EMT: Electrical metallic tubing.
- D. ENT: Electrical nonmetallic tubing.
- E. EPDM: Ethylene-propylene-diene terpolymer rubber.
- F. FMC: Flexible metal conduit.
- G. LFMC: Liquidtight flexible metal conduit.
- H. LFNC: Liquidtight flexible nonmetallic conduit.
- I. NBR: Acrylonitrile-butadiene rubber.
- J. RNC: Rigid nonmetallic conduit.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

## SECTION 260533 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

- B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

### 1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:
  - 1. Structural members in paths of conduit groups with common supports.
  - 2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.
- B. Source quality-control reports.

## PART 2 - PRODUCTS

### 2.1 METAL CONDUITS, TUBING, AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. AFC Cable Systems, Inc.
  - 2. Alflex Inc.
  - 3. Allied Tube & Conduit; a Tyco International Ltd. Co.
  - 4. Anamet Electrical, Inc.; Anaconda Metal Hose.
  - 5. Electri-Flex Co.
  - 6. Manhattan/CDT/Cole-Flex.
  - 7. Maverick Tube Corporation.
  - 8. O-Z Gedney; a unit of General Signal.
  - 9. Wheatland Tube Company.
  - 10. Hylsa
- B. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. GRC: Comply with ANSI C80.1 and UL 6.
- D. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.
  - 1. Comply with NEMA RN 1.
  - 2. Coating Thickness: 0.040 inch, minimum.
- E. EMT: Comply with ANSI C80.3 and UL 797.
- F. FMC: Comply with UL 1; zinc-coated steel.
- G. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.
- H. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.

## SECTION 260533 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886 and NFPA 70.
  2. Fittings for EMT:
    - a. Material: die cast.
    - b. Type: set-screw.
  3. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
  4. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch, with overlapping sleeves protecting threaded joints.
- I. Joint Compound for GRC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

### 2.2 NONMETALLIC CONDUITS, TUBING, AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. AFC Cable Systems, Inc.
  2. Anamet Electrical, Inc.; Anaconda Metal Hose.
  3. Arco Corporation.
  4. CANTEX Inc.
  5. CertainTeed Corp.; Pipe & Plastics Group.
  6. Condux International, Inc.
  7. ElecSYS, Inc.
  8. Electri-Flex Co.
  9. Lamson & Sessions; Carlon Electrical Products.
  10. Manhattan/CDT/Cole-Flex.
  11. RACO; a Hubbell Company.
  12. Thomas & Betts Corporation.
- B. Listing and Labeling: Nonmetallic conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. RNC: Type EPC-40-PVC complying with NEMA TC 2 and UL 651 unless otherwise indicated.
- D. LFNC: Comply with UL 1660.
- E. RTRC: Comply with UL 1684A and NEMA TC 14.
- F. Fittings for and RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.
- G. Fittings for LFNC: Comply with UL 514B.

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### 2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Cooper B-Line, Inc.
  - 2. Hoffman.
  - 3. Square D; Schneider Electric.
- B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1 or Type 3R unless otherwise indicated, and sized according to NFPA 70.
  - 1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- D. Wireway Covers: Hinged type unless otherwise indicated.
- E. Finish: Manufacturer's standard enamel finish.

### 2.4 NONMETALLIC WIREWAYS AND AUXILIARY GUTTERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Hoffman.
  - 2. Lamson & Sessions; Carlon Electrical Products.
- B. Listing and Labeling: Nonmetallic wireways and auxiliary gutters shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Description: Fiberglass polyester, extruded and fabricated to required size and shape, without holes or knockouts. Cover shall be gasketed with oil-resistant gasket material and fastened with captive screws treated for corrosion resistance. Connections shall be flanged and have stainless-steel screws and oil-resistant gaskets.
- D. Fittings and Accessories: Couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings shall match and mate with wireways as required for complete system.

### 2.5 SURFACE RACEWAYS

- A. Listing and Labeling: Surface raceways and tele-power poles shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.



## SECTION 260533 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

- B. Surface Metal Raceways: Galvanized steel with snap-on covers complying with UL 5. Manufacturer's standard enamel finish in color selected by Architect.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Thomas & Betts Corporation.
    - b. Walker Systems, Inc.; Wiremold Company (The).
    - c. Wiremold Company (The); Electrical Sales Division.
    - d. Panduit.
- C. Tele-Power Poles:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Wiremold Company (The); Electrical Sales Division.
    - b. Panduit
  - 2. Material: Aluminum with clear anodized finish.
  - 3. Fittings and Accessories: Dividers, end caps, covers, cutouts, wiring harnesses, devices, mounting materials, and other fittings shall match and mate with tele-power pole as required for complete system.

### 2.6 BOXES, ENCLOSURES, AND CABINETS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
  - 2. EGS/Appleton Electric.
  - 3. Erickson Electrical Equipment Company.
  - 4. Hoffman.
  - 5. Hubbell Incorporated; Killark Electric Manufacturing Co. Division.
  - 6. O-Z/Gedney; a unit of General Signal.
  - 7. RACO; a Hubbell Company.
  - 8. Robroy Industries, Inc.; Enclosure Division.
  - 9. Spring City Electrical Manufacturing Company.
  - 10. Thomas & Betts Corporation.
  - 11. Walker Systems, Inc.; Wiremold Company (The).
- B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.
- C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, aluminum, Type FD, with gasketed cover.
- E. Metal Floor Boxes:
  - 1. Material: sheet metal.

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2. Type: Fully adjustable.
  3. Shape: Rectangular.
  4. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- F. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb. Outlet boxes designed for attachment of luminaires weighing more than 50 lb shall be listed and marked for the maximum allowable weight.
- G. Paddle Fan Outlet Boxes: Nonadjustable, designed for attachment of paddle fan weighing 70 lb.
1. Listing and Labeling: Paddle fan outlet boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- H. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- I. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.
- J. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
- K. Device Box Dimensions: 4 inches by 2-1/8 inches by 2-1/8 inches deep.
- L. Gangable boxes are allowed as long as permitted by the NEC.
- M. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 for indoor applications and Type 3R (stainless steel) outdoor with continuous-hinge cover with flush latch unless otherwise indicated.
1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
  2. Nonmetallic Enclosures: Fiberglass.
  3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.
- N. Cabinets:
1. NEMA 250, Type 1, Type 3R galvanized-steel or 4XSS box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
  2. Hinged door in front cover with flush latch and concealed hinge.
  3. Key latch to match panelboards.
  4. Metal barriers to separate wiring of different systems and voltage.
  5. Accessory feet where required for freestanding equipment.
  6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

### 2.7 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

- A. General Requirements for Handholes and Boxes:

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1. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.
  2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel, fiberglass, or a combination of the two.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  2. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
    - a. Armorcast Products Company.
    - b. Carson Industries LLC.
    - c. CDR Systems Corporation.
    - d. NewBasis.
  3. Standard: Comply with SCTE 77.
  4. Configuration: Designed for flush burial with open bottom unless otherwise indicated.
  5. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
  6. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
  7. Cover Legend: Molded lettering, "ELECTRIC".
  8. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
  9. Handholes 18 Inches Wide by 24 Inches Long and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

### 2.8 SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES

- A. Handhole and Pull-Box Prototype Test: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.
1. Tests of materials shall be performed by an independent testing agency.
  2. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
  3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012 and traceable to NIST standards.

## PART 3 - EXECUTION

### 3.1 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below unless otherwise indicated:
1. Exposed Conduit: GRC.
  2. Concealed Conduit, Aboveground: GRC.

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3. Underground Conduit: RNC, Type EPC-40-PVC.
  4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
  5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R or Type 4SS as noted on plans.
- B. Indoors: Apply raceway products as specified below unless otherwise indicated:
1. Exposed, Not Subject to Physical Damage: EMT.
  2. Exposed and Subject to Severe Physical Damage: GRC. Raceway locations include the following:
    - a. Loading dock.
    - b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
    - c. Mechanical rooms.
    - d. Gymnasiums.
  3. Concealed in Ceilings and Interior Walls and Partitions: EMT
  4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
  5. Damp or Wet Locations: GRC.
  6. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel in institutional and commercial kitchens and damp or wet locations.
- C. Minimum Raceway Size: 1/2-inch trade size.
- D. Raceway Fittings: Compatible with raceways and suitable for use and location.
1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
  2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
  3. EMT: Use setscrew steel fittings. Comply with NEMA FB 2.10.
  4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.
- E. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.
- F. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.
- G. Install surface raceways only where indicated on Drawings.
- H. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F.

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### 3.2 INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
- B. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- C. Complete raceway installation before starting conductor installation.
- D. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.
- E. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- F. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.
- G. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- H. Support conduit within 12 inches of enclosures to which attached.
- I. Raceways Embedded in Slabs:
  - 1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum 10-foot intervals.
  - 2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
  - 3. Arrange raceways to keep a minimum of 2 inches of concrete cover in all directions.
  - 4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
  - 5. Change from RNC, Type EPC-40-PVC TO EMT or GRC before rising above floor.
- J. Stub-ups to Above Recessed Ceilings:
  - 1. Use EMT for raceways.
  - 2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
- K. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- L. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.

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- M. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.
- N. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
- O. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.
- P. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.
- Q. Cut conduit perpendicular to the length. For conduits 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.
- R. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.
- S. Surface Raceways:
  - 1. Install surface raceway with a minimum 2-inch radius control at bend points.
  - 2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.
- T. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.
- U. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:
  - 1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
  - 2. Where an underground service raceway enters a building or structure.
  - 3. Where otherwise required by NFPA 70.
- V. Comply with manufacturer's written instructions for solvent welding RNC and fittings.
- W. Expansion-Joint Fittings:
  - 1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F and that has straight-run length that exceeds 25 feet. Install in each run of aboveground RMC conduit that is located where environmental

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- temperature change may exceed 100 deg F and that has straight-run length that exceeds 100 feet.
2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
    - a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
    - b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
    - c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
    - d. Attics: 135 deg F.
    - e. .
  3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F of temperature change for metal conduits.
  4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
  5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.
- X. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches of flexible conduit for recessed and semirecessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
1. Use LFMC in damp or wet locations subject to severe physical damage.
  2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.
- Y. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.
- Z. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.
- AA. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
- BB. Locate boxes so that cover or plate will not span different building finishes.
- CC. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.
- DD. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
- EE. Set metal floor boxes level and flush with finished floor surface.
- FF. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

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### 3.3 INSTALLATION OF UNDERGROUND CONDUIT

#### A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Division 3 for pipe less than 6 inches in nominal diameter.
2. Install backfill as specified in Division 3."
3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Division 3."
4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through floor unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.
  - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete for a minimum of 12 inches on each side of the coupling.
  - b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.
6. Warning Planks: Bury warning planks approximately 12 inches above direct-buried conduits but a minimum of 6 inches below grade. Align planks along centerline of conduit.
7. Underground Warning Tape: Comply with requirements in Section 260553 "Identification for Electrical Systems."

### 3.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.
- B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.
- C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch above finished grade.
- D. Install handholes with bottom below frost line, below grade.
- E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables but short enough to preserve adequate working clearances in enclosure.



## SECTION 260533 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

- F. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

### 3.5 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

### 3.6 FIRESTOPPING

- A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

### 3.7 PROTECTION

- A. Protect coatings, finishes, and cabinets from damage and deterioration.
  - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
  - 2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 260533

## SECTION 260536 - CABLE TRAYS FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Ladder cable trays.
  - 2. Through cable trays.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include data indicating dimensions and finishes for each type of cable tray indicated.
- B. Shop Drawings: For each type of cable tray.
  - 1. Show fabrication and installation details of cable trays, including plans, elevations, and sections of components and attachments to other construction elements. Designate components and accessories, including clamps, brackets, hanger rods, splice-plate connectors, expansion-joint assemblies, straight lengths, and fittings.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Floor plans and sections, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  - 1. Include scaled cable tray layout and relationships between components and adjacent structural, electrical, and mechanical elements.
  - 2. Vertical and horizontal offsets and transitions.
  - 3. Clearances for access above and to side of cable trays.
  - 4. Vertical elevation of cable trays above the floor or below bottom of ceiling structure.
- B. Field quality-control reports.

## SECTION 260536 - CABLE TRAYS FOR ELECTRICAL SYSTEMS

### PART 2 - PRODUCTS

#### 2.1 GENERAL REQUIREMENTS FOR CABLE TRAYS

- A. Cable Trays and Accessories: Identified as defined in NFPA 70 and marked for intended location, application, and grounding.
  - 1. Source Limitations: Obtain cable trays and components from single manufacturer.
- B. Sizes and Configurations: See the Cable Tray Schedule on Drawings for specific requirements for types, materials, sizes, and configurations.
- C. Structural Performance: See articles on individual cable tray types for specific values for the following parameters:
  - 1. Uniform Load Distribution: Capable of supporting a uniformly distributed load on the indicated support span when supported as a simple span and tested according to NEMA VE 1.
  - 2. Concentrated Load: A load applied at midpoint of span and centerline of tray.
  - 3. Load and Safety Factors: Applicable to both side rails and rung capacities.

#### 2.2 LADDER AND THROUGH CABLE TRAYS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Cablofil, Inc.
  - 2. Chalfant Manufacturing Company.
  - 3. Cooper B-Line, Inc.
  - 4. Cope, T. J., Inc.; a subsidiary of Allied Tube & Conduit.
  - 5. GS Metals Corp.; GLOBETRAYS Products.
  - 6. MPHusky.
  - 7. PW Industries.
- B. Ladder Tray Description:
  - 1. Configuration: Two I-beam side rails with transverse rungs welded to side rails.
  - 2. Rung Spacing: 12 inches o.c.
  - 3. Radius-Fitting Rung Spacing: 9 inches at center of tray's width.
  - 4. Minimum Cable-Bearing Surface for Rungs: 7/8-inch width with radius edges.
  - 5. No portion of the rungs shall protrude below the bottom plane of side rails.
  - 6. Structural Performance of Each Rung: Capable of supporting a maximum cable load, with a safety factor of 1.5, plus a 200-lb concentrated load, when tested according to NEMA VE 1.
  - 7. Minimum Usable Load Depth: 4 inches.
  - 8. Straight Section Lengths: 12 feet except where shorter lengths are required to facilitate tray assembly.
  - 9. Width: 12 inches unless otherwise indicated on Drawings.
  - 10. Fitting Minimum Radius: 24 inches.

## SECTION 260536 - CABLE TRAYS FOR ELECTRICAL SYSTEMS

11. Class Designation: Comply with NEMA VE 1, Class 12B.
12. Splicing Assemblies: Bolted type using serrated flange locknuts.
13. Hardware and Fasteners: Steel, zinc plated according to ASTM B 633.
14. Splice Plate Capacity: Splices located within support span shall not diminish rated loading capacity of cable tray.

### C. Through Tray Description:

1. Configuration: Two longitudinal members (side rails) with a solid sheet over rungs exposed on the interior of the trough, or corrugated sheet with both edges welded to the side rails.
2. Rung Spacing: Rungs or corrugations shall be spaced a maximum of 6 inches o.c. and have a minimum flat bearing surface of 2 inches.
3. Radius-Fitting Rung Spacing: 9 inches at center of tray's width.
4. Structural Performance: Capable of supporting a maximum cable load, with a safety factor of 1.5, plus a 200-lb concentrated load, when tested according to NEMA VE 1.
5. Minimum Usable Load Depth: 4 inches.
6. Straight Section Lengths: 12 feet except where shorter lengths are required to facilitate tray assembly.
7. Width: 12 inches unless otherwise indicated on Drawings.
8. Fitting Minimum Radius: 24 inches.
9. Class Designation: Comply with NEMA VE 1, Class 12B.
10. Splicing Assemblies: Bolted type using serrated flange locknuts.
11. Splicing Assembly Capacity: Splices located within support span shall not diminish rated loading capacity of cable tray.
12. Hardware and Fasteners: Steel, zinc plated according to ASTM B 633.

## 2.3 MATERIALS AND FINISHES

### A. Steel:

1. Straight Section and Fitting Side Rails and Rungs: Steel complies with the minimum mechanical properties of ASTM A 1008/A 1008M, Grade 33, Type 2.
2. Steel Tray Splice Plates: ASTM A 1011/A 1011M, HSLAS, Grade 50, Class 1.
3. Fasteners: Steel complies with the minimum mechanical properties of ASTM A 510/A 510M, Grade 1008.
4. Finish: Mill galvanized before fabrication.
  - a. Standard: Comply with ASTM A 653/A 653M, G90 (Z275).
  - b. Hardware: Galvanized, ASTM B 633

## 2.4 CABLE TRAY ACCESSORIES

- A. Fittings: Tees, crosses, risers, elbows, and other fittings as indicated, of same materials and finishes as cable tray.
- B. Barrier Strips: Same materials and finishes as for cable tray.

## SECTION 260536 - CABLE TRAYS FOR ELECTRICAL SYSTEMS

- C. Cable tray supports and connectors, including bonding jumpers, as recommended by cable tray manufacturer.

### 2.5 WARNING SIGNS

- A. Lettering: 1-1/2-inch high, black letters on yellow background with legend "Warning! Not To Be Used as Walkway, Ladder, or Support for Ladders or Personnel."
- B. Comply with requirements for fasteners in Section 260553 "Identification for Electrical Systems."

### 2.6 SOURCE QUALITY CONTROL

- A. Testing: Test and inspect cable trays according to NEMA VE 1.

## PART 3 - EXECUTION

### 3.1 CABLE TRAY INSTALLATION

- A. Install cable trays according to NEMA VE 2.
- B. Install cable trays as a complete system, including fasteners, hold-down clips, support systems, barrier strips, adjustable horizontal and vertical splice plates, elbows, reducers, tees, crosses, cable dropouts, adapters, covers, and bonding.
- C. Install cable trays so that the tray is accessible for cable installation and all splices are accessible for inspection and adjustment.
- D. Remove burrs and sharp edges from cable trays.
- E. Fasten cable tray supports to building structure.
- F. Design fasteners and supports to carry cable tray, the cables, and a concentrated load of 200 lb. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems."
- G. Place supports so that spans do not exceed maximum spans on schedules and provide clearances shown on Drawings. Install intermediate supports when cable weight exceeds the load-carrying capacity of the tray rungs.
- H. Construct supports from channel members, threaded rods, and other appurtenances furnished by cable tray manufacturer. Arrange supports in trapeze or wall-bracket form as required by application.
- I. Support bus assembly to prevent twisting from eccentric loading.
- J. Locate and install supports according to NEMA VE 2. Do not install more than one cable tray splice between supports.

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- K. Make connections to equipment with flanged fittings fastened to cable trays and to equipment. Support cable trays independent of fittings. Do not carry weight of cable trays on equipment enclosure.
- L. Install expansion connectors where cable trays cross building expansion joints and in cable tray runs that exceed dimensions recommended in NEMA VE 2. Space connectors and set gaps according to applicable standard.
- M. Make changes in direction and elevation using manufacturer's recommended fittings.
- N. Make cable tray connections using manufacturer's recommended fittings.
- O. Seal penetrations through fire and smoke barriers. Comply with requirements in Section 078413 "Penetration Firestopping."
- P. Install capped metal sleeves for future cables through firestop-sealed cable tray penetrations of fire and smoke barriers.
- Q. Install cable trays with enough workspace to permit access for installing cables.
- R. Install barriers to separate cables of different systems, such as power, communications, and data processing; or of different insulation levels, such as 600, 5000, and 15 000 V.
- S. Install permanent covers, if used, after installing cable. Install cover clamps according to NEMA VE 2.
- T. Clamp covers on cable trays installed outdoors with heavy-duty clamps.
- U. Install warning signs in visible locations on or near cable trays after cable tray installation.

### 3.2 CABLE TRAY GROUNDING

- A. Ground cable trays according to NFPA 70 unless additional grounding is specified. Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Bond cable trays to power source for cables contained within with bonding conductors sized according to NFPA 70, Article 250.122, "Size of Equipment Grounding Conductors."

### 3.3 CABLE INSTALLATION

- A. Install cables only when each cable tray run has been completed and inspected.
- B. Fasten cables on horizontal runs with cable clamps or cable ties according to NEMA VE 2. Tighten clamps only enough to secure the cable, without indenting the cable jacket. Install cable ties with a tool that includes an automatic pressure-limiting device.
- C. Fasten cables on vertical runs to cable trays every 18 inches.
- D. Fasten and support cables that pass from one cable tray to another or drop from cable trays to equipment enclosures. Fasten cables to the cable tray at the point of exit and support cables

## SECTION 260536 - CABLE TRAYS FOR ELECTRICAL SYSTEMS

independent of the enclosure. The cable length between cable trays or between cable tray and enclosure shall be no more than 72 inches.

- E. In existing construction, remove inactive or dead cables from cable trays.

### 3.4 CONNECTIONS

- A. Remove paint from all connection points before making connections. Repair paint after the connections are completed.
- B. Connect raceways to cable trays according to requirements in NEMA VE 2 and NEMA FG 1.

### 3.5 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections.
  1. After installing cable trays and after electrical circuitry has been energized, survey for compliance with requirements.
  2. Visually inspect cable insulation for damage. Correct sharp corners, protuberances in cable trays, vibrations, and thermal expansion and contraction conditions, which may cause or have caused damage.
  3. Verify that the number, size, and voltage of cables in cable trays do not exceed that permitted by NFPA 70. Verify that communications or data-processing circuits are separated from power circuits by barriers or are installed in separate cable trays.
  4. Verify that there are no intruding items such as pipes, hangers, or other equipment in the cable tray.
  5. Remove dust deposits, industrial process materials, trash of any description, and any blockage of tray ventilation.
  6. Visually inspect each cable tray joint and each ground connection for mechanical continuity. Check bolted connections between sections for corrosion. Clean and retorqued in suspect areas.
  7. Check for improperly sized or installed bonding jumpers.
  8. Check for missing, incorrect, or damaged bolts, bolt heads, or nuts. When found, replace with specified hardware.
  9. Perform visual and mechanical checks for adequacy of cable tray grounding; verify that all takeoff raceways are bonded to cable trays. Test entire cable tray system for continuity. Maximum allowable resistance is 1 ohm.
- B. Prepare test and inspection reports.

### 3.6 PROTECTION

- A. Protect installed cable trays and cables.
  1. Install temporary protection for cables in open trays to safeguard exposed cables against falling objects or debris during construction. Temporary protection for cables and cable tray can be constructed of wood or metal materials and shall remain in place until the risk of damage is over.

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2. Repair damage to galvanized finishes with zinc-rich paint recommended by cable tray manufacturer.
3. Repair damage to paint finishes with matching touchup coating recommended by cable tray manufacturer.

END OF SECTION 260536



## SECTION 260544 - SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

### 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. Sleeves for raceway and cable penetration of non-fire-rated construction walls and floors.
- 2. Sleeve-seal systems.
- 3. Sleeve-seal fittings.
- 4. Grout.
- 5. Silicone sealants.

- B. Related Requirements:

- 1. Section 078413 "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

### PART 2 - PRODUCTS

#### 2.1 SLEEVES

- A. Wall Sleeves:

- 1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.
- 2. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

- B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.

- C. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.

## SECTION 260544 - SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

- D. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.
- E. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.
- F. Sleeves for Rectangular Openings:
  - 1. Material: Galvanized sheet steel.
  - 2. Minimum Metal Thickness:
    - a. For sleeve cross-section rectangle perimeter less than 50 inches and with no side larger than 16 inches, thickness shall be 0.052 inch.
    - b. For sleeve cross-section rectangle perimeter 50 inches or more and one or more sides larger than 16 inches, thickness shall be 0.138 inch.

### 2.2 SLEEVE-SEAL SYSTEMS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
  - 1. Manufacturers:
    - a. Advance Products & Systems, Inc.
    - b. Calpico, Inc.
    - c. Metraflex Co.
    - d. Pipeline Seal and Insulator, Inc.
  - 2. Sealing Elements: Nitrile (Buna N rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
  - 3. Pressure Plates: Carbon steel.
  - 4. Connecting Bolts and Nuts: [Carbon steel, with corrosion-resistant coating,] of length required to secure pressure plates to sealing elements.

### 2.3 SLEEVE-SEAL FITTINGS

- A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.

### 2.4 GROUT

- A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.
- B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- C. Design Mix: 5000-psi, 28-day compressive strength.

## SECTION 260544 - SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

- D. Packaging: Premixed and factory packaged.

### 2.5 SILICONE SEALANTS

- A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.
  - 1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.
  - 2. Sealant shall have VOC content of 150 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  - 3. Sealant 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. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

## PART 3 - EXECUTION

### 3.1 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

- A. Comply with NECA 1.
- B. Comply with NEMA VE 2 for cable tray and cable penetrations.
- C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:
  - 1. Interior Penetrations of Non-Fire-Rated Walls and Floors:
    - a. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 079200 "Joint Sealants."
    - b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.
  - 2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
  - 3. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed.
  - 4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
  - 5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches above finished floor level. Install sleeves during erection of floors.

## SECTION 260544 - SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

- D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:
  - 1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
  - 2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.
- E. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- F. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- G. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing sleeve-seal system.

### 3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.
- B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

### 3.3 SLEEVE-SEAL-FITTING INSTALLATION

- A. Install sleeve-seal fittings in new walls and slabs as they are constructed.
- B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.
- C. Secure nailing flanges to concrete forms.
- D. Using grout, seal the space around outside of sleeve-seal fittings.

END OF SECTION 260544

## SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
1. Identification for raceways.
  2. Identification of power and control cables.
  3. Identification for conductors.
  4. Underground-line warning tape.
  5. Warning labels and signs.
  6. Instruction signs.
  7. Equipment identification labels.
  8. Miscellaneous identification products.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each electrical identification product indicated.

#### 1.3 QUALITY ASSURANCE

- A. Comply with ANSI A13.1.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.
- D. Comply with ANSI Z535.4 for safety signs and labels.
- E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

### PART 2 - PRODUCTS

#### 2.1 POWER AND CONTROL RACEWAY IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.
- B. Colors for Raceways Carrying Circuits at 600 V or Less:
1. Black letters on an orange field.
  2. Legend: Indicate voltage and system or service type.

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- C. Vinyl Labels for Raceways Carrying Circuits at 600 V or Less: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.

### 2.2 ARMORED AND METAL-CLAD CABLE IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each cable size.
- B. Colors for Cables Carrying Circuits at 600 V and Less:
  - 1. Black letters on an orange field.
  - 2. Legend: Indicate voltage and system or service type.
- C. Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.
- D. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; 2 inches wide; compounded for outdoor use.
- E. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tube with machine-printed identification label. Sized to suit diameter of and shrinks to fit firmly around cable it identifies. Full shrink recovery at a maximum of 200 deg F. Comply with UL 224.

### 2.3 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.
- B. Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.
- C. Self-Adhesive, Self-Laminating Polyester Labels: Preprinted, 3-mil thick flexible label with acrylic pressure-sensitive adhesive that provides a clear, weather- and chemical- resistant, self-laminating, protective shield over the legend. Labels sized to fit the cable diameter such that the clear shield overlaps the entire printed legend.
- D. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tube with machine-printed identification label. Sized to suit diameter of and shrinks to fit firmly around cable it identifies. Full shrink recovery at a maximum of 200 deg F. Comply with UL 224.
- E. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of cable it identifies and to stay in place by gripping action.
- F. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches long, with diameter sized to suit diameter of cable it identifies and to stay in place by gripping action.

## SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

### 2.4 CONDUCTOR IDENTIFICATION MATERIALS

- A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.
- B. Self-Adhesive, Self-Laminating Polyester Labels: Preprinted, 3-mil- thick flexible label with acrylic pressure-sensitive adhesive that provides a clear, weather- and chemical- resistant, self-laminating, protective shield over the legend. Labels sized to fit the conductor diameter such that the clear shield overlaps the entire printed legend.
- C. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tube with machine-printed identification label. Sized to suit diameter of and shrinks to fit firmly around conductor it identifies. Full shrink recovery at a maximum of 200 deg F. Comply with UL 224.
- D. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

### 2.5 WARNING LABELS AND SIGNS

- A. Comply with NFPA 70 and 29 CFR 1910.145.
- B. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.
- C. Baked-Enamel Warning Signs:
  - 1. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.
  - 2. 1/4-inch grommets in corners for mounting.
  - 3. Nominal size, 7 by 10 inches.
- D. Metal-Backed, Butyrate Warning Signs:
  - 1. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch galvanized-steel backing; and with colors, legend, and size required for application.
  - 2. 1/4-inch grommets in corners for mounting.
  - 3. Nominal size, 10 by 14 inches.
- E. Warning label and sign shall include, but are not limited to, the following legends:
  - 1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
  - 2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."

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### 2.6 INSTRUCTION SIGNS

- A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch thick for signs up to 20 sq. inches and 1/8 inch thick for larger sizes.
  - 1. Engraved legend with black letters on white face.
  - 2. Punched or drilled for mechanical fasteners.
  - 3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.
- B. Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch.
- C. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch. Overlay shall provide a weatherproof and UV-resistant seal for label.

### 2.7 EQUIPMENT IDENTIFICATION LABELS

- A. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch. Overlay shall provide a weatherproof and UV-resistant seal for label.
- B. Self-Adhesive, Engraved, Laminated Acrylic or Melamine Label: Adhesive backed, with white letters on a dark-gray background. Minimum letter height shall be 3/8 inch.
- C. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be 1 inch.

### 2.8 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior).
- B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- B. Apply identification devices to surfaces that require finish after completing finish work.



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- C. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.
- D. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
- E. Attach plastic raceway and cable labels that are not self-adhesive type with clear vinyl tape with adhesive appropriate to the location and substrate.
- F. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.
- G. Underground-Line Detectable Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches overall.
- H. Painted Identification: Comply with requirements in painting Sections for surface preparation and paint application.

### 3.2 IDENTIFICATION SCHEDULE

- A. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits More Than 30 A, and 120 V to ground: Install labels at 30-foot maximum intervals.
- B. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels with the wiring system legend and system voltage. System legends shall be as follows:
  - 1. Emergency Power.
  - 2. Power.
  - 3. UPS.
  - 4. Fire Alarm System
  - 5. Fire-Suppression Supervisory and Control System
  - 6. Security System
  - 7. Mechanical and Electrical Supervisory System
  - 8. Telecommunication System.
  - 9. Control Wiring.
- C. Power-Circuit Conductor Identification: For secondary conductors No. 1/0 AWG and larger in vaults, pull and junction boxes, manholes, and handholes use color-coding conductor tape. Identify source and circuit number of each set of conductors. For single conductor cables, identify phase in addition to the above.
- D. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull

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and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.

1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded service feeder and branch-circuit conductors.
  - a. Color shall be factory applied or field applied for sizes larger than No. 8 AWG, if authorities having jurisdiction permit.
  - b. Colors for 208/120-V Circuits:
    - 1) Phase A: Black.
    - 2) Phase B: Red.
    - 3) Phase C: Blue.
  - c. Colors for 480/277-V Circuits:
    - 1) Phase A: Brown.
    - 2) Phase B: Orange.
    - 3) Phase C: Yellow.
  - d. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.
- E. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.
- F. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use write-on tags with the conductor or cable designation, origin, and destination.
- G. Control-Circuit Conductor Termination Identification: For identification at terminations provide heat-shrink preprinted tubes with the conductor designation.
- H. Conductors to Be Extended in the Future: Attach write-on tags to conductors and list source.
- I. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.
  1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
  2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
  3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.
- J. Locations of Underground Lines: Identify with underground-line detectable warning tape for power, lighting, communication, and control wiring and optical fiber cable.
  1. Limit use of underground-line warning tape to direct-buried cables.
  2. Install underground-line warning tape for both direct-buried cables and cables

## SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

in raceway.

- K. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall be as required by NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.
- L. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive warning labels.
  - 1. Comply with 29 CFR 1910.145.
  - 2. Identify system voltage with black letters on an orange background.
  - 3. Apply to exterior of door, cover, or other access.
  - 4. For equipment with multiple power or control sources, apply to door or cover of equipment including, but not limited to, the following:
    - a. Power transfer switches.
    - b. Controls with external control power connections.
- M. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.
- N. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch-high letters for emergency instructions at equipment used for power transfer and load shedding.
- O. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.
  - 1. Labeling Instructions:
    - a. Indoor Equipment: Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on 1-1/2-inch-high label; where two lines of text are required, use labels 2 inches high.
    - b. Outdoor Equipment: Engraved, laminated acrylic or melamine label Stenciled legend 4 inches high.
    - c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
    - d. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.
  - 2. Equipment to Be Labeled:
    - a. Panelboards, electrical cabinets, and enclosures.

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- b. Distribution panelboards and Switchboards – label each circuit breaker
- c. Access doors and panels for concealed electrical items.
- d. Electrical switchgear and switchboards.
- e. Transformers.
- f. Emergency system boxes and enclosures.
- g. Motor-control centers.
- h. Disconnect switches.
- i. Enclosed circuit breakers.
- j. Motor starters.
- k. Push-button stations.
- l. Power transfer equipment.
- m. Contactors.
- n. Remote-controlled switches, dimmer modules, and control devices.
- o. Power-generating units.
- p. Voice and data cable terminal equipment.
- q. Master clock and program equipment.
- r. Intercommunication and call system master and staff stations.
- s. Fire-alarm control panel and annunciators.
- t. Security and intrusion-detection control stations, control panels, terminal cabinets, and racks.
- u. Uninterruptible power supply equipment.
- v. Terminals, racks, and patch panels for voice and data communication and for signal and control functions.

### 3.3 INSTALLATION

Verify identity of each item before installing identification products.

END OF SECTION 260553

## SECTION 260572 - OVERCURRENT PROTECTIVE DEVICE SHORT-CIRCUIT STUDY

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section includes a computer-based, fault-current study to determine the minimum interrupting capacity of circuit protective devices.

#### 1.3 DEFINITIONS

- A. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.
- B. One-Line Diagram: A diagram which shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.
- C. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion from the system.
- D. SCCR: Short-circuit current rating.
- E. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For computer software program to be used for studies.
- B. Other Action Submittals: Submit the following after the approval of system protective devices submittals. Submittals may be in digital form.
  - 1. Short-circuit study input data, including completed computer program input data sheets.
  - 2. Short-circuit study and equipment evaluation report; signed, dated, and sealed by a qualified professional engineer.
    - a. Submit study report for action prior to receiving final approval of the distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that the selection of devices and associated characteristics is satisfactory.

## SECTION 260572 - OVERCURRENT PROTECTIVE DEVICE SHORT-CIRCUIT STUDY

- b. Revised single-line diagram, reflecting field investigation results and results of short-circuit study.

### 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Short-Circuit Study Software Developer and Short-Circuit Study Specialist.
- B. Product Certificates: For short-circuit study software, certifying compliance with IEEE 399.

### 1.6 QUALITY ASSURANCE

- A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are unacceptable.
- B. Short-Circuit Study Software Developer Qualifications: An entity that owns and markets computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.
  - 1. The computer program shall be developed under the charge of a licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.
- C. Short-Circuit Study Specialist Qualifications: Professional engineer in charge of performing the study and documenting recommendations, licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional engineer.
- A. Coordination-Study Specialist Qualifications: An organization experienced in the application of computer software used for studies having performed successful studies of similar magnitude on electrical distribution systems using similar devices and being in this type service/business for at least 10 years.

## PART 2 - PRODUCTS

### 2.1 COMPUTER SOFTWARE

- A. Computer Software Developers: Subject to compliance with requirements, provide computer software programs developed by one of the following:
  - 1. CYME International, Inc.
  - 2. EDSA Micro Corporation.
  - 3. Electrical Systems Analysis, Inc.
  - 4. SKM Systems Analysis, Inc.
- B. Comply with IEEE 399 and IEEE 551.

## SECTION 260572 - OVERCURRENT PROTECTIVE DEVICE SHORT-CIRCUIT STUDY

- C. Analytical features of fault-current-study computer software program shall have the capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.
- D. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output.

### 2.2 SHORT-CIRCUIT STUDY REPORT CONTENTS

- A. Executive summary.
- B. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of the computer printout.
- C. One-line diagram, showing the following:
  - 1. Protective device designations and ampere ratings.
  - 2. Cable size and lengths.
  - 3. Transformer kilovolt ampere (kVA) and voltage ratings.
  - 4. Motor and generator designations and kVA ratings.
  - 5. Switchgear, switchboard, motor-control center, and panelboard designations.
- D. Comments and recommendations for system improvements, where needed.
- E. Protective Device Evaluation:
  - 1. Evaluate equipment and protective devices and compare to short-circuit ratings.
  - 2. Tabulations of circuit breaker, fuse, and other protective device ratings versus calculated short-circuit duties.
  - 3. For 600-V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
  - 4. For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in the standards to 1/2-cycle symmetrical fault current.
  - 5. Verify adequacy of phase conductors at maximum three-phase bolted fault currents; verify adequacy of equipment grounding conductors and grounding electrode conductors at maximum ground-fault currents. Ensure that short-circuit withstand ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
- F. Short-Circuit Study Input Data: As described in "Power System Data" Article in the Evaluations.
- G. Short-Circuit Study Output:
  - 1. Low-Voltage Fault Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
    - a. Voltage.
    - b. Calculated fault-current magnitude and angle.
    - c. Fault-point X/R ratio.
    - d. Equivalent impedance.

## SECTION 260572 - OVERCURRENT PROTECTIVE DEVICE SHORT-CIRCUIT STUDY

2. Momentary Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
  - a. Voltage.
  - b. Calculated symmetrical fault-current magnitude and angle.
  - c. Fault-point X/R ratio.
  - d. Calculated asymmetrical fault currents:
    - 1) Based on fault-point X/R ratio.
    - 2) Based on calculated symmetrical value multiplied by 1.6.
    - 3) Based on calculated symmetrical value multiplied by 2.7.
3. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
  - a. Voltage.
  - b. Calculated symmetrical fault-current magnitude and angle.
  - c. Fault-point X/R ratio.
  - d. No AC Decrement (NACD) ratio.
  - e. Equivalent impedance.
  - f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a symmetrical basis.
  - g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a total basis.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Obtain all data necessary for the conduct of the study.
  1. Verify completeness of data supplied on the one-line diagram. Call any discrepancies to the attention of Architect.
  2. For equipment provided that is Work of this Project, use characteristics submitted under the provisions of action submittals and information submittals for this Project.
  3. For relocated equipment that which is existing to remain, obtain required electrical distribution system data by field investigation and surveys, conducted by qualified technicians and engineers. The qualifications of technicians and engineers shall be qualified as defined by NFPA 70E.
- B. Gather and tabulate the following input data to support the short-circuit study. Comply with recommendations in IEEE 551 as to the amount of detail that is required to be acquired in the field. Field data gathering shall be under the direct supervision and control of the engineer in charge of performing the study, and shall be by the engineer or its representative who holds NETA ETT Level III certification or NICET Electrical Power Testing Level III certification.
  1. Product Data for Project's overcurrent protective devices involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.



## SECTION 260572 - OVERCURRENT PROTECTIVE DEVICE SHORT-CIRCUIT STUDY

2. Obtain electrical power utility impedance at the service.
3. Power sources and ties.
4. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
5. For reactors, provide manufacturer and model designation, voltage rating, and impedance.
6. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip, SCCR, current rating, and breaker settings.
7. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
8. Busway manufacturer and model designation, current rating, impedance, lengths, and conductor material.
9. Motor horsepower and NEMA MG 1 code letter designation.
10. Cable sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).

### 3.2 SHORT-CIRCUIT STUDY

- A. Perform study following the general study procedures contained in IEEE 399.
- B. Calculate short-circuit currents according to IEEE 551.
- C. Base study on the device characteristics supplied by device manufacturer.
- D. The extent of the electrical power system to be studied is indicated on Drawings.
- E. Begin short-circuit current analysis at the service, extending down to the system overcurrent protective devices as follows:
  1. To normal system low-voltage load buses where fault current is 10 kA or less.
  2. Exclude equipment rated 240-V ac or less when supplied by a single transformer rated less than 125 kVA.
- F. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Study all cases of system-switching configurations and alternate operations that could result in maximum fault conditions.
- G. The calculations shall include the ac fault-current decay from induction motors, synchronous motors, and asynchronous generators and shall apply to low- and medium-voltage, three-phase ac systems. The calculations shall also account for the fault-current dc decrement, to address the asymmetrical requirements of the interrupting equipment.
  1. For grounded systems, provide a bolted line-to-ground fault-current study for areas as defined for the three-phase bolted fault short-circuit study.
- H. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault at each of the following:
  1. Electric utility's supply termination point.
  2. Incoming switchgear.

## SECTION 260572 - OVERCURRENT PROTECTIVE DEVICE SHORT-CIRCUIT STUDY

3. Unit substation primary and secondary terminals.
4. Low-voltage switchgear.
5. Motor-control centers.
6. Control panels.
7. Standby generators and automatic transfer switches.
8. Branch circuit panelboards.
9. Disconnect switches.

### 3.3 ADJUSTING

- A. Make minor modifications to equipment as required to accomplish compliance with short-circuit study.

### 3.4 DEMONSTRATION

- A. Train Owner's operating and maintenance personnel in the use of study results.

END OF SECTION 260572

## SECTION 260574 - OVERCURRENT PROTECTIVE DEVICE ARC-FLASH STUDY

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section includes a computer-based, arc-flash study to determine the arc-flash hazard distance and the incident energy to which personnel could be exposed during work on or near electrical equipment.

#### 1.3 DEFINITIONS

- A. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.
- B. One-Line Diagram: A diagram which shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.
- C. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion from the system.
- D. SCCR: Short-circuit current rating.
- E. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For computer software program to be used for studies.
- B. Other Action Submittals: Submit the following submittals after the approval of system protective devices submittals. Submittals may be in digital form.
  - 1. Arc-flash study input data, including completed computer program input data sheets.
  - 2. Arc-flash study report; signed, dated, and sealed by a qualified professional engineer.
    - a. Submit study report for action prior to receiving final approval of the distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that the selection of devices and associated characteristics is satisfactory.

## SECTION 260574 - OVERCURRENT PROTECTIVE DEVICE ARC-FLASH STUDY

### 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Arc-Flash Study Software Developer and Arc-Flash Study Specialist.
- B. Product Certificates: For arc-flash hazard analysis software, certifying compliance with IEEE 1584 and NFPA 70E.

### 1.6 CLOSEOUT SUBMITTALS

- A. Maintenance procedures according to requirements in NFPA 70E shall be provided in the equipment manuals.
- B. Operation and Maintenance Procedures: In addition to items specified in Section 017823 "Operation and Maintenance Data," provide maintenance procedures for use by Owner's personnel that comply with requirements in NFPA 70E.

### 1.7 QUALITY ASSURANCE

- A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are unacceptable.
- B. Arc-Flash Study Software Developer Qualifications: An entity that owns and markets computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.
  - 1. The computer program shall be developed under the charge of a licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.
- C. Arc-Flash Study Specialist Qualifications: Professional engineer in charge of performing the study, analyzing the arc flash, and documenting recommendations, licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional engineer.
- D. Coordination-Study Specialist Qualifications: An organization experienced in the application of computer software used for studies having performed successful studies of similar magnitude on electrical distribution systems using similar devices and being in this type service/business for at least 10 years.

## PART 2 - PRODUCTS

### 2.1 COMPUTER SOFTWARE DEVELOPERS

- A. Computer Software Developers: Subject to compliance with requirements, provide computer software programs developed by one of the following:
  - 1. CYME International, Inc.

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2. EDSA Micro Corporation.
3. Electrical Systems Analysis, Inc.
4. SKM Systems Analysis, Inc.

B. Comply with IEEE 1584 and NFPA 70E.

C. Analytical features of device coordination study computer software program shall have the capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

### 2.2 ARC-FLASH STUDY REPORT CONTENT

A. Executive summary.

B. Study descriptions, purpose, basis and scope.

C. One-line diagram, showing the following:

1. Protective device designations and ampere ratings.
2. Cable size and lengths.
3. Transformer kilovolt ampere (kVA) and voltage ratings.
4. Motor and generator designations and kVA ratings.
5. Switchgear, switchboard, motor-control center and panelboard designations.

D. Study Input Data: As described in "Power System Data" Article.

E. Short-Circuit Study Output: As specified in "Short Circuit Study Output" Paragraph in "Short-Circuit Study Report Contents" Article in Section 260572 "Overcurrent Protective Device Short-Circuit Study."

F. Protective Device Coordination Study Report Contents: As specified in "Protective Device Coordination Study Report Contents" Article in Section 260573 "Overcurrent Protective Device Coordination Study."

G. Arc-Flash Study Output:

1. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
  - a. Voltage.
  - b. Calculated symmetrical fault-current magnitude and angle.
  - c. Fault-point X/R ratio.
  - d. No AC Decrement (NACD) ratio.
  - e. Equivalent impedance.
  - f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a symmetrical basis.
  - g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a total basis.

H. Incident Energy and Flash Protection Boundary Calculations:

## SECTION 260574 - OVERCURRENT PROTECTIVE DEVICE ARC-FLASH STUDY

1. Arcing fault magnitude.
  2. Protective device clearing time.
  3. Duration of arc.
  4. Arc-flash boundary.
  5. Working distance.
  6. Incident energy.
  7. Hazard risk category.
  8. Recommendations for arc-flash energy reduction.
- I. Fault study input data, case descriptions, and fault-current calculations including a definition of terms and guide for interpretation of the computer printout.

### 2.3 ARC-FLASH WARNING LABELS

- A. Comply with requirements in Section 260553 "Identification for Electrical Systems." Produce a 3.5-by-5-inch thermal transfer label of high-adhesion polyester for each work location included in the analysis.
- B. The label shall have an orange header with the wording, "WARNING, ARC-FLASH HAZARD," and shall include the following information taken directly from the arc-flash hazard analysis:
1. Location designation.
  2. Nominal voltage.
  3. Flash protection boundary.
  4. Hazard risk category.
  5. Incident energy.
  6. Working distance.
  7. Engineering report number, revision number, and issue date.
- C. Labels shall be machine printed, with no field-applied markings.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine Project overcurrent protective device submittals. Proceed with arc-flash study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to arc-flash study may not be used in study.

### 3.2 ARC-FLASH HAZARD ANALYSIS

- A. Comply with NFPA 70E and its Annex D for hazard analysis study.
- B. Preparatory Studies:

## SECTION 260574 - OVERCURRENT PROTECTIVE DEVICE ARC-FLASH STUDY

1. Short-Circuit Study Output: As specified in "Short-Circuit Study Output" Paragraph in "Short-Circuit Study Report Contents" Article in Section 260572 "Overcurrent Protective Device Short-Circuit Study."
  2. Protective Device Coordination Study Report Contents: As specified in "Protective Device Coordination Study Report Contents" Article in Section 260573 "Overcurrent Protective Device Coordination Study."
- C. Calculate maximum and minimum contributions of fault-current size.
1. The minimum calculation shall assume that the utility contribution is at a minimum and shall assume no motor load.
  2. The maximum calculation shall assume a maximum contribution from the utility and shall assume motors to be operating under full-load conditions.
- D. Calculate the arc-flash protection boundary and incident energy at locations in the electrical distribution system where personnel could perform work on energized parts.
- E. Include medium- and low-voltage equipment locations, except equipment rated 240-V ac or less fed from transformers less than 125 kVA.
- F. Safe working distances shall be specified for calculated fault locations based on the calculated arc-flash boundary, considering incident energy of 1.2 cal/sq.cm.
- G. Incident energy calculations shall consider the accumulation of energy over time when performing arc-flash calculations on buses with multiple sources. Iterative calculations shall take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators shall be decremented as follows:
1. Fault contribution from induction motors should not be considered beyond three to five cycles.
  2. Fault contribution from synchronous motors and generators should be decayed to match the actual decrement of each as closely as possible (e.g., contributions from permanent magnet generators will typically decay from 10 per unit to three per unit after 10 cycles).
- H. Arc-flash computation shall include both line and load side of a circuit breaker as follows:
1. When the circuit breaker is in a separate enclosure.
  2. When the line terminals of the circuit breaker are separate from the work location.
- I. Base arc-flash calculations on actual overcurrent protective device clearing time. Cap maximum clearing time at two seconds based on IEEE 1584, Section B.1.2.

### 3.3 POWER SYSTEM DATA

- A. Obtain all data necessary for the conduct of the arc-flash hazard analysis.
1. Verify completeness of data supplied on the one-line diagram on Drawings and under "Preparatory Studies" Paragraph in "Arc-Flash Hazard Analysis" Article. Call discrepancies to the attention of Architect.

## SECTION 260574 - OVERCURRENT PROTECTIVE DEVICE ARC-FLASH STUDY

2. For new equipment, use characteristics submitted under the provisions of action submittals and information submittals for this Project.
  3. For existing equipment, whether or not relocated, obtain required electrical distribution system data by field investigation and surveys, conducted by qualified technicians and engineers.
- B. Electrical Survey Data: Gather and tabulate the following input data to support study. Comply with recommendations in IEEE 1584 and NFPA 70E as to the amount of detail that is required to be acquired in the field. Field data gathering shall be under the direct supervision and control of the engineer in charge of performing the study, and shall be by the engineer or its representative who holds NETA ETT Level III certification or NICET Electrical Power Testing Level III certification.
1. Product Data for overcurrent protective devices specified in other Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
  2. Obtain electrical power utility impedance at the service.
  3. Power sources and ties.
  4. Short-circuit current at each system bus, three phase and line-to-ground.
  5. Full-load current of all loads.
  6. Voltage level at each bus.
  7. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in per cent, and phase shift.
  8. For reactors, provide manufacturer and model designation, voltage rating and impedance.
  9. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip and available range of settings, SCCR, current rating, and breaker settings.
  10. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
  11. For relays, provide manufacturer and model designation, current transformer ratios, potential transformer ratios, and relay settings.
  12. Busway manufacturer and model designation, current rating, impedance, lengths, and conductor material.
  13. Motor horsepower and NEMA MG 1 code letter designation.
  14. Low-voltage cable sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).
  15. Medium-voltage cable sizes, lengths, conductor material, and cable construction and metallic shield performance parameters.

### 3.4 LABELING

- A. Apply one arc-flash label for 600-V ac, 480-V ac, and applicable 208-V ac panelboards and disconnects and for each of the following locations:
1. Motor-control center.
  2. Low-voltage switchboard.
  3. Switchgear.
  4. Medium-voltage switch.
  5. Control panel.



## SECTION 260574 - OVERCURRENT PROTECTIVE DEVICE ARC-FLASH STUDY

### 3.5 APPLICATION OF WARNING LABELS

- A. Install the arc-fault warning labels under the direct supervision and control of the Arc-Flash Study Specialist.

### 3.6 DEMONSTRATION

- A. Engage the Arc-Flash Study Specialist to train Owner's maintenance personnel in the potential arc-flash hazards associated with working on energized equipment and the significance of the arc-flash warning labels.

END OF SECTION 260574

## SECTION 260800 - COMMISSIONING OF ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section includes commissioning process requirements for the following MEP systems, assemblies, and equipment:
  - 1. Electrical lighting and lighting controls.
- B. Related Requirements:
  - 1. Section 019113 "General Commissioning Requirements" for general commissioning process requirements and Commissioning Coordinator responsibilities.

#### 1.3 DEFINITIONS

- A. Refer to Section 019113 "General Commissioning Requirements" for additional definitions and assignment of responsibilities.

#### 1.4 CONTRACTOR'S RESPONSIBILITIES

- A. Refer to Section 019113 "General Commissioning Requirements".
- B. Perform commissioning tests at the direction of the CxA.
- C. Attend construction phase controls coordination meeting.
- D. Participate in electrical systems, assemblies, equipment, and component maintenance orientation and inspection.
- 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 complete range of testing for the required test period.
- G. Provide Project-specific construction checklists and commissioning process test procedures for actual electrical systems, assemblies, equipment, and components to be furnished and installed as part of the construction contract.
- H. Direct and coordinate commissioning testing among subcontractors, suppliers, and vendors.

## SECTION 260800 - COMMISSIONING OF ELECTRICAL SYSTEMS

- I. Verify testing and adjusting of Work are complete.
- J. Provide test data, inspection reports, and certificates in Systems Manual.

### 1.5 COMMISSIONING DOCUMENTATION

- A. Provide the following information to the CxA for inclusion in the commissioning plan:
  - 1. Plan for delivery and review of 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 pre-start and startup checklists for electrical systems, assemblies, equipment, and components to be verified and tested.
  - 4. Certificate of completion certifying that installation, pre-start checks, and startup procedures have been completed.
  - 5. Certificate of readiness certifying that electrical systems, subsystems, equipment, and associated controls are ready for testing.
  - 6. Test and inspection reports and certificates.
  - 7. Corrective action documents.

### 1.6 INFORMATIONAL SUBMITTALS

- A. Construction Checklists: See related Sections for technical requirements, and generate construction checklists for the following:
  - 1. Revise list of construction checklists below to suit Project. Coordinate list with appropriate related Sections' content. Below are examples of common construction checklists.
  - 2. Electrical lighting and lighting control systems.
- B. Certificates of readiness.
- C. Certificates of completion of installation, pre-start, and startup activities.

## PART 2 - PRODUCTS (Not Used)

## PART 3 - EXECUTION

### 3.1 GENERAL REQUIREMENTS

- A. Refer to Section 019113 "General Commissioning Requirements".

## SECTION 260800 - COMMISSIONING OF ELECTRICAL SYSTEMS

### 3.2 SYSTEMS READINESS CHECKLISTS

- A. Construction Checklists: Assist CxA in the preparation of detailed Systems Readiness checklists for systems, subsystems, equipment, and components.
  - 1. Contributors to the development of checklists shall include, but are not limited to:
    - a. Systems and equipment installers.
    - b. Electrical and lighting technicians.
    - c. Lighting controls installers.
- B. Contractor shall conduct Systems Readiness Testing to document compliance with installation and Systems Readiness checklists prepared by Commissioning Authority for Division-26 items.
- C. Refer to Section 019113 "General Commissioning Requirements" for issues relating to Systems Readiness checklists and testing, description of process, details on non-conformance issues relating to pre-functional checklists and test.
- D. Contractor shall participate in Pre-Functional testing activities to document electrical work associated with mechanical and plumbing systems.

### 3.3 SYSTEM START-UP

- A. Contractor is solely responsible for system start-up. CxA may, at his discretion, witness start up procedures, but will not perform any Functional Testing of systems until Contractor has completed start-up and resolved all operating deficiencies.

### 3.4 TESTING PREPARATION

- A. Certify that electrical systems, subsystems, and equipment have been installed, calibrated, and started and are operating according to the Contract Documents.
- B. Certify that electrical instrumentation and control systems have been completed and calibrated, that they are operating according to the Contract Documents and approved Shop Drawings and submittals, and that pretest set points have been recorded.
- C. Set systems, subsystems, and equipment into operating mode to be tested according to approved test procedures (e.g., normal shutdown, normal auto position, normal manual position, unoccupied cycle, and alarm conditions).
- D. Inspect and verify the position of each device and interlocks identified on checklists.
- E. Check safety cutouts, alarms, and interlocks with smoke control and life-safety systems during each mode of operation.
- F. Testing Instrumentation: Install measuring instruments and logging devices to record test data as required.

## SECTION 260800 - COMMISSIONING OF ELECTRICAL SYSTEMS

### 3.5 GENERAL TESTING REQUIREMENTS

- A. Provide technicians, instrumentation, and tools to perform commissioning test at the direction of the CxA.
- B. Test all operating modes, interlocks, control responses, and responses to abnormal or emergency conditions, and verify proper response of automation system controllers and sensors.
- C. Tests will be performed using design conditions whenever possible.
- D. 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 Contracting Officer and document simulated conditions and methods of simulation. After tests, return settings to normal operating conditions.
- E. The CxA may direct that set points be altered when simulating conditions is not practical.
- F. 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.
- G. If tests cannot be completed because of a deficiency outside the scope of the electrical system, document the deficiency and report it to the Owner. After deficiencies are resolved, reschedule tests.
- H. If the testing plan indicates specific seasonal testing, complete appropriate initial performance tests and documentation and schedule seasonal tests.

### 3.6 FUNCTIONAL TEST PROCEDURES FOR SYSTEMS TO BE COMMISSIONED

- A. General
  - 1. The following paragraphs outline the functional test procedures for the various Div. 26 items to be commissioned. Functional testing will take place only after System Readiness checklists have been completed, equipment has been started-up, and Contractor has certified that systems are ready for functional testing.
  - 2. All systems controlled via the Building Automation System shall have all control points and sequences tested by Controls Contractor prior to requesting testing by CX Authority.

### 3.7 COMMISSIONING TESTS

- A. Lighting Systems:
  - 1. Light Fixtures: Verify all lamps work without flicker.
  - 2. Light Switches: Verify switches control lights per design
  - 3. Lighting Controls: Verify Schedule and/or photocell controls
- B. Customized system readiness checklists and function testing requirements will be released after the submittal review phase.

SECTION 260800 - COMMISSIONING OF ELECTRICAL SYSTEMS

3.8 TRAINING AND O&M MANUALS

- A. Refer to Div. 26 specifications.

END OF SECTION 260800

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Single space wireless lighting control systems and associated components:
  - 1. Wireless occupancy/vacancy sensors.
  - 2. Wireless daylight sensors.
  - 3. Wired load control modules with wireless communication inputs.
    - a. Includes fixture control modules with wired occupancy/vacancy/daylight sensors.
  - 4. Wired receptacles with wireless communication inputs.
  - 5. Wireless fixture control components factory-installed in luminaires not specified in this section.
  - 6. Wired wall dimmers and switches with wireless communication inputs.
  - 7. Wired wallbox occupancy sensors with wireless communication inputs.
  - 8. Wireless control stations.
  - 9. Fluorescent electronic dimming ballasts.
  - 10. LED Drivers.
  - 11. Power interfaces.
  - 12. Digital dimming ballast modules.
- B. Wireless hub(s) for centralized control, monitoring, and system integration.
- C. Software data and analytics dashboard, including server requirements.

1.2 RELATED REQUIREMENTS

- A. Section <<\_\_\_\_\_>>: Building automation system, for interface with lighting control system.
- B. Section 26 0553 - *Identification for Electrical Systems*: Identification products and requirements.
- C. Section 26 2726 - *Wiring Devices - Lutron*:
  - 1. Finish requirements for wall controls specified in this section.
  - 2. Accessory receptacles and wallplates, to match lighting controls specified in this section.
- D. Section 26 5133 - *Luminaires, Ballasts, and Drivers - Lutron*.

1.3 REFERENCE STANDARDS

- A. 47 CFR 15 - Radio Frequency Devices; *current edition*.
- B. ANSI C82.11 - American National Standard for Lamp Ballasts - High Frequency Fluorescent Lamp Ballasts - Supplements; *2011*.
- C. ANSI/ESD S20.20 - Protection of Electrical and Electronic Parts, Assemblies and Equipment (Excluding Electrically Initiated Explosive Devices); *2014*.

- D. ASTM D4674 - Standard Practice for Accelerated Testing for Color Stability of Plastics Exposed to Indoor Office Environments; *2002a (Reapproved 2010)*.
- E. CAL TITLE 24 P6 – California Code of Regulations, Title 24, Part 6 (California Energy Code); *2013*.
- F. CSA C22.2 No. 223 – Power Supplies with Extra-low-voltage Class 2 Outputs; *2015*.
- G. IEC 60929 - AC and/or DC-Supplied Electronic Control Gear for Tubular Fluorescent Lamps - Performance Requirements; *2015*.
- H. IEC 61000-4-2 - Electromagnetic Compatibility (EMC) - Part 4-2: Testing and Measurement Techniques - Electrostatic Discharge Immunity Test; *2008*.
- I. IEC 61347-2-3 - Lamp Control Gear - Part 2-3: Particular Requirements for A.C. and/or D.C. Supplied Electronic Control Gear for Fluorescent Lamps; *2011, with Amendments, 2016*.
- J. IEEE 1789 - Recommended Practice for Modulating Current in High-Brightness LEDs for Mitigating Health Risks to Viewers; *2015*.
- K. IEEE C62.41.2 - Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and less) AC Power Circuits; *2002 (Cor 1, 2012)*.
- L. ISO 9001 - Quality Management Systems-Requirements; *2008*.
- M. NECA 1 - Standard for Good Workmanship in Electrical Construction; *2015*.
- N. NECA 130 - Standard for Installing and Maintaining Wiring Devices; National Electrical Contractors Association; *2010*.
- O. NEMA 410 - Performance Testing for Lighting Controls and Switching Devices with Electronic Drivers and Discharge Ballasts; National Electrical Manufacturers Association; *2015*.
- P. NEMA WD 1 - General Color Requirements for Wiring Devices; National Electrical Manufacturers Association; *1999 (R 2015)*.
- Q. NFPA 70 - National Electrical Code; National Fire Protection Association; *Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements*.
- R. UL 20 - General-Use Snap Switches; *Current Edition, Including All Revisions*.
- S. UL 508 - Industrial Control Equipment; Underwriters Laboratories Inc.; *Current Edition, Including All Revisions*.
- T. UL 924 - Emergency Lighting and Power Equipment; *Current Edition, Including All Revisions*.
- U. UL 935 - Fluorescent-Lamp Ballasts; *Current Edition, Including All Revisions*.



- V. UL 1310 – Class 2 Power Units; *Current Edition, Including All Revisions.*
- W. UL 1472 - Solid-State Dimming Controls; *Current Edition, Including All Revisions.*
- X. UL 1598C - Light-Emitting Diode (LED) Retrofit Luminaire Conversion Kits; *Current Edition, Including All Revisions.*
- Y. UL 2043 - Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air-Handling Spaces; *Current Edition, Including All Revisions.*
- Z. UL 8750 - Light Emitting Diode (LED) Equipment for Use in Lighting Products; *Current Edition, Including All Revisions.*

#### 1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
  - 1. Coordinate the placement of sensors and wall controls with millwork, furniture, equipment, etc. installed under other sections or by others.
  - 2. Coordinate the placement of wall controls with actual installed door swings.
  - 3. Coordinate the placement of daylight sensors with windows, skylights, and luminaires to achieve optimum operation. Coordinate placement with ductwork, piping, equipment, or other potential obstructions to light level measurement installed under other sections or by others.
  - 4. Coordinate the work to provide luminaires and lamps compatible with the lighting controls to be installed.
  - 5. Notify Architect of any conflicts or deviations from the contract documents to obtain direction prior to proceeding with work.
- B. Pre-Wire Meeting; *Lutron LSC-PREWIRE*: Include additional costs for Lighting Control Manufacturer to conduct on-site meeting prior to commencing work. Manufacturer to review with installer:
  - 1. Low voltage wiring requirements.
  - 2. Separation of power and low voltage/data wiring.
  - 3. Wire labeling.
  - 4. Wireless hub locations and installation.
  - 5. Where Lighting Control Manufacturer Sensor Layout and Tuning service is specified in Part 2 under "LIGHTING CONTROLS - GENERAL REQUIREMENTS", sensor locations to be reviewed in accordance with layout provided by Lighting Control Manufacturer. Lighting Control Manufacturer may direct Contractor regarding sensor relocation should conditions require a deviation from locations indicated.
  - 6. Control locations.
  - 7. Computer jack locations.
  - 8. Load circuit wiring.
  - 9. Network wiring requirements.
  - 10. Connections to other equipment.
  - 11. Installer responsibilities.
- C. Sequencing:

1. Do not install sensors and wall controls until final surface finishes<< and painting>> are complete.

#### 1.5 SUBMITTALS

- A. See Section 01 3000 - *Administrative Requirements* for submittal procedures.
- B. Design Documents: Where Lighting Control Manufacturer Sensor Layout and Tuning service is specified in Part 2 under "LIGHTING CONTROLS - GENERAL REQUIREMENTS", Lighting Control Manufacturer to provide plans indicating occupancy/vacancy and/or daylight sensor locations.
- C. Product Data: Include ratings, configurations, standard wiring diagrams, dimensions, colors, service condition requirements, and installed features.
  1. Occupancy/Vacancy Sensors: Include detailed basic motion detection coverage range diagrams.
  2. Wall Dimmers: Include derating information for ganged multiple devices.
- D. Samples:
  1. Wall Controls:
    - a. Show available color and finish selections.
- E. Manufacturer's Installation Instructions: Include application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- F. Warranty: Submit sample of manufacturer's Warranty or Enhanced Warranty as specified in Part 1 under "WARRANTY". Submit documentation of final executed warranty completed in Owner's name and registered with manufacturer.

#### 1.6 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Manufacturer Qualifications:
  1. Company with not less than ten years of experience manufacturing lighting control products using wireless communication between devices.
  2. Registered to ISO 9001, including in-house engineering for product design activities.
  3. Provides factory direct technical support hotline available 24 hours per day, 7 days per week.
  4. Qualified to supply specified products and to honor claims against product presented in accordance with warranty.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store products in a clean, dry space in original manufacturer's packaging in accordance with manufacturer's written instructions until ready for installation.

1.8 FIELD CONDITIONS

- A. Maintain field conditions within manufacturer's required service conditions during and after installation.
  - 1. Basis of Design System Requirements - *Lutron*, Unless Otherwise Indicated:
    - a. Ambient Temperature:
      - 1) Lighting Control System Components, Except Fluorescent Electronic Dimming Ballasts: Between 32 and 104 degrees F (0 and 40 degrees C).
      - 2) Fluorescent Electronic Dimming Ballasts: Between 50 and 140 degrees F (10 and 60 degrees C).
    - b. Relative Humidity: Less than 90 percent, non-condensing.
    - c. Protect lighting controls from dust.

1.9 WARRANTY

- A. See *Section 01 7800 - Closeout Submittals*, for additional warranty requirements.
- B. Manufacturer's Standard Warranty, With Manufacturer Full-Scope Start-Up; *Lutron Standard 2-Year Warranty; Lutron LSC-B2*:
  - 1. Manufacturer Lighting Control System Components, Except Lighting Management System Computer, Ballasts/Drivers and Ballast Modules:
    - a. First Two Years:
      - 1) 100 percent replacement parts coverage, 100 percent manufacturer labor coverage to troubleshoot and diagnose a lighting issue.
      - 2) First-available on-site or remote response time.
      - 3) Remote diagnostics for applicable systems.
    - b. Telephone Technical Support: Available 24 hours per day, 7 days per week, excluding manufacturer holidays.
  - 2. Lighting Management System Computer: One year 100 percent parts coverage, one year 100 percent manufacturer labor coverage.
  - 3. Ballasts/Drivers and Ballast Modules:
    - a. With Remote Full-Scope Start-Up: Three years 100 percent parts coverage, no manufacturer labor coverage.
    - b. With On-Site Full-Scope Start-Up: Five years 100 percent parts coverage, no manufacturer labor coverage.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Design Manufacturer: *Lutron Electronics Company, Inc; Vive; www.lutron.com*.
- B. Other Acceptable Manufacturers:
  - 1. Crestron
  - 2. Products by listed manufacturers are subject to compliance with specified requirements

3. Substitutions: <<See Section 01 6000 - Product Requirements; All proposed substitutions (clearly delineated as such) must be submitted in writing for approval by Architect a minimum of <<10; working days prior to the bid date and must be made available to all bidders. Proposed substitutes must be accompanied by a review of the specification noting compliance on a line-by-line basis.
  4. Any proposed substitutions to be reviewed by Architect. By using pre-approved substitutions, Contractor accepts responsibility and associated costs for all required modifications to related equipment and wiring. Provide complete engineered shop drawings (including power wiring) with deviations from the original design highlighted in an alternate color for review and approval by Architect prior to rough-in.
- C. Source Limitations: Furnish products produced by a single manufacturer and obtained from a single supplier.

## 2.2 LIGHTING CONTROLS - GENERAL REQUIREMENTS

- A. LUTRON VIVE – Basis of Design
- B. Design lighting control equipment for 10 year operational life while operating continually at any temperature in an ambient temperature range of 32 degrees F (0 degrees C) to 104 degrees F (40 degrees C) and 90 percent non-condensing relative humidity.
- C. Electrostatic Discharge Tolerance: Design and test equipment to withstand electrostatic discharges without impairment when tested according to IEC 61000-4-2.
- D. Power Failure Recovery: When power is interrupted for periods up to <<10 years; and subsequently restored, lights to automatically return to same levels (dimmed setting, full on, or full off) as prior to power interruption.
- E. Wireless Devices:
1. Wireless device family includes area or fixture level sensors, area or fixture level load controls for dimming or switching, and load controls that can be mounted in a wallbox, on a junction box, or at the fixture.
  2. Wireless devices including sensors, load controls, and wireless remotes or wall stations, can be set up using simple button press programming without needing any other equipment (e.g. central hub, processor, computer, or other smart device).
  3. Wireless hub adds the ability to set up the system using any smart device with a web browser (e.g. smartphone, tablet, PC, or laptop).
  4. System does not require a factory technician to set up or program the system.
  5. Capable of diagnosing system communications.
  6. Capable of having addresses automatically assigned to them.
  7. Receives signals from other wireless devices and provides feedback to user.
  8. Capable of determining which devices have been addressed.

9. RF Range: 60 feet (18 m) line-of-sight or 30 feet (9 m) through typical construction materials between RF transmitting devices and compatible RF receiving devices.
  10. Electromagnetic Interference/Radio Frequency Interference (EMI/RFI) Limits: Comply with FCC requirements of CFR, Title 47, Part 15, for Class B application.
- F. Wireless Network:
1. RF Frequency: 434 MHz; operate in FCC governed frequency spectrum for periodic operation; continuous transmission spectrum is not permitted.
    - a. Wireless sensors, wireless wall stations and wireless load control devices do not operate in the noisy 2.4 GHz frequency band where high potential for RF interference exists.
    - b. Wireless devices operate in an uncongested frequency band providing reliable operation.
    - c. Fixed network architecture ensures all associated lights and load controls respond in a simultaneous and coordinated fashion from a button press, sensor signal, or command from the wireless hub (i.e. no popcorning).
  2. Distributed Architecture: Local room devices communicate directly with each other. If the wireless hub is removed or damaged, local control, sensing, and operation continues to function without interruption.
  3. Local room devices communicate directly with each other (and not through a central hub or processor) to ensure:
    - a. Reliability of system performance.
    - b. Fast response time to events in the space (e.g. button presses or sensor signals).
    - c. Independent operation in the event of the wireless hub being removed or damaged.
- G. Device Finishes:
1. Wall Controls: White; Standard Colors: Comply with NEMA WD1 where applicable.
  2. Color Variation in Same Product Family: Maximum delta E of 1, CIE L\*a\*b color units.
  3. Visible Parts: Exhibit ultraviolet color stability when tested with multiple actinic light sources as defined in ASTM D4674. Provide proof of testing upon request.
- H. Interface with building automation system

### 2.3 WIRELESS SENSORS

- A. General Requirements:
1. Operational life of 10 years without the need to replace batteries when installed per manufacturer's instructions.
  2. Communicates directly to compatible RF receiving devices through use of a radio frequency communications link.
  3. Does not require external power packs, power wiring, or communication wiring.
  4. Capable of being placed in test mode to verify correct operation from the face of the unit.

- B. Wireless Occupancy/Vacancy Sensors:
  - 1. General Requirements:
    - a. Provides a clearly visible method of indication to verify that motion is being detected during testing and that the unit is communicating to compatible RF receiving devices.
    - b. Utilize multiple segmented lens, with internal grooves to eliminate dust and residue build-up.
    - c. Sensing Mechanism: Passive infrared coupled with technology for sensing fine motions; *Lutron XCT Technology*. Signal processing technology detects fine-motion passive infrared (PIR) signals without the need to change the sensor's sensitivity threshold.
    - d. Provide optional, readily accessible, user-adjustable controls for timeout, automatic/manual-on, and sensitivity.
    - e. Turns off lighting after reasonable and adjustable time delay once the last person to occupy the space vacates a room or area. Provide adjustable timeout settings of 1, 5, 15, and 30 minutes.
    - f. Capable of turning dimmer's lighting load on to an optional locked preset level selectable by the user. Locked preset range to be selectable on the dimmer from 1 percent to 100 percent.
    - g. Color: White.
    - h. Provide all necessary mounting hardware and instructions for both temporary and permanent mounting.
    - i. Provide temporary mounting means for drop ceilings to allow user to check proper performance and relocate as needed before permanently mounting sensor. Temporary mounting method to be design for easy, damage-free removal.
    - j. Sensor lens to illuminate during test mode when motion is detected to allow installer to place sensor in ideal location and to verify coverage prior to permanent mounting.
    - k. Ceiling-Mounted Sensors:
      - 1) Provide surface mounting bracket compatible with drywall, plaster, wood, concrete, and compressed fiber ceilings.
      - 2) Provide recessed mounting bracket compatible with drywall and compressed fiber ceilings.
    - l. Wall-Mounted Sensors: Provide wall or corner mounting brackets compatible with drywall and plaster walls.
  - 2. Wireless Combination Occupancy/Vacancy Sensors:
    - a. Ceiling-Mounted Sensors: Programmable to operate as an occupancy sensor (automatic-on and automatic-off), an occupancy sensor with low light feature (automatic-on when less than one footcandle of ambient light available and automatic-off), or a vacancy sensor (manual-on and automatic-off).
    - b. Wall-Mounted Sensors: Programmable to operate as an occupancy sensor (automatic-on and automatic-off), or a vacancy sensor (manual-on and automatic-off).
    - c. Product(s):
      - 1) Ceiling-Mounted Occupancy/Vacancy Sensor; << Lutron Radio Powr Savr Series, Model LFR2-OCR2B-P-WH; or Coverage from 324 square feet (30.2 sq m) to 676 square feet (62.4 sq m) depending on ceiling height from 8 to 12 feet (2.4 to 3.7 m); 360 degree field of view.

- 2) Corner-Mounted Occupancy/Vacancy Sensor; << Lutron Radio Powr Savr Series, Model LFR2-OKLB-P-WH; quare feet (113.8 sq m) and major motion coverage of 2500 square feet (232.3 sq m) with mounting height of 6 to 8 feet (1.8 to 2.4 m); 90 degree field of view.
  - 3) Hallway Occupancy/Vacancy Sensor; << Lutron Radio Powr Savr Series, Model LFR2-OHLB-P-WH Major motion coverage of up to 150 feet (45.7 m) with mounting height of 6 to 8 feet (1.8 to 2.4 m); narrow field of view.
3. Wireless Vacancy-Only Sensors:
- 1) Ceiling-Mounted Vacancy-Only Sensor; << Lutron Radio Powr Savr Series, Model LFR2-VCR2B-P-WH Coverage from 324 square feet (30.2 sq m) to 676 square feet (62.4 sq m) depending on ceiling height from 8 to 12 feet (2.4 to 3.7 m); 360 degree field of view.
  - 2) Wall-Mounted Vacancy-Only Sensor; << Lutron Radio Powr Savr Series, Model LFR2-VWLB-P-WH Minor motion coverage of 1500 square feet (139.4 sq m) and major motion coverage of 3000 square feet (278.7 sq m) with mounting height of 6 to 8 feet (1.8 to 2.4 m); 180 degree field of view.
  - 3) Corner-Mounted Vacancy-Only Sensor; << Lutron Radio Powr Savr Series, Model LFR2-VKLB-P-WH; Minor motion coverage of 1225 square feet (113.8 sq m) and major motion coverage of 2500 square feet (232.3 sq m) with mounting height of 6 to 8 feet (1.8 to 2.4 m); 90 degree field of view.
  - 4) Hallway Vacancy-Only Sensor; << Lutron Radio Powr Savr Series, Model LFR2-VHLB-P-WH; or Lutron Radio Powr Savr Series Major motion coverage of up to 150 feet (45.7 m) with mounting height of 6 to 8 feet (1.8 to 2.4 m); narrow field of view.
- C. Wireless Daylight Sensors:
1. Product: *Lutron Radio Powr Savr Series, Model LFR2-DCRB-WH.*
  2. Open-loop basis for daylight sensor control scheme.
  3. Stable output over temperature from 32 degrees F (0 degrees C) to 104 degrees F (40 degrees C).
  4. Partially shielded for accurate detection of available daylight to prevent fixture lighting and horizontal light component from skewing sensor detection.
  5. Provide linear response from 2 to 150 footcandles.
  6. Color: White.
  7. Mounting:
    - a. Provide surface mounting bracket compatible with drywall, plaster, wood, concrete, and compressed fiber ceilings.
    - b. Provide all necessary mounting hardware and instructions for both temporary and permanent mounting.
    - c. Provide temporary mounting means for drop ceilings to allow user to check proper performance and relocate as needed before permanently mounting sensor. Temporary mounting method to be design for easy, damage-free removal.
  8. Meets CAL TITLE 24 P6 requirements.

## 2.4 LOAD CONTROL MODULES

- A. Provide wireless load control modules as indicated or as required to control the loads as indicated.
- B. Junction Box-Mounted Modules:
1. Plenum rated.
  2. 0-10 V Dimming Modules:
    - a. Product(s):
      - 1) 8 A dimming module with 0-10V control, without emergency lighting mode; << Lutron PowPak Dimming Module Model RMJS-8T-DV-B8 A dimming module with 0-10V control, with emergency lighting mode; Lutron PowPak Dimming Module Model RMJS-8T-DV-B-EM.
    - b. Communicates via radio frequency with up to ten compatible occupancy/vacancy sensors, ten wireless control stations, and one daylight sensor.
    - c. Single low voltage dimming module with Class 1 or Class 2 isolated 0-10V output signal conforming to IEC 60929 Annex E.2; source or sink automatically configures.
    - d. Selectable minimum light level.
    - e. Configurable high- and low-end trim.
    - f. Relay: Rated for 0-10 V ballasts, LED drivers, or fixtures that conform with NEMA 410.
    - g. Dimming Modules with Emergency Lighting Mode:
      - 1) Operation With *Lutron Vive* Wireless Hub: Upon loss of power, dimming module enters and remains in emergency lighting mode as long as wireless hub is de-energized; upon restoration of power to wireless hub, dimming module returns to normal mode and lights automatically return to same levels (dimmed setting, full on, or full off) as prior to power interruption.
      - 2) Operation Without *Lutron Vive* Wireless Hub: Upon loss of power, dimming module enters and remains in emergency lighting mode for 90 minutes, during which time local unit buttons and wireless controls are disabled.
      - 3) UL 924 listed.
  3. Relay Modules:
    - a. Product(s):
      - 1) 16 A relay module, without emergency lighting mode, without contact closure output; << Lutron PowPak Relay Module Model RMJS-16R-DV-B
      - 2) 16 A relay module, with emergency lighting mode, without contact closure output; Lutron PowPak Relay Module Model RMJS-16R-DV-B-EM.
      - 3) 5 A relay module, without emergency lighting mode, without contact closure output; *Lutron PowPak Relay Module Model RMJS-5R-DV-B*.
    - b. Communicates via radio frequency with up to ten compatible occupancy/vacancy sensors, ten wireless control stations, and one daylight sensor.
    - c. Relay:



- 1) Rated Life of Relay: Typical of 1,000,000 cycles at fully rated 16 A for all lighting loads.
  - 2) Load switched in manner that prevents arcing at mechanical contacts when power is applied to and removed from load circuits.
  - 3) Fully rated output continuous duty for inductive, capacitive, and resistive loads.
- d. Contact Closure Output:
- 1) Single contact closure output with normally open and normally closed dry maintained contacts suitable for connection to third party equipment (e.g. building management system, HVAC system, etc.).
  - 2) Contact Ratings: Resistive load; 1 A at 0-24 VDC, 0.5 A at 0-24 VAC.
  - 3) Controlled by associated occupancy/vacancy sensors and wall controls.
- e. Relay Modules With Emergency Lighting Mode:
- 1) Operation With *Lutron Vive* Wireless Hub: Upon loss of power, relay module enters and remains in emergency lighting mode as long as wireless hub is de-energized; upon restoration of power to wireless hub, relay module returns to normal mode and lights automatically return to same levels (dimmed setting, full on, or full off) as prior to power interruption.
  - 2) Operation Without *Lutron Vive* Wireless Hub: Upon loss of power, relay module enters and remains in emergency lighting mode for 90 minutes, during which time local unit buttons and wireless controls are disabled.
  - 3) UL 924 listed.
- f. Relay:
- 1) Load switched in manner that prevents arcing at mechanical contacts when power is applied to and removed from load circuits.
  - 2) Motor rating of 1 HP at 120 V, 2 HP at 277 V.

## 2.5 WIRED WALL DIMMERS AND SWITCHES WITH WIRELESS COMMUNICATION INPUTS

### A. General Requirements:

1. Provide air gap service switch to disconnect power to load for safe lamp replacement, accessible without removing faceplate.

## 2.6 low voltage (600 W, 120 V); neutral required; multi-location capability WIRED WALLBOX OCCUPANCY SENSORS WITH WIRELESS COMMUNICATION INPUTS

### A. 0-10 V Wall Dimmer/Switch Combination Occupancy/Vacancy Sensors with Wireless Communication Inputs; *Lutron Maestro Wireless 0-10 Dimmer Sensor/Maestro Wireless Sensor Switch Series*:

1. Communicates via radio frequency with up to ten compatible wireless occupancy/vacancy sensors, ten wireless control stations, and one wireless daylight sensor.

2. Compatible with sourcing electronic 0-10 V ballasts/drivers, as per IEC 60929 Annex E.2 0-10 V protocol.
3. Selectable option to enable low light feature (automatic-on when ambient light is below threshold). Ambient light threshold to be selectable as either adaptive utilizing occupant feedback (Lutron Smart Ambient Light Detection) or as fixed (high, medium, low, and minimum presets).
4. Occupancy/Vacancy Sensors:
  - a. Utilize multiple segmented lens, with internal grooves to eliminate dust and residue build-up.
  - b. Sensing Mechanism: Passive infrared coupled with technology for sensing fine motions; *Lutron XCT Technology*. Signal processing technology detects fine-motion passive infrared (PIR) signals without the need to change the sensor's sensitivity threshold.
  - c. Programmable to operate as an occupancy sensor (automatic-on and automatic-off) or a vacancy sensor (manual-on and automatic-off).
  - d. Turns off lighting after reasonable and adjustable time delay once the last person to occupy the space vacates a room or area; adjustable timeout settings (1, 5, 15, or 30 minutes).
  - e. Adjustable sensitivity (high, medium, low, and minimum presets).
  - f. Selectable option to inhibit automatic turn-on of lights after manual-off operation while room is occupied for applications such as presentation viewing in conference rooms and classrooms; when room is vacated, returns to normal automatic-on operation after time delay period.
  - g. Selectable walk-through mode to override selected timeout and automatically turn off lights if no motion is detected within 3 minutes after initial occupancy for applications where space may be briefly occupied.
5. Vacancy-Only Sensors:
  - a. Operates only as a vacancy sensor (manual-on and automatic-off) << *in accordance with California Title 24 requirements* >>.
  - b. Adjustable sensitivity (high, medium, low, and minimum presets).
6. Dimmer Features:
  - a. Adjustable high/low end trims.
  - b. Selectable dimming curve (linear or switched).
  - c. Selectable fade on/fade off times (15, 5, 2.5, or 0.75 sec).
  - d. Adjustable auto-on light level (fully adjustable from one to 100 percent).
7. Dimmer Control: Multi-function tap switch with small, raised rocker for dimmer adjustment.
  - a. Rocker raises/lowers light level, with new level becoming the current preset level.
  - b. Switch single tap raises lights to preset level or fades lights to off.
  - c. Switch double tap raises light to full on level.
8. Switch Control: Switch single tap turns lights on/off.

## 2.7 LESS CONTROL STATIONS

- A. Product(s):
  1. 2-Button Control; <<Lutron Pico Wireless Control Model PJ2-2B;
    - a. Button Marking: <<Light (icons); As indicated on drawings
  2. 2-Button with Raise/Lower Control; <<Lutron Pico Wireless Control Model PJ2-2BRL

- a. Button Marking: <<Light (icons)
  3. 3-Button Control; <<Lutron Pico Wireless Control Model PJ2-3B;
  4. Button Marking: <<Light (icons); 3-Button with Raise/Lower Cl; <<Lutron Pico Wireless Control Model PJ2-3BRL
    - a. Button Marking: <<Light (icons);
    - b. ; <<Lutron Pico Wireless Control Model PJ2-4B; Button Marking: <<Zone controls (light); Scene keypads (light); 2-group controllers (lights); 4-group toggle
  5. Wallbox Adapter; *Lutron Model PICO-WBX-ADAPT*.
- B. Quantity: <<As indicated on the drawings; Communicates directly to compatible RF receiving devices through use of a radio frequency communications link.
- C. Does not require external power packs, power or communication wiring.
- D. Allows for easy reprogramming without replacing unit.
- E. Button Programming:
  1. Single action.
  2. Toggle action.
- F. Includes LED to indicate button press or programming mode status.
- G. Mounting:
  1. Capable of being mounted with a table stand or directly to a wall under a faceplate.
  2. Faceplates: Provide concealed mounting hardware.
- H. Power: Battery-operated with minimum ten-year battery life (3-year battery life for night light models).
- I. Finish: <<As specified for wall controls in "Device Finishes" under LIGHTING CONTROLS - GENERAL REQUIREMENTS article above; White; .

## 2.8 WIRELESS HUBS

1. Wireless hub with BACnet; *Lutron Vive Premium Hub*.
  - a. Flush-mount wireless hub; *Model HJS-2-FM*; supports up to 700 total paired devices.
- B. Integrated multicolor LED provides feedback on what mode the hub is in for simple identification and diagnosis.
- C. Integrated processor and web server allows hub to set up and operate the system without any external connections to outside processors, servers, or the internet.
- D. Utilizes Ethernet connection for:
  1. Networking up to 64 hubs together to create a larger system.
  2. Integration with Building Management System (BMS) via native BACnet; does not require interface (*Lutron Vive Premium* wireless hub with BACnet only).

3. Remote connectivity capabilities, including maintaining system date/time and receiving periodic firmware updates (requires internet connection).
- E. A single hub or network of hubs can operate on either a dedicated lighting control only network or can be integrated with an existing building network as a VLAN.
- F. Communicates directly to compatible *Lutron Vive* RF devices through use *Lutron Clear Connect* radio frequency communications link; does not require communication wiring; RF range of 71 feet (23 m) through walls to cover an area of 15836 square feet (1471 sq m) (device and hub must be on the same floor).
- G. Communicates directly to mobile device (smartphone or tablet) or computer using built-in Wi-Fi, 2.4 GHz 802.11b/g; wireless range of 71 feet (23 m) through walls (device and hub must be on the same floor).
  1. Does not require external Wi-Fi router for connecting to the hub.
- H. Allows for system setup, control, and monitoring from mobile device or computer using *Vive* web-based software:
  1. Supports paired devices up to maximum number indicated including compatible wireless sensors, wireless control stations, and wireless load devices.
  2. Allows for timeclock scheduling of events, both time of day and astronomic (sunrise and sunset).
    - a. Timeclock is integrated into the unit and does not require a constant internet connection.
    - b. Retains time and programming information after a power loss.
    - c. 365-day schedulable timeclock allows for:
      - 1) Scheduling of events years in advance.
      - 2) Setting of recurring events with exceptions on holidays.
    - d. Time clock events can be scheduled to:
      - 1) Send lights to a desired level and select the fade rate desired to reach that level.
      - 2) Adjust level lights go to when occupied.
      - 3) Adjust level lights go to when unoccupied.
      - 4) Enable/disable occupancy.
      - 5) Control individual devices, areas, or groups of areas. When connected to *Vive Vue* server, only areas or groups of areas can be controlled with timeclock events.
  3. Daylighting:
    - a. Daylighting can be enabled/disabled. Can be used to override the control currently taking place in the space.
    - b. Daylight set point can be adjusted with the software to increase or decrease the electric light level in the room based on the same amount of natural light.
  4. Allows for control, monitoring, and adjustment from anywhere in the world (*Lutron Vive* wireless hub internet connection required).
  5. Uses RF signal strength detection to find nearby devices for quick association and programming without having to climb ladders.
    - a. Association and setup does not require a factory technician to perform.
  6. System using *Lutron Vive* wireless hub(s) can operate with or without connection to the internet.
  7. Supports energy reporting.

- a. Reports measured energy data for *PowPak* fixture control modules at accuracy of plus/minus 2 percent or 0.5 W (whichever is higher).
  - b. Reports calculated energy data for *PowPak* junction box mounted modules at accuracy of 10 percent.
  - c. .
  - 8. Supports automatic demand response for load shedding via:
    - a. Local contact closure without need for separate interface.
    - b. OpenADR® 2.0b compliant utility command.
    - c. BACnet (*Lutron Vive Premium* wireless hub with BACnet only).
  - 9. Wireless hub can be firmware upgraded to provide new software features and system updates.
    - a. Firmware update can be done either locally using a wired Ethernet connection or Wi-Fi connection, or remotely if the wireless hub is connected to the internet.
- I. *Lutron Vive* Web-Based Application:
- 1. Accessibility and Platform Support:
    - a. Web-based; runs on most HTML5 compatible browsers (including Safari and Chrome).
    - b. Supports multiple platforms and devices; runs from a tablet, desktop, laptop, or smartphone.
    - c. User interface supports multi-touch gestures such as pinch to zoom, drag to pan, etc.
    - d. Utilizes HTTPS (industry-standard certificate-based encryption and authentication for security).
    - e. Multi-level Password Protected Access: Individual password protection on both the integrated Wi-Fi network and web-based software.
    - f. WPA2 security for Wi-Fi communication with wireless hub.
  - 2. System Navigation and Status Reporting:
    - a. Area Tree View: Easy navigation by area name to view status and make programing adjustments through the software.
    - b. Area and device names can be changed in real time.
  - 3. Setup app available for iOS and Android that allows for:
    - a. Job registration to extend product warranty.
    - b. Management of setup for multiple projects in different locations.
    - c. Creation of handoff documents that are sent directly to a facility manager via email once setup is complete.
    - d. Backup of *Vive* wireless hub database to *Lutron* cloud for hub replacement.
    - e. Access to native help and instructions to assist user with *Vive* system setup.
- J. BACnet Integration (*Lutron Vive Premium* wireless hub with BACnet only):
- 1. Provide ability to communicate by means of native BACnet IP communication (does not require interface) to lighting control system from a user-supplied 10BASE-T or 100BASE-T Ethernet network.
  - 2. Requires only one network connection per hub.
  - 3. BACnet Integrator Capabilities:
    - a. The BACnet integrator can command:
      - 1) Area light output.

- 2) Area load shed level.
- 3) Area load shed enable/disable.
- 4) Enable/Disable:
  - (a) Area occupancy sensors.
  - (b) Area daylighting.
- 5) Daylighting level.
- 6) Area occupied and unoccupied level
- 7) Occupancy sensor timeouts (for fixture sensors).
- b. The BACnet integrator can monitor:
  - 1) Area on/off status.
  - 2) Area occupancy status.
  - 3) Area load shed status.
  - 4) Area instantaneous energy usage and maximum potential power usage.
  - 5) Enable/Disable:
    - (a) Area occupancy sensors.
    - (b) Daylighting.
    - (c) Timeclocks.
  - 6) Daylighting level.
  - 7) Light levels from photo sensors.
  - 8) Area occupied and unoccupied level.
  - 9) Occupancy sensor timeouts.
- K. Contact Closure Interface: Provide two contact closure inputs; accepts both momentary and maintained contact closures that can be used for automatic demand response.
- L. Rated for use in air-handling spaces as defined in UL 2043.
- M. Meets CAL TITLE 24 P6 requirements.
- N. Provide Ethernet switch(es) as required for inter-hub network wiring per manufacturer's instructions; do not exceed manufacturer's required maximum wiring segment lengths.
  - 1. Product(s):
    - a. *Lutron Model ETH-SWITCH-16*; 16 port.

## 2.9 SOFTWARE DATA AND ANALYTICS DASHBOARD

- A. Control and Monitor Software:
  - 1. Product: *Lutron Vive Vue*.
  - 2. General Requirements:
    - a. Web-based; runs on most HTML5 compatible browsers (including Internet Explorer, Chrome, and Safari).
    - b. Supports multiple platforms and devices; runs from a tablet, desktop, laptop, or smartphone; optimized for displays of 1024 by 768 pixels or higher.
    - c. User interface supports multi-touch gestures such as pinch to zoom, drag to pan, etc.

- d. Utilizes HTTPS (industry-standard certificate-based encryption and authentication for security).
- e. All functionality listed below must be available via a single application.
- 3. System Navigation and Status Reporting:
  - a. Performed using graphical floor plan view or a generic system layout.
  - b. Graphical Floor Plan View: Utilizes customized CAD based drawing of the building. Pan and zoom feature allows for easy navigation; dynamically adjusts the details presented based on zoom level.
- 4. Control of Lights:
  - a. Control and monitor zone/area lights.
    - 1) Area lights can be monitored for on/off status from a graphical floor plan or generic system layout.
    - 2) All lights in an area can be turned on/off (dimmable lights can also be dimmed up/down from current level).
- 5. Occupancy:
  - a. Area occupancy can be monitored.
    - 1) Can be monitored graphically if a graphical floor plan has been created.
    - 2) Can be monitored historically in space utilization reports.
  - b. Scheduled events can be created to change occupancy parameters as described under “Scheduling” below.
- 6. Load Shedding: View current load shed status (active/inactive) for each *Vive* wireless hub and enable/disable load shed for the entire building/system.
- 7. Scheduling: Schedule time of day and astronomic time clock events to automate functions.
  - a. Scheduled events can control the following:
    - 1) Area light levels for all dimmable lights in an area.
    - 2) On/off status of all switched lights and contact-closure outputs in an area.
    - 3) On/off status of all switched receptacles in an area.
  - b. Scheduled events can be created to change the following occupancy parameters:
    - 1) Enable/disable sensors.
    - 2) Change occupancy mode (auto-on/auto-off versus manual-on/auto-off).
    - 3) Adjust occupied and/or unoccupied level.
    - 4) For compatible individual fixture sensors, sensor timeout can be adjusted.
  - c. Easily monitor and adjust scheduled events using a weekly calendar view.
- 8. Reporting: Provide reporting capability that allows the building manager to gather real-time and historical information about the system as follows:
  - a. Energy Reports: Show a comparison of cumulative energy used over a period of time for one or more areas.
  - b. Power Reports: Show power usage trend over a period of time for one or more areas.
  - c. Space Utilization/Occupancy Reports: Show historical occupancy over a period of time for one or more areas using a graphical floor plan, generic system layout, and graphs and charts.
- 9. Administration:

- a. Users: Allows new user accounts to be created and existing user accounts to be edited.
    - 1) Supports Active Directory (LDAP) tying user accounts to network accounts.
  - b. Area and feature access can be restricted based on login credentials.
  - c. Supports up to 20 concurrent users and 10,000 user accounts.
10. Devices/Settings Adjustment:
- a. Users with appropriate permissions can navigate to the wireless hub setup screens in order to view and/or adjust specific settings for areas or devices (including load shed settings, daylighting settings, device associations and programming, occupancy settings, high-end/low-end trim settings, etc).

#### 2.10 SOURCE QUALITY CONTROL

- A. See Section 01 4000 - *Quality Requirements*, for additional requirements.
- B. Factory Testing; *Lutron Standard Factory Testing*:
  - 1. Perform full-function factory testing on all completed assemblies. Statistical sampling is not acceptable.
  - 2. Perform full-function factory testing on 100 percent of all ballasts and LED drivers.

### PART 3 EXECUTION

#### 3.1 EXAMINATION

- A. Verify that field measurements are as shown on the drawings.
- B. Verify that ratings and configurations of system components are consistent with the indicated requirements.
- C. Verify that mounting surfaces are ready to receive system components.
- D. Verify that conditions are satisfactory for installation prior to starting work.

#### 3.2 PREPARATION

- A. System and Network Integration Consultation; *Lutron LSC-INT-VISIT*: Include additional costs for Lighting Control Manufacturer to conduct meeting with facility representative and other related equipment manufacturers to discuss equipment and integration procedures.
  - 1. Coordinate scheduling of visit with Lighting Control Manufacturer. Manufacturer recommends that this visit be scheduled early in construction phase, after system purchase but prior to system installation.

#### 3.3 INSTALLATION

- A. Perform work in a neat and workmanlike manner in accordance with NECA 1 and, where applicable, NECA 130. Install products in accordance with manufacturer's instructions.



- B. Sensor Locations:
  - 1. Where Lighting Control Manufacturer Sensor Layout and Tuning service is specified in Part 2 under "LIGHTING CONTROLS - GENERAL REQUIREMENTS", locate sensors in accordance with layout provided by Lighting Control Manufacturer. Lighting Control Manufacturer may direct Contractor regarding sensor relocation should conditions require a deviation from locations indicated. Where Lighting Control Manufacturer Sensor Layout and Tuning service is not specified, locate sensors in accordance with Drawings.
  - 2. Sensor locations indicated are diagrammatic. Within the design intent, reasonably minor adjustments to locations may be made in order to optimize coverage and avoid conflicts or problems affecting coverage, in accordance with manufacturer's recommendations.
- C. Ensure that daylight sensor placement minimizes sensor view of electric light sources. Locate ceiling-mounted and luminaire-mounted daylight sensors to avoid direct view of luminaires.
- D. Lamp Burn-In: Operate lamps at full output for prescribed period per manufacturer's recommendations prior to use with any dimming controls. Replace lamps that fail prematurely due to improper lamp burn-in.
- E. Lamp Lead Lengths: Do not exceed 3 feet (0.9 m) for T4 4-pin compact and T5 BIAx lamps and 7 feet (2.1 m) for T5, T5-HO, T8 U-bend, and T8 linear fluorescent lamps.
- F. LED Light Engine/Array Lead Length: Do not exceed 100 feet (31 m).
- G. Identify system components in accordance with Section 26 0553.

#### 3.4 FIELD QUALITY CONTROL

- A. See Section 01 4000 - *Quality Requirements*, for additional requirements.
- B. Manufacturer's Full-Scope Start-Up Service: Provide On-Site Full-Scope Start-Up Service by authorized Lutron System technician.
  - 1. On-Site Full-Scope Start-Up Service; *Lutron LSC-OS-SU-VIVE*: Manufacturer's authorized Service Representative to conduct site visit upon completion of lighting control system installation to perform system startup and verify proper operation:
    - a. Where Lighting Control Manufacturer Sensor Layout and Tuning service is specified in Part 2 under "LIGHTING CONTROLS - GENERAL REQUIREMENTS", authorized Service Representative to verify sensor locations, in accordance with layout provided by Lighting Control Manufacturer; Lighting Control Manufacturer may direct Contractor regarding sensor relocation should conditions require a deviation from locations indicated.
    - b. Verify connection of power wiring and load circuits.
    - c. Verify connection and location of controls.
    - d. Energize wireless hubs.
    - e. Associate occupancy/vacancy sensors, daylight sensors, wireless remotes, and wall stations to load control devices.

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- f. Provide initial rough calibration of sensors; fine-tuning of sensors is responsibility of Contractor unless provided by Lighting Control Manufacturer as part of Sensor Layout and Tuning service where specified in Part 2 under "LIGHTING CONTROLS - GENERAL REQUIREMENTS".
- g. Program timeclock schedules per approved sequence of operations.
- h. Configure load shed parameters per approved sequence of operations.
- i. Verify system operation control by control.
- j. Obtain sign-off on system functions.
- k. Train Owner's representative on system capabilities, operation, and maintenance, as specified in Part 3 under "Closeout Activities".

### 3.5 CLEANING

- A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

### 3.6 COMMISSIONING

- A. See Section 01 9113 for commissioning requirements.
- B. Training:
  - 1. Include services of manufacturer's certified service representative to perform on-site training of Owner's personnel on operation, adjustment, and maintenance of lighting control system as part of on-site system start-up services.
  - 2. Customer-Site Solution Training Visit; *Lutron LSC-TRAINING-SP*: Include as part of the base bid additional costs for Lighting Control Manufacturer to provide (1) day of additional on-site system training.

### 3.7 MAINTENANCE

- A. See Section 01 7000 – *Execution and Closeout Requirements*, for additional requirements relating to maintenance service.

### 3.8 PROTECTION

- A. Protect installed products from subsequent construction operations.

END OF SECTION 260924

## SECTION 262200 - LOW-VOLTAGE TRANSFORMERS

### 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: Distribution and buck-boost dry-type transformers rated 600 V and less, with capacities up to 1500 kVA
- B. Copper-wound transformers exceeding US Department of Energy 2016 mandated minimum efficiency. These transformers shall be UL listed to feed a K-7 electronic equipment load profile and be optimized to minimize operating cost under light loading.
- B. Compliance with full specification is required
- C. Basic compliance with NEMA TP1/EPACT2005, NEMA Premium, CEE Tier 1, or CSL3 is not sufficient to meet this specification due to the following:
  - 1. Efficiencies must exceed the US DOE 2016 minimum requirement
  - 2. No load losses must comply with those defined in this specification
  - 3. Efficiency at low load and under nonlinear K-7 load must meet the minimum requirements of this specification
  - 4. K-7 listing per UL 1561 is required
  - 5. Comprehensive testing under linear and nonlinear loading is required to verify specified performance
  - 6. Performance submittals are required
- D. Load Mix: Transformer shall be UL 1561 Listed to feed a mix of equipment load profiles such as computers without de-rating or significant degradation of efficiency.

#### 1.3 REFERENCES

- A. US Department of Energy, 10 CFR Part 431, April 18, 2013. Energy Conservation Program: Energy Conservation Standards for Distribution Transformers; Final Rule
- B. DOE Test Method for Measuring the Energy Consumption of Distribution Transformers under Appendix A to Subpart K of 10 CFR part 431.
- C. ANSI/NEMA ST 20 - Dry Type Transformers for General Applications.
- D. NEMA Premium Efficiency Transformers Program

## SECTION 262200 - LOW-VOLTAGE TRANSFORMERS

- E. Consortium for Energy Efficiency (CEE): Specification for Low-Voltage, Dry- Type Distribution Transformers
- F. EPACT 2005 - United States Energy Policy Act 2005 / NEMA TP1 - Guide for Determining Energy Efficiency for Distribution Transformers
- G. ANSI/NEMA TP-2 – Standard Test Method for Measuring Energy Consumption of Distribution Transformers
- H. Metering Standards:
  - 1. Computational algorithms per IEEE Std 1459-2000
  - 2. UL 916, UL 61010C-1 CAT III
- I. IEEE C57.110-1998 – IEEE Recommended Practice for establishing transformer capability when feeding nonsinusoidal load currents
- J. IEEE Std C57.12.91-1995 Standard Test Code for Dry-Type Transformers
- K. IEEE-1100 – Recommended Practice for Powering and Grounding Sensitive Electronic Equipment
- L. LEED – Leadership in Energy and Environmental Design, U.S. Green Building Council.
- M. Seismic Qualification References: International Building Code, 2006/2009 Edition, California Building Code, 2007/2010 Edition, ASCE Standard 7, 2005 Edition to OSHPD CAN 2-1708A.5, Rev. , ICC-ES AC 156, Effective 01/01/2007, OSHPD
- N. ISO 9001:2008 – International Standards Organization - Quality Management System
- O. ISO 14001:2004 – International Standards Organization - Environmental Management System
- P. ISO 17025 – International Standards Organization - General requirements for the competence of testing and calibration laboratories

### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type and size of transformer.
  - 2. Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, and performance for each type and size of transformer.
- B. Certified Test Reports
  - 1. Provide test reports certified by factory test engineer for both transformer types and each kVA used on this project documenting compliance of previously manufactured units.
  - 2. Provide details of factory ISO compliant production nonlinear load test
  - 3. Provide performance under nonlinear load profile typical of modern electronic equipment

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4. Provide NEMA TP2 test reports

C. Shop 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. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment.
3. Include diagrams for power, signal, and control wiring.

D. Qualification Data: For testing agency.

E. Source quality-control reports.

F. Field quality-control reports.

### 1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For transformers to include in emergency, operation, and maintenance manuals.

### 1.5 MANUFACTURERS

A. Subject to compliance with requirements, manufacturers offering transformers that may be incorporated into the Work include the following:

1. Powersmiths International Corp Model ESAVER2016 (Non-harmonics canceling type).
2. Powersmiths International Corp. Model T10002016 (harmonics canceling type).
3. Square D NEMA Premium 30
4. Eaton corp. CSL3
5. Others as approved by Engineer prior to bidding.

B. Source Limitations: Obtain each transformer type from single source from single manufacturer.

### 1.1 GENERAL TRANSFORMER REQUIREMENTS

- A. Description: Factory-assembled and -tested, air-cooled units of types specified, designed for 60-Hz service.
- B. Cores: Grain-oriented, non-aging silicon steel.
- C. Coils: Continuous windings without splices, except for taps.
- D. Internal Coil Connections: Brazed or pressure type.
- E. Enclosure: Class complies with NEMA 250 for the environment in which installed.
- F. Warranty: 25 years pro-rated

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- G. International Standard Organization registration
  - 1. Registration to current ISO standard is required.
  - 2. Independent annual audits are required.
  - 3. Product shall be manufactured in registered facility
  - 4. ISO 9001:2000 Registered – Quality Management System
  - 5. ISO 14001:2004 Registered – Environmental Management System
  
- H. Low-Sound-Level Units: NEMA ST 20 standard sound levels when factory tested according to IEEE C57.12.91. All units on this project to be sound level tested and meet the NEMA ST-20 levels.
  
- I. Wall Brackets: Manufacturer's standard brackets.

1.2 GENERAL-PURPOSE DISTRIBUTION AND POWER TRANSFORMERS

- A. Comply with NEMA ST 20 and list and label as complying with UL 1561.
- B. Cores: One leg per phase.
- C. Windings: One coil per phase in primary and secondary.
- D. K-Factor rating: K-7
- E. Exceed minimum efficiency requirements of US Department of Energy, 10 CFR Part 431, April 18, 2013, Energy Conservation Program: Energy Conservation Standards for Distribution Transformers; Final Rule which takes effect January 1, 2016, and comply with the table of Maximum No Load Losses, efficiency requirements at 1/6 load, efficiency at 35% load per 10 CFR Part 431, and efficiency at 25% load under a K-7 load profile.

kVA	No load losses (Watts)	Efficiency @ 1/6 load (%)	Efficiency @ 35% load (%)	Efficiency at 25% load under K-7 nonlinear load
15	47	97.85%	98.28	98.00%
20	60	98.05%	98.34	98.10%
25	66	98.15%	98.41	98.15%
30	71	98.27%	98.50	98.30%
45	97	98.40%	98.66	98.40%
50	112	98.45%	98.67	98.42%
63	120	98.50%	98.75	98.48%
75	135	98.63%	98.82	98.60%
100	180	98.65%	98.88	98.65%
112.5	195	98.70%	98.92	98.70%
125	215	98.73%	98.94	98.72%
150	235	98.80%	98.99	98.80%
175	270	98.82%	99.02	98.82%
200	310	98.84%	99.05	98.84%

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<b>225</b>	330	98.90%	99.09	98.90%
<b>250</b>	365	98.91%	99.10	98.92%
<b>300</b>	400	98.95%	99.15	99.00%
<b>400</b>	530	98.96%	99.20	99.02%
<b>450</b>	600	98.97%	99.22	99.03%
<b>500</b>	650	99.00%	99.25	99.05%
<b>600</b>	800	99.01%	99.28	99.07%
<b>750</b>	875	99.10%	99.32	99.10%
<b>850</b>	950	99.11%	99.34	99.11%
<b>1000</b>	1200	99.12%	99.36	99.12%

- F. Enclosure: Indoor, ventilated with lockable hinged door
- G. Maximum Footprint for 115 degree C rise model in a NEMA 1 enclosure:
1. 18" Wide x 17" Deep x 27" High for 15kVA.
  2. 26" Wide x 18" Deep x 30" High for 20, 30, 45kVA
  3. 33" Wide x 22" Deep x 40" High for 50, 63, 75, 100, 112.5kVA
  4. 38" Wide x 27" Deep x 48" High for 125,150, 175, 200kVA
  5. 38" Wide x 32" Deep x 52" High for 225, 250, 300kVA
  6. 52" Wide x 38" Deep x 61" High for 400, 450, 500kVA
  7. 64" Wide x 47" Deep x 67" High for 600, 750kVA
  8. 64" Wide x 53" Deep x 67" High for 850, 1000kVA
- H. Insulation Class: 185 or 220 deg C class for transformers 15 kVA or smaller; 220 deg C class for transformers larger than 15 kVA.
- I. Rated Temperature Rise: 130 deg C maximum rise above 40 deg C.
- J. Taps: For transformers 3 kVA and larger, full-capacity taps in high-voltage windings are as follows:
1. If all transformers have same voltage taps, select from 4 subparagraphs below. If taps vary, delete all and show on Drawings. First item is standard.
  2. Taps, 3 through 25 kVA: Two 5-percent taps below rated high voltage.
  3. Taps, 3 through 10 kVA: Two 5-percent taps below rated high voltage.
  4. Taps, 15 through 500 kVA: Six 2.5-percent taps, 2 above and 4 below rated high voltage.
- K. Electrostatic Shielding: Each winding is independently single shielded with a full-width copper electrostatic shield arranged to minimize interwinding capacitance.
1. Coil leads and terminal strips are arranged to minimize capacitive coupling between input and output connections.
  2. Shield Terminal: Separate; marked "Shield" for grounding connection.
  3. Capacitance: Shield limits capacitance between primary and secondary to a maximum of 33 picofarads over a frequency range of 20 Hz to 1 MHz.

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4. Common-Mode Noise Attenuation: Minus 120 dB minimum, 0.5 to 1.5 kHz; minus 65 dB minimum, 1.5 to 100 kHz.
5. Normal-Mode Noise Attenuation: Minus 52 dB minimum, 1.5 to 10 kHz.

### 1.3 HARMONIC CANCELING TRANSFORMERS

- A. Transformers designed to treat a broad spectrum of odd harmonic currents, up to the 25<sup>th</sup> harmonic frequency.
- B. 3<sup>rd</sup> Harmonic Treatment: 3<sup>rd</sup>, 9<sup>th</sup>, and other zero sequence currents shall not be coupled into the primary winding.
- C. Voltage Distortion: Change in voltage THD between transformer primary and secondary terminals shall be minimized.
- D. Fundamental current imbalance shall be reduced on the primary side of the transformer compared to the secondary side.
- E. Exceed minimum efficiency requirements of US Department of Energy, 10 CFR Part 431, April 18, 2013, Energy Conservation Program: Energy Conservation Standards for Distribution Transformers; Final Rule which takes effect January 1, 2016, and comply with the table of Maximum No Load Losses, efficiency requirements at 1/6 load, efficiency at 35% load per 10 CFR Part 431, and efficiency at 50% load under a K-7 load profile.

kVA	No load losses (Watts)	Efficiency @ 1/6 load (%)	Efficiency @ 35% load (%)	Efficiency at 50% load under K-9 nonlinear load
15	52	97.80%	98.28%	97.75%
20	66	97.95%	98.34%	97.80%
25	73	98.00%	98.41%	97.85%
30	78	98.20%	98.50%	97.88%
45	107	98.30%	98.66%	97.95%
50	123	98.35%	98.67%	97.98%
63	132	98.40%	98.75%	98.00%
75	149	98.50%	98.82%	98.10%
100	198	98.57%	98.88%	98.30%
112.5	215	98.60%	98.92%	98.35%
125	237	98.65%	98.94%	98.40%
150	259	98.70%	98.99%	98.47%
175	297	98.72%	99.02%	98.50%
200	341	98.75%	99.05%	98.55%
225	363	98.80%	99.09%	98.60%
250	402	98.83%	99.10%	98.63%
300	440	98.88%	99.15%	98.70%
400	583	98.90%	99.20%	98.73%



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<b>450</b>	660	98.92%	99.22%	98.75%
<b>500</b>	715	98.94%	99.25%	98.77%
<b>600</b>	880	98.95%	99.28%	98.79%
<b>750</b>	963	98.96%	99.32%	98.84%
<b>850</b>	1045	98.98%	99.34%	98.96%
<b>1000</b>	1320	99.00%	99.36%	98.90%

- F. Enclosure: Indoor, ventilated with lockable hinged door
- G. Maximum Footprint for 115 degree C rise model in a NEMA 1 enclosure:
  - 1. 18" Wide x 17" Deep x 27" High for 15kVA.
  - 2. 26" Wide x 18" Deep x 30" High for 20, 30, 45kVA
  - 3. 33" Wide x 22" Deep x 40" High for 50, 63, 75, 100, 112.5kVA
  - 4. 38" Wide x 27" Deep x 48" High for 125,150, 175, 200kVA
  - 5. 38" Wide x 32" Deep x 52" High for 225, 250, 300kVA
  - 6. 52" Wide x 38" Deep x 61" High for 400, 450, 500kVA
  - 7. 64" Wide x 47" Deep x 67" High for 600, 750kVA
  - 8. 64" Wide x 53" Deep x 67" High for 850, 1000kVA
- H. Insulation Class: 185 or 220 deg C class for transformers 15 kVA or smaller; 220 deg C class for transformers larger than 15 kVA.
- I. Rated Temperature Rise: 115 deg C maximum rise above 40 deg C.
- J. Taps: For transformers 3 kVA and larger, full-capacity taps in high-voltage windings are as follows:
- K. Taps, 15 through 500 kVA: Four 2.5-percent taps, 2 above and 2 below rated high voltage.
- L. Electrostatic Shielding: Each winding is independently single shielded with a full-width copper electrostatic shield arranged to minimize interwinding capacitance.
- M. Coil leads and terminal strips are arranged to minimize capacitive coupling between input and output connections.
  - 1. Shield Terminal: Separate; marked "Shield" for grounding connection.
  - 2. Capacitance: Shield limits capacitance between primary and secondary to a maximum of 33 picofarads over a frequency range of 20 Hz to 1 MHz
  - 3. Common-Mode Noise Attenuation: Minus 120 dB minimum, 0.5 to 1.5 kHz; minus 65 dB minimum, 1.5 to 100 kHz.
  - 4. Normal-Mode Noise Attenuation: Minus 52 dB minimum, 1.5 to 10 kHz.

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### 1.4 BUCK-BOOST TRANSFORMERS

- A. Description: Self-cooled, two-winding dry type, rated for continuous duty and with wiring terminals suitable for connection as autotransformer. Transformers shall be listed and labeled as complying with UL 506 or UL 1561.
1. Standard impedance at 60Hz: 2 percent to 5 percent (up to 10 kVA), 4 percent to 6.5 percent (above 10 kVA).
  2. Nameplate Rating: Linear load, 60Hz.
  3. Insulation Class: 220 deg C system.
  4. Temperature Rise: 80deg C.
  5. Core Construction: Electrical grade, non-aging silicon steel with high permeability and low hysteresis losses.
  6. Coil Conductors: Continuous aluminum windings, with terminations brazed, welded, or bolted.
  7. Coil Impregnation: Vacuum impregnated with polyester resin.
  8. Sound Level: Not exceeding values listed above for distribution transformers.
  9. Enclosure: Ventilated, NEMA 250, Type 3R.
  10. Terminations: Transformer coils shall terminate in mounting pads. Mounting lugs shall be provided on all units up to and including 270 A ratings.
  11. Antivibration pads or isolators shall be used between the transformer core and coil and the enclosure.
  12. Ground core and coil assembly to enclosure with a flexible copper grounding strap or equivalent.
  13. Mounting:
    - a. Ventilated Units up to 750 lb.: Suitable for wall, floor, or ceiling mounting (drip plate required).
    - b. Ventilated Units over 750 lb.: Suitable for floor mounting only.
    - c. Encapsulated Units up to 285 lb.: Suitable for wall or floor mounting.
    - d. Encapsulated Units over 285 lb.: Suitable for floor mounting only.
- B. Enclosure: Ventilated, NEMA 250, Type 3R.
1. Finish Color: NSF/ANSI 49 gray.

### 1.5 IDENTIFICATION DEVICES

- A. Nameplates: Engraved, laminated-plastic or metal nameplate for each distribution and buck-boost transformer, mounted with corrosion-resistant screws. Nameplates and label products are specified in Section 260553 "Identification for Electrical Systems."

### 1.6 SOURCE QUALITY CONTROL

- A. Test and inspect transformers according to IEEE C57.12.01 and IEEE C57.12.91.
1. Resistance measurements of all windings at the rated voltage connections and at all tap connections.
  2. Ratio tests at the rated voltage connections and at all tap connections.

## SECTION 262200 - LOW-VOLTAGE TRANSFORMERS

3. Phase relation and polarity tests at the rated voltage connections.
  4. No load losses, and excitation current and rated voltage at the rated voltage connections.
  5. Impedance and load losses at rated current and rated frequency at the rated voltage connections.
  6. Applied and induced tensile tests.
  7. Regulation and efficiency at rated load and voltage.
  8. Insulation Resistance Tests:
    - a. High-voltage to ground.
    - b. Low-voltage to ground.
    - c. High-voltage to low-voltage.
  9. Temperature tests.
- B. Factory Sound-Level Tests: Conduct prototype sound-level tests on production-line products.

## PART 2 - EXECUTION

### 2.1 EXAMINATION

- A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.
- B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's written instructions.
- C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.
- D. Verify that ground connections are in place and requirements in Section 260526 "Grounding and Bonding for Electrical Systems" have been met. Maximum ground resistance shall be 5 ohms at location of transformer.
- E. Environment: Enclosures shall be rated for the environment in which they are located. Covers for NEMA 250, Type 4X enclosures shall not cause accessibility problems.
- F. Proceed with installation only after unsatisfactory conditions have been corrected.

### 2.2 INSTALLATION

- A. Install wall-mounted transformers level and plumb with wall brackets fabricated by transformer manufacturer.
  1. Coordinate installation of wall-mounted and structure-hanging supports with actual transformer provided.
- B. Install transformers level and plumb on a concrete base with vibration-dampening supports. Locate transformers away from corners and not parallel to adjacent wall surface.

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- C. Construct concrete bases according to Section 033000 "Cast-in-Place Concrete" or [Section 033053 "Miscellaneous Cast-in-Place Concrete" and anchor floor-mounted transformers according to manufacturer's written instructions and requirements in Section 260529 "Hangers and Supports for Electrical Systems."
  - 1. Coordinate size and location of concrete bases with actual transformer provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.
- D. Secure transformer to concrete base according to manufacturer's written instructions.
- E. Secure covers to enclosure and tighten all bolts to manufacturer-recommended torques to reduce noise generation.
- F. Remove shipping bolts, blocking, and wedges.

### 2.3 CONNECTIONS

- A. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- D. Provide flexible connections at all conduit and conductor terminations and supports to eliminate sound and vibration transmission to the building structure.

### 2.4 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections and prepare test reports.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.
- C. Efficiency & Harmonic Performance Validation: To insure that the products shipped to the job site meet this specification, provide on-site revenue class accurate efficiency and harmonic measurements of transformers once installed and operating at customer's site. Data shall be collected from primary and secondary sides of the transformer simultaneously on a synchronized cycle-by-cycle basis. The use of two discrete meters that are not synchronized is not acceptable. Sampling shall be of 10% of transformers on the project once installed and operating, as selected by customer. Submit a detailed report to the project engineer.
- D. Perform tests and inspections and prepare test reports.

## SECTION 262200 - LOW-VOLTAGE TRANSFORMERS

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.
- E. Tests and Inspections:
  1. Perform each visual and mechanical inspection and electrical test stated in NETA ATS for dry-type, air-cooled, low-voltage transformers. Certify compliance with test parameters.
- F. Remove and replace units that do not pass tests or inspections and retest as specified above.
- G. Infrared Scanning: Two months after Substantial Completion, perform an infrared scan of transformer connections.
  1. Use an infrared-scanning device designed to measure temperature or detect significant deviations from normal values. Provide documentation of device calibration.
  2. Perform two follow-up infrared scans of transformers, one at four months and the other at 11 months after Substantial Completion.
  3. Prepare a certified report identifying transformer checked and describing results of scanning. Include notation of deficiencies detected, remedial action taken, and scanning observations after remedial action.
- H. Test Labeling: On completion of satisfactory testing of each unit, attach a dated and signed "Satisfactory Test" label to tested component.

### 2.5 ADJUSTING

- A. Record transformer secondary voltage at each unit for at least 48 hours of typical occupancy period. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 5 percent and not being lower than nameplate voltage minus 3 percent at maximum load conditions. Submit recording and tap settings as test results.
- B. Connect buck-boost transformers to provide nameplate voltage of equipment being served, plus or minus 5 percent, at secondary terminals.
- C. Output Settings Report: Prepare a written report recording output voltages and tap settings.

### 2.6 CLEANING

- A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

END OF SECTION 262200

## SECTION 262416 - PANELBOARDS

### 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. Distribution panelboards.
  - 2. Lighting and appliance branch-circuit panelboards.
  - 3. Load centers.
  - 4. Engraved nameplates for each circuit breaker on Power Panelboards

#### 1.3 DEFINITIONS

- A. ATS: Acceptance testing specification.
- B. GFCI: Ground-fault circuit interrupter.
- C. GFEP: Ground-fault equipment protection.
- D. HID: High-intensity discharge.
- E. MCCB: Molded-case circuit breaker.
- F. SPD: Surge protective device.
- G. VPR: Voltage protection rating.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of panelboard.
  - 1. Include materials, switching and overcurrent protective devices, SPDs, accessories, and components indicated.
  - 2. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each panelboard and related equipment.
  - 1. Include dimensioned plans, elevations, sections, and details.
  - 2. Show tabulations of installed devices with nameplates, conductor termination sizes, equipment features, and ratings.

## SECTION 262416 - PANELBOARDS

3. Detail enclosure types including mounting and anchorage, environmental protection, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.
4. Detail bus configuration, current, and voltage ratings.
5. Short-circuit current rating of panelboards and overcurrent protective devices.
6. Include evidence of NRTL listing for series rating of installed devices.
7. Include evidence of NRTL listing for SPD as installed in panelboard.
8. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
9. Include wiring diagrams for power, signal, and control wiring.
10. Key interlock scheme drawing and sequence of operations.
11. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device. Include an Internet link for electronic access to downloadable PDF of the coordination curves.

### 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.

### 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
  1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
  2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

### 1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  1. Keys: Two spares for each type of panelboard cabinet lock.
  2. Circuit Breakers Including GFCI and GFEP Types: Two spares for each panelboard.
  3. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

### 1.8 QUALITY ASSURANCE

- A. Manufacturer Qualifications: ISO 9001 or 9002 certified.

## SECTION 262416 - PANELBOARDS

### 1.9 DELIVERY, STORAGE, AND HANDLING

- A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.
- B. Handle and prepare panelboards for installation according to NEMA PB 1.

### 1.10 FIELD CONDITIONS

- A. Environmental Limitations:
  - 1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
  - 2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
    - a. Ambient Temperature: Not exceeding 23 deg F to plus 104 deg F.
    - b. Altitude: Not exceeding 6600 feet.
- B. Service Conditions: NEMA PB 1, usual service conditions, as follows:
  - 1. Ambient temperatures within limits specified.
  - 2. Altitude not exceeding 6600 feet.
- C. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
  - 1. Notify Architect no fewer than 7 days in advance of proposed interruption of electric service.
  - 2. Do not proceed with interruption of electric service without Architect's, Construction Manager's and Owner's written permission.
  - 3. Comply with NFPA 70E.

### 1.11 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace panelboards that fail in materials or workmanship within specified warranty period.
  - 1. Panelboard Warranty Period: 18 months from date of Substantial Completion.
- B. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace SPD that fails in materials or workmanship within specified warranty period.
  - 1. SPD Warranty Period: Five years from date of Substantial Completion.



## SECTION 262416 - PANELBOARDS

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS:

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Square D Co.
  - 2. Eaton Corporation.
  - 1. Siemens
  - 2. General Electric

#### 2.2 PANELBOARDS COMMON REQUIREMENTS

- A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Section 260548.16 "Seismic Controls for Electrical Systems."
- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- C. 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.
- D. Comply with NEMA PB 1.
- E. Comply with NFPA 70.
- F. Enclosures: Flush and Surface-mounted, dead-front cabinets.
  - 1. Rated for environmental conditions at installed location.
    - a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
    - b. Outdoor Locations: NEMA 250, Type 3R or 4XSS (as noted on plans).
    - c. Kitchen Areas: NEMA 250, Type 4X, stainless steel.
    - d. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
    - e. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 5 or Type 12 (as noted on plans).
  - 2. Height: 84 inches maximum.
  - 3. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box. Trims shall cover all live parts and shall have no exposed hardware.
  - 4. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover. Trims shall cover all live parts and shall have no exposed hardware.
  - 5. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.
  - 6. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.

## SECTION 262416 - PANELBOARDS

7. Finishes:
  - a. Panels and Trim: Steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
  - b. Back Boxes: Same finish as panels and trim.
  
- G. Incoming Mains:
  1. Location: coordinated on the field by the electrical contractor.
  2. Main Breaker: Main lug interiors up to 400 amperes shall be field convertible to main breaker.
  
- H. Phase, Neutral, and Ground Buses:
  1. Material: Hard-drawn copper, 98 percent conductivity.
    - a. Plating shall run entire length of bus.
    - b. Bus shall be fully rated the entire length.
  2. Interiors shall be factory assembled into a unit. Replacing switching and protective devices shall not disturb adjacent units or require removing the main bus connectors.
  3. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
  4. Isolated Ground Bus: Adequate for branch-circuit isolated ground conductors; insulated from box.
  5. Full-Sized Neutral: Equipped with full-capacity bonding strap for service entrance applications. Mount electrically isolated from enclosure. Do not mount neutral bus in gutter.
  6. Extra-Capacity Neutral Bus: Neutral bus rated 200 percent of phase bus and listed and labeled by an NRTL acceptable to authority having jurisdiction, as suitable for nonlinear loads in electronic-grade panelboards and others designated on Drawings. Connectors shall be sized for double-sized or parallel conductors as indicated on Drawings. Do not mount neutral bus in gutter.
  7. Split Bus: Vertical buses divided into individual vertical sections.
  
- I. Conductor Connectors: Suitable for use with conductor material and sizes.
  1. Material: Hard-drawn copper, 98 percent conductivity.
  2. Terminations shall allow use of 75 deg C rated conductors without derating.
  3. Size: Lugs suitable for indicated conductor sizes, with additional gutter space, if required, for larger conductors.
  4. Main and Neutral Lugs: Mechanical type, with a lug on the neutral bar for each pole in the panelboard.
  5. Ground Lugs and Bus-Configured Terminators: Mechanical type, with a lug on the bar for each pole in the panelboard.
  6. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
  7. Subfeed (Double) Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.

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8. Gutter-Tap Lugs: Mechanical type suitable for use with conductor material and with matching insulating covers. Locate at same end of bus as incoming lugs or main device.
9. Extra-Capacity Neutral Lugs: Rated 200 percent of phase lugs mounted on extra-capacity neutral bus.
  
- J. NRTL Label: Panelboards or load centers shall be labeled by an NRTL acceptable to authority having jurisdiction for use as service equipment with one or more main service disconnecting and overcurrent protective devices. Panelboards or load centers shall have meter enclosures, wiring, connections, and other provisions for utility metering. Coordinate with utility company for exact requirements.
- K. Future Devices: Panelboards or load centers shall have mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
  1. Percentage of Future Space Capacity: Ten percent.
- L. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals. Assembly listed by an NRTL for 100 percent interrupting capacity.
  1. Panelboards and overcurrent protective devices rated 240 V or less shall have short-circuit ratings as shown on Drawings, but not less than 10,000 A rms symmetrical.
  2. Panelboards and overcurrent protective devices rated above 240 V and less than 600 V shall have short-circuit ratings as shown on Drawings, but not less than 14,000 A rms symmetrical.

### 2.3 PERFORMANCE REQUIREMENTS

- A. Surge Suppression: Factory installed as an integral part of indicated panelboards, complying with UL 1449 SPD Type 1 or Type 2 (as noted on plans).

### 2.4 POWER PANELBOARDS

- A. Panelboards: NEMA PB 1, distribution type.
- B. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
  1. For doors more than 36 inches high, provide two latches, keyed alike.
- C. Mains: Circuit breaker or Lugs only (as noted on plans).
- D. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.
- E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers.

## SECTION 262416 - PANELBOARDS

### 2.5 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- B. Mains: Circuit breaker or Lugs only (as noted on plans).
- C. Branch Overcurrent Protective Devices: Plug-in circuit breakers, replaceable without disturbing adjacent units.
- D. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.
- E. Doors: Door-in-door construction with concealed hinges; secured with multipoint latch with tumbler lock; keyed alike. Outer door shall permit full access to the panel interior. Inner door shall permit access to breaker operating handles and labeling, but current carrying terminals and bus shall remain concealed.

### 2.6 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. MCCB: Comply with UL 489, with interrupting capacity to meet available fault currents.
  - 1. Thermal-Magnetic Circuit Breakers:
    - a. Inverse time-current element for low-level overloads.
    - b. Instantaneous magnetic trip element for short circuits.
    - c. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
  - 2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
  - 3. Electronic Trip Circuit Breakers:
    - a. RMS sensing.
    - b. Field-replaceable rating plug or electronic trip.
    - c. Digital display of settings, trip targets, and indicated metering displays.
    - d. Multi-button keypad to access programmable functions and monitored data.
    - e. Ten-event, trip-history log. Each trip event shall be recorded with type, phase, and magnitude of fault that caused the trip.
    - f. Integral test jack for connection to portable test set or laptop computer.
    - g. Field-Adjustable Settings:
      - 1) Instantaneous trip.
      - 2) Long- and short-time pickup levels.
      - 3) Long and short time adjustments.
      - 4) Ground-fault pickup level, time delay, and I squared T response.
  - 4. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6-mA trip).
  - 5. GFEP Circuit Breakers: Class B ground-fault protection (30-mA trip).
  - 6. Arc-Fault Circuit Interrupter Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.
  - 7. Subfeed Circuit Breakers: Vertically mounted.
  - 8. MCCB Features and Accessories:

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- a. Standard frame sizes, trip ratings, and number of poles.
- b. Breaker handle indicates tripped status.
- c. UL listed for reverse connection without restrictive line or load ratings.
- d. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
- e. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and HID lighting circuits.
- f. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
- g. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 75 percent of rated voltage.
- h. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional with field-adjustable 0.1- to 0.6-second] time delay.
- i. Rating Plugs: Three-pole breakers with ampere ratings greater than 150 amperes shall have interchangeable rating plugs or electronic adjustable trip units.
- j. Auxiliary Contacts: Two, SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts and "b" contacts operate in reverse of circuit-breaker contacts.
- k. Alarm Switch: Single-pole, normally open contact that actuates only when circuit breaker trips.
- l. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
- m. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function with other upstream or downstream devices.
- n. Multipole units enclosed in a factory assembled to operate as a single unit.
- o. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or off position.
- p. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.

### 2.7 IDENTIFICATION

- A. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles shall be located on the interior of the panelboard door.
- B. Breaker Labels: Faceplate shall list current rating, UL and IEC certification standards, and AIC rating.
- C. Circuit Directory: Directory card inside panelboard door, mounted in metal frame with transparent protective cover.
  1. Circuit directory shall identify specific purpose with detail sufficient to distinguish it from all other circuits.
- D. Circuit Directory: Computer-generated circuit directory mounted inside panelboard door with transparent plastic protective cover.
  1. Circuit directory shall identify specific purpose with detail sufficient to distinguish it from all other circuits.

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### 2.8 ACCESSORY COMPONENTS AND FEATURES

- A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.
- B. Portable Test Set: For testing functions of solid-state trip devices without removing from panelboard. Include relay and meter test plugs suitable for testing panelboard meters and switchboard class relays.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify actual conditions with field measurements prior to ordering panelboards to verify that equipment fits in allocated space in, and comply with, minimum required clearances specified in NFPA 70.
- B. Receive, inspect, handle, and store panelboards according to NECA 407 and NEMA PB 1.1.
- C. Examine panelboards before installation. Reject panelboards that are damaged, rusted, or have been subjected to water saturation.
- D. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Comply with NECA 1.
- C. Install panelboards and accessories according to NECA 407 and NEMA PB 1.1.
- D. Equipment Mounting:
  - 1. Install panelboards on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete." and or Section 033053 "Miscellaneous Cast-in-Place Concrete."
  - 2. Attach panelboard to the vertical finished or structural surface behind the panelboard.
- E. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.

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- F. Mount top of trim 90 inches above finished floor unless otherwise indicated.
- G. Mount panelboard cabinet plumb and rigid without distortion of box.
- H. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- I. Mounting panelboards with space behind is recommended for damp, wet, or dirty locations. The steel slotted supports in the following paragraph provide an even mounting surface and the recommended space behind to prevent moisture or dirt collection.
- J. Mount surface-mounted panelboards to steel slotted supports 5/8 inch in depth. Orient steel slotted supports vertically.
- K. Install overcurrent protective devices and controllers not already factory installed.
  - 1. Set field-adjustable, circuit-breaker trip ranges.
  - 2. Tighten bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver per manufacturer's written instructions.
- L. Make grounding connections and bond neutral for services and separately derived systems to ground. Make connections to grounding electrodes, separate grounds for isolated ground bars, and connections to separate ground bars.
- M. Install filler plates in unused spaces.
- N. Stub four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch empty conduits into raised floor space or below slab not on grade.
- O. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.

### 3.3 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Handwritten directories are not acceptable. Install directory inside panelboard door.
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- D. Device Nameplates: Label each branch circuit device in [Power Panelboards](#) with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

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- E. Install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems" identifying source of remote circuit.

### 3.4 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. Acceptance Testing Preparation:
  - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
  - 2. Test continuity of each circuit.
- D. Tests and Inspections:
  - 1. Perform each visual and mechanical inspection and electrical test for low-voltage air circuit breakers and low-voltage surge arrestors stated in NETA ATS, Paragraph 7.6 Circuit Breakers and Paragraph 7.19.1 Surge Arrestors, Low-Voltage. Certify compliance with test parameters.
  - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
  - 3. Perform the following infrared scan tests and inspections and prepare reports:
    - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each panelboard. Remove front panels so joints and connections are accessible to portable scanner.
    - b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each panelboard 11 months after date of Substantial Completion.
    - c. Instruments and Equipment:
      - 1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
- E. Panelboards will be considered defective if they do not pass tests and inspections.
- F. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results, with comparisons of the two scans. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.



## SECTION 262416 - PANELBOARDS

### 3.5 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges as specified in Section 260573 "Overcurrent Protective Device Coordination Study."
- C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes. Prior to making circuit changes to achieve load balancing, inform Architect of effect on phase color coding.
  - 1. Measure loads during period of normal facility operations.
  - 2. Perform circuit changes to achieve load balancing outside normal facility operation schedule or at times directed by the Architect. Avoid disrupting services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
  - 3. After changing circuits to achieve load balancing, recheck loads during normal facility operations. Record load readings before and after changing circuits to achieve load balancing.
  - 4. Tolerance: Maximum difference between phase loads, within a panelboard, shall not exceed 20 percent.

### 3.6 PROTECTION

- A. Temporary Heating: Prior to energizing panelboards, apply temporary heat to maintain temperature according to manufacturer's written instructions.

END OF SECTION 262416

## SECTION 262713 - ELECTRICITY METERING

### 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 equipment for electricity metering by utility company.

#### 1.3 DEFINITIONS

- A. KY Pulse: Term used by the metering industry to describe a method of measuring consumption of electricity that is based on a relay opening and closing in response to the rotation of the disk in the meter.
- B. PC: Personal computer.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For electricity-metering equipment.
  - 1. Dimensioned plans and sections or elevation layouts.
  - 2. Wiring Diagrams: For power, signal, and control wiring. Identify terminals and wiring designations and color-codes to facilitate installation, operation, and maintenance. Indicate recommended types, wire sizes, and circuiting arrangements for field-installed wiring, and show circuit protection features.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
  - 1. Application and operating software documentation.
  - 2. Software licenses.
  - 3. Software service agreement.
  - 4. Hard copies of manufacturer's operating specifications, design user's guides for software and hardware, and PDF files on CD-ROM of the hard-copy Submittal.

## SECTION 262713 - ELECTRICITY METERING

### 1.7 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.

### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Receive, store, and handle modular meter center according to NECA 400.

### 1.9 PROJECT CONDITIONS

- A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:
  - 1. Notify Architect no fewer than 5 days in advance of proposed interruption of electrical service.
  - 2. Do not proceed with interruption of electrical service without Architect's written permission.

### 1.10 COORDINATION

- A. Electrical Service Connections: Coordinate with utility companies and components they furnish as follows:
  - 1. Comply with requirements of utilities providing electrical power services.
  - 2. Coordinate installation and connection of utilities and services, including provision for electricity-metering components.

## PART 2 - PRODUCTS

### 2.1 EQUIPMENT FOR ELECTRICITY METERING BY UTILITY COMPANY

- A. Meters will be furnished by utility company.
- B. Current-Transformer Cabinets: Comply with requirements of electrical-power utility company.
- C. Meter Sockets: Comply with requirements of electrical-power utility company.
- D. Meter Sockets: Steady-state and short-circuit current ratings shall meet indicated circuit ratings.
- E. Modular Meter Center: Factory-coordinated assembly of a main service disconnect device, wireways, tenant meter socket modules, and tenant feeder circuit breakers arranged in adjacent vertical sections. Assembly shall be complete with interconnecting buses and other features as specified below.
  - 1. Comply with requirements of utility company for meter center.

## SECTION 262713 - ELECTRICITY METERING

2. Housing: NEMA 250, Type 3R enclosure.
3. Minimum Short-Circuit Rating: 42,000 A symmetrical at rated voltage.
4. Main Disconnect Device: Circuit breaker, series-combination rated for use with downstream feeder and branch circuit breakers.
5. Main Disconnect Device: Fusible switch, series-combination rated by circuit-breaker manufacturer to protect downstream feeder and branch circuit breakers.
6. Tenant Feeder Circuit Breakers: Series-combination-rated molded-case units, rated to protect circuit breakers in downstream tenant and to house load centers and panelboards that have 10,000-A interrupting capacity.
  - a. Identification: Complying with requirements in Section 260553 "Identification for Electrical Systems" with legend identifying tenant's address.
  - b. Physical Protection: Tamper resistant, with hasp for padlock.
7. Meter Socket: Rating coordinated with indicated tenant feeder circuit rating.
8. Surge Protection: For main disconnect device, comply with requirements in Section 264313 "Surge Protection for Low-Voltage Electrical Power Circuits."

### 3.1 SUB PANEL METERING EQUIPMENT - POWER METERS

- A. The meter shall be UL listed and CE marked.
- B. The meter shall come pre-wired as per NEC coloring code in either a UL approved NEMA 1 enclosure or a UL approved NEMA 4X enclosure.
  1. The enclosure shall be available in either of two configurations: 277/480 Volt or 120/240 Volt.
    - a. The 277/480 Volt enclosure shall come equipped with a control power transformer.
  2. The enclosure shall come with Voltage fuses and a shorting block for use with current transformers.
  3. The enclosure shall have a lockable door.
- C. The meter shall be designed for Multifunction Electrical Measurement on 3 phase power systems. The meter shall perform to spec in harsh electrical applications in high and low voltage power systems.
  1. The meter shall support 3-Element Wye, 2.5 Element Wye, 2 Element Delta, 4 wire Delta systems.
  2. The meter shall accept universal voltage input.
  3. The meter's surge withstand shall conform to IEEE C37.90.1.
  4. The meter shall be user programmable for voltage range to any PT ratio.
  5. The meter shall accept a burden up to 0.36VA per phase, Max at 600V, and 0.014VA at 120 Volts.
  6. The meter shall accept a voltage input range of up to 416 Volts Line to Neutral, and up to 721 Volts Line to Line.
  7. The meter shall accept a current reading of up to 11 Amps continuous.
  8. The meter shall have color-coordinated voltage and current inputs.
  9. The meter shall have a phasor diagram that clearly shows wiring status.

## SECTION 262713 - ELECTRICITY METERING

- D. The meter shall use a dual input method for current inputs. Method one shall allow the CT to pass directly through the meter without any physical termination on the meter. The second method shall provide additional termination pass-through bars, allowing the CT leads to be terminated on the meter. The meter must support both termination methods.
1. Fault Current Withstand shall be 100 Amps for 10 seconds, 300 Amps for 3 seconds, and 500 Amps for 1 second.
  2. The meter shall be programmable for current to any CT ratio.
  3. The meter shall accept a burden of 0.005VA per phase, Max at 11 Amps.
  4. The meter shall begin reading at 0.1% of the nominal current.
  5. Pass through wire gauge dimension of 0.177" / 4.5 mm shall be available.
  6. All inputs and outputs shall be galvanically isolated to 2500 Volts AC.
  7. The meter shall accept current inputs of class 10: (0 to 10) A, 5 Amp Nominal, and class 2 (0 to 2) A, 1A Nominal Secondary.
- E. The meter shall have an accuracy of +/- 0.1% or better for Volts and Amps, and 0.2% for power and energy functions. The meter shall have a Frequency measurement accuracy +/- 0.01Hz or better. The meter shall meet the accuracy requirements of IEC62053-22 (Class 0.2%) and ANSI C12.20 (Class 0.2%).
1. The meter shall provide true RMS measurements of voltage, phase to neutral and phase to phase; current, per phase and neutral.
  2. The meter shall provide sampling at 400+ samples per cycle on all channels measured readings simultaneously.
  3. The meter shall utilize 24 bit Analog to Digital conversion.
  4. The meter shall provide Harmonics %THD (% of total Harmonic Distortion).
- F. The meter shall include a three-line, bright red, .56" LED display.
1. The meter must display a % of Load Bar on the front panel to provide an analog feel. The % Load bar shall have not less than 10 segments.
- G. The meter shall be a traceable revenue meter, which shall contain a utility grade test pulse allowing power providers to verify and confirm that the meter is performing to its rated accuracy.
- H. The meter shall include 2 independent communications ports on the back and face plate, with advanced features.
1. One port, through backplate, shall be an RJ45 port, providing 100BaseT Ethernet communication speaking BACnet/IP protocol and Modbus TCP, and a Web server.
  2. The meter shall provide an optical IrDA port (through faceplate), as the second communication port, which shall allow the unit to be set up and programmed using a remote laptop PC without need for a communication cable.
- I. The meter shall provide user configured fixed window or rolling window demand. This shall allow user to set up the particular utility demand profile.
1. Readings for kW, kVAR, kVA and PF shall be calculated using utility demand features.
  2. All other parameters shall offer max and min capability over the user selectable averaging period.

SECTION 262713 - ELECTRICITY METERING

- 3. Voltage shall provide an instantaneous max and min reading displaying the highest surge and lowest sag seen by the meter.
  
- J. The meter shall support Universal power supply of (90 to 265) Volts AC and (100 to 370) Volts DC.
  - 1. The meter power supply shall accept a burden of 10 VA max.
  
- K. The meter shall provide an update rate of every 6 cycles for Watts, VAR, and VA, and every 60 cycles for all other parameters.
  
- L. The meter shall have native BACnet/IP protocol.
  - 1. The meter shall provide 40 embedded BACnet Objects consisting of standard voltage, current, and power parameters. The Objects shall be named such that they can be readily identified.
  - 2. The meter shall have an embedded Web interface for configuration and viewing.
    - a. The Web interface shall have a Home page with power and energy snapshot information.
    - b. The Web interface shall have a page for configuring the BACnet/IP settings, including IP address, Network mask, Default Gateway, and the like.
    - c. The Web interface shall allow the user to activate the new configuration and reboot the meter.
    - d. The Web interface shall have a feature that lets the user download BACnet Object data as a .csv file that can be viewed in Microsoft® Excel or saved as a Microsoft® Excel file.
    - e. The Web interface shall have a webpage that displays the BACnet objects, their readings, and information about the objects.
    - f. The Web interface shall have a webpage displaying statistics for the unit, e.g., the number of meter reboots, and the number of BACnet/IP packets sent and received.
    - g. The Web interface shall allow the user to discard any changes and return to the saved configuration, or return to the factory default configuration.
    - h. The Web interface shall be viewable with any standard Internet browser.
  - 3. The meter shall be configurable on the Host PC through LAN configuration.
  - 4. The meter's BACnet/IP shall integrate with any BACnet applications or servers.
  - 5. The meter shall also have an open socket for Modbus TCP that shall be simultaneously available through the LAN interface.
  
- M. The meter shall have a standard 4-year warranty.
  
- N. The meter shall be able to be stored in (-20 to +70) degrees C.
  - 1. Operating temperature shall be (-20 to +70) degrees C.
  
- O. The following options shall be available for ordering:

<b>Model</b>	<b>Voltage</b>	<b>Frequency</b>	<b>Current Class</b>	<b>Power Supply</b>
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SECTION 262713 - ELECTRICITY METERING

ENC5HK100B Shark® 100B in NEMA 1 Enclosure	-120: 120-240 Volts	-50: 50 HZ System	-10: 5 Amp Sec- ondary	-D2 (90-265)VAC or (100-370)VDC
ENC4XSHK100B Shark® 100B in NEMA 4 Enclosure	-277: 277 Volts	-60: 60 HZ System	-2 : 1 Amp Sec- ondary	

- P. Acceptable product is Electro Industries/GaugeTech,  
Model ENC4XSHK100B-120-60-10-D2 for 120VAC services and/or  
Model ENC4XSHK100B-277-60-10-D2 for 277/480VAC services.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with equipment installation requirements in NECA 1.
- B. Install meters furnished by utility company. Install raceways and equipment according to utility company's written requirements. Provide empty conduits for metering leads and extend grounding connections as required by utility company.
- C. Install modular meter center according to NECA 400 switchboard installation requirements.

3.2 IDENTIFICATION

- A. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
  - 1. Series Combination Warning Label: Self-adhesive type, with text as required by NFPA 70.
  - 2. Equipment Identification Labels: Adhesive film labels with clear protective overlay. For residential meters, provide an additional card holder suitable for printed, weather-resistant card with occupant's name.

3.3 FIELD QUALITY CONTROL

- A. 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.

END OF SECTION 262713

## SECTION 262726 - WIRING DEVICES

### 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. Receptacles, receptacles with integral GFCI, and associated device plates.
2. Twist-locking receptacles.
3. Receptacles with integral surge-suppression units.
4. Isolated-ground receptacles.
5. USB charger electrical outlet
6. Tamper-resistant receptacles.
7. Weather-resistant receptacles.
8. Snap switches and wall-box dimmers.
9. Wall-switch and exterior occupancy sensors.
10. Pendant cord-connector devices.
11. Cord and plug sets.
12. Floor service outlets, poke-through assemblies, service poles, and multioutlet assemblies.

#### 1.3 DEFINITIONS

- A. EMI: Electromagnetic interference.
- B. GFCI: Ground-fault circuit interrupter.
- C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.
- D. RFI: Radio-frequency interference.
- E. TVSS: Transient voltage surge suppressor.
- F. UTP: Unshielded twisted pair.

#### 1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:

1. Receptacles for Owner-Furnished Equipment: Match plug configurations.
2. Cord and Plug Sets: Match equipment requirements.



## SECTION 262726 - WIRING DEVICES

### 1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.
- C. Samples: One for each type of device and wall plate specified, in each color specified.

### 1.6 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

### 1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing-label warnings and instruction manuals that include labeling conditions.

### 1.8 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Service/Power Poles: One for every 10, but no fewer than one.
  - 2. Floor Service-Outlet Assemblies: One for every 10 but no fewer than one.
  - 3. Poke-Through, Fire-Rated Closure Plugs: One for every five floor service outlets installed, but no fewer than two.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:
  - 1. Cooper Wiring Devices; a division of Eaton.
  - 2. Wiring Device-Kellems; a division of Hubbell.
  - 3. Leviton Mfg. Company Inc.
  - 4. Pass & Seymour; a division of LeGrand.

### 2.2 GENERAL WIRING-DEVICE REQUIREMENTS

- A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.

## SECTION 262726 - WIRING DEVICES

- C. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:
  - 1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.
  - 2. Devices shall comply with the requirements in this Section.

### 2.3 STRAIGHT-BLADE RECEPTACLES

- A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.
- B. Hospital-Grade, Duplex Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498 Supplement sd, and FS W-C-596.
  - 1. Description: Single-piece, rivetless, nickel-plated, all-brass grounding system. Nickel-plated, brass mounting strap.
- C. Isolated-Ground, Duplex Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.
  - 1. Description: Straight blade; equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.
- D. Tamper-Resistant Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498 Supplement sd, and FS W-C-596.
  - 1. Description: Labeled shall comply with NFPA 70, "Health Care Facilities" Article, "Pediatric Locations" Section.

### 2.4 GFCI RECEPTACLES

- A. General Description:
  - 1. Straight blade, feed-through type.
  - 2. Comply with NEMA WD 1, NEMA WD 6, UL 498, UL 943 Class A, and FS W-C-596.
  - 3. Include indicator light that shows when the GFCI has malfunctioned and no longer provides proper GFCI protection.
- B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:
- C. Tamper-Resistant GFCI Convenience Receptacles, 125 V, 20 A:
- D. Hospital-Grade, Duplex GFCI Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498 Supplement sd, and FS W-C-596.

## SECTION 262726 - WIRING DEVICES

### 2.5 TVSS RECEPTACLES

- A. General Description: Comply with NEMA WD 1, NEMA WD 6, UL 498, UL 1449, and FS W-C-596, with integral TVSS in line to ground, line to neutral, and neutral to ground.
  - 1. TVSS Components: Multiple metal-oxide varistors; with a nominal clamp-level rating of 400 V and minimum single transient pulse energy dissipation of 240 J, according to IEEE C62.41.2 and IEEE C62.45.
  - 2. Active TVSS Indication: Visual and audible, with light visible in face of device to indicate device is "active" or "no longer in service."
- B. Duplex TVSS Convenience Receptacles:
  - 1. Description: Straight blade, 125 V, 20 A; NEMA WD 6 Configuration 5-20R.
- C. Isolated-Ground, Duplex Convenience Receptacles:
  - 1. Description:
    - a. Straight blade, 125 V, 20 A; NEMA WD 6 Configuration 5-20R.
    - b. Equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.

### 2.6 USB CHARGER RECEPTACLES

- A. General Description: Comply with NEMA WD 1, NEMA WD 6. Comparable with iPad, iPhone, Tablets, Mobile Phone, Smartphones, Digital Cameras.
  - 1. Components: 20A tamper resistant receptacle, two 5 volt DC, 2100 mA USB ports (2.0 and 3.0), 10.5 watts.
  - 2. 2.1-amp USB type A receptacles, back and side wire terminals
  - 3. Legrand TMBUSWCC6
- B. Hospital-Grade, Duplex Convenience Receptacles: Comply with UL 498 Supplement sd.
  - 1. Description: Straight blade, 125 V, 20 A; NEMA WD 6 Configuration 5-20R.
  - 2. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  - 3. Comply with NFPA 70.
- C. Isolated-Ground, Hospital-Grade, Duplex Convenience Receptacles:
  - 1. Description:
    - a. Straight blade, 125 V, 20 A; NEMA WD 6 Configuration 5-20R.
    - b. Comply with UL 498 Supplement sd.

## SECTION 262726 - WIRING DEVICES

- c. Equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.

### 2.7 HAZARDOUS (CLASSIFIED) LOCATION RECEPTACLES

- A. Wiring Devices for Hazardous (Classified) Locations: Comply with NEMA FB 11 and UL 1010.

### 2.8 TWIST-LOCKING RECEPTACLES

- A. Single Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration L5-20R, and UL 498.
- B. Isolated-Ground, Single Convenience Receptacles, 125 V, 20 A:
  1. Description:
    - a. Comply with NEMA WD 1, NEMA WD 6 Configuration L5-20R, and UL 498.
    - b. Equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.

### 2.9 PENDANT CORD-CONNECTOR DEVICES

- A. Description:
  1. Matching, locking-type plug and receptacle body connector.
  2. NEMA WD 6 Configurations L5-20P and L5-20R, heavy-duty grade, and FS W-C-596.
  3. Body: Nylon, with screw-open, cable-gripping jaws and provision for attaching external cable grip.
  4. External Cable Grip: Woven wire-mesh type made of high-strength, galvanized-steel wire strand, matched to cable diameter, and with attachment provision designed for corresponding connector.

### 2.10 CORD AND PLUG SETS

- A. Description:
  1. Match voltage and current ratings and number of conductors to requirements of equipment being connected.
  2. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and ampacity of at least 130 percent of the equipment rating.

## SECTION 262726 - WIRING DEVICES

3. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

### 2.11 TOGGLE SWITCHES

- A. Comply with NEMA WD 1, UL 20, and FS W-S-896.
- B. Switches, 120/277 V, 20 A:
  1. Single Pole
  2. Two Pole
  3. Three Way
  4. Four Way
- C. Pilot-Light Switches, 20 A:
  1. Description: Single pole, with neon-lighted handle, illuminated when switch is "off."
- D. Key-Operated Switches, 120/277 V, 20 A:
  1. Description: Single pole, Corbin type with factory-supplied key in lieu of switch handle.
- E. Single-Pole, Double-Throw, Momentary-Contact, Center-off Switches: 120/277 V, 20 A; for use with mechanically held lighting contactors.
- F. Key-Operated, Single-Pole, Double-Throw, Momentary-Contact, Center-off Switches: 120/277 V, 20 A; for use with mechanically held lighting contactors, with factory-supplied key in lieu of switch handle.

### 2.12 WALL-BOX DIMMERS

- A. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on-off switches, with audible frequency and EMI/RFI suppression filters.
- B. Control: Continuously adjustable slider; with single-pole or three-way switching. Comply with UL 1472.
- C. Incandescent Lamp Dimmers: 120 V; control shall follow square-law dimming curve. On-off switch positions shall bypass dimmer module.
  1. 600 W; dimmers shall require no derating when ganged with other devices. Illuminated when "off."
- D. Fluorescent Lamp Dimmer Switches: Modular; compatible with dimmer ballasts; trim potentiometer to adjust low-end dimming; dimmer-ballast combination capable of consistent dimming with low end not greater than 20 percent of full brightness.

### 2.13 WALL PLATES

- A. Single and combination types shall match corresponding wiring devices.

## SECTION 262726 - WIRING DEVICES

1. Plate-Securing Screws: Tamper proof metal with head color to match plate finish.
  2. Material for Finished Spaces: Type 302 stainless steel, 0.04-inch thick.
  3. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.
- B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant, die-cast aluminum with lockable cover.

### 2.14 FLOOR SERVICE FITTINGS

- A. Type: Modular, flap-type, dual-service units suitable for wiring method used.
- B. Compartments: Barrier separates power from voice and data communication cabling.
- C. Service Plates, Rectangular, solid brass with satin finish. Select accordingly to be fully flush with the finished surface:
1. Suitable for Wood floor
  2. Suitable for Carpet floor.
  3. Suitable for Tile floor.
- D. Power Receptacle: NEMA WD 6 Configuration 5-20R, gray finish, unless otherwise indicated.
- E. Voice and Data Communication Outlet: Blank cover with bushed cable opening.

### 2.15 POKE-THROUGH ASSEMBLIES

- A. Description:
1. Factory-fabricated and -wired assembly of below-floor junction box with multichanneled, through-floor raceway/firestop unit and detachable matching floor service-outlet assembly.
  2. Comply with UL 514 scrub water exclusion requirements.
  3. Service-Outlet Assembly: Flush type with four simplex receptacles and space for four RJ-45 jacks complying with requirements in Section 271500 "Communications Horizontal Cabling."
  4. Size: Selected to fit nominal 4-inch cored holes in floor and matched to floor thickness.
  5. Fire Rating: Unit is listed and labeled for fire rating of floor-ceiling assembly.
  6. Closure Plug: Arranged to close unused 4-inch cored openings and reestablish fire rating of floor.
  7. Wiring Raceways and Compartments: For a minimum of four No. 12 AWG conductors and a minimum of four, four-pair cables that comply with requirements in Section 271500 "Communications Horizontal Cabling."

### 2.16 PREFABRICATED MULTIOUTLET ASSEMBLIES

- A. Description:
1. Two-piece surface metal raceway, with factory-wired multioutlet harness.

## SECTION 262726 - WIRING DEVICES

2. Components shall be products from single manufacturer designed for use as a complete, matching assembly of raceways and receptacles.

B. Raceway Material: Metal, with manufacturer's standard finish.

C. Multioutlet Harness:

1. Receptacles: 15-A, 125-V, NEMA WD 6 Configuration 5-15R receptacles complying with NEMA WD 1, UL 498, and FS W-C-596.
2. Receptacle Spacing: 12 inches or as noted on plans.
3. Wiring: No. 12 AWG solid, Type THHN copper, single circuit or two circuit (as noted on plans), connecting alternating receptacles.

### 2.17 SERVICE POLES

A. Description:

1. Factory-assembled and -wired units to extend power and voice and data communication from distribution wiring concealed in ceiling to devices or outlets in pole near floor.
2. Poles: Nominal 2.5-inch-square cross section, with height adequate to extend from floor to at least 6 inches above ceiling, and with separate channels for power wiring and voice and data communication cabling.
3. Mounting: Ceiling trim flange with concealed bracing arranged for positive connection to ceiling supports; with pole foot and carpet pad attachment.
4. Finishes: Satin-anodized aluminum.
5. Wiring: Sized for minimum of five No. 12 AWG power and ground conductors and a minimum of four, four-pair, Category 3 or Category 5 voice and data communication cables.
6. Power Receptacles: Two duplex, 20-A, straight-blade receptacles complying with requirements in this Section.
7. Voice and Data Communication Outlets: Blank insert with bushed cable opening (Four RJ-45 jacks)

### 2.18 FINISHES

A. Device Color:

1. Wiring Devices Connected to Normal Power System: Ivory or as selected by Architect unless otherwise indicated or required by NFPA 70 or device listing.
2. Wiring Devices Connected to Emergency Power System: Red.
3. TVSS Devices: Blue.
4. Isolated-Ground Receptacles: Orange.

B. Wall Plate Color: For plastic covers, match device color.

## SECTION 262726 - WIRING DEVICES

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.
- B. Coordination with Other Trades:
  - 1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
  - 2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
  - 3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
  - 4. Install wiring devices after all wall preparation, including painting, is complete.
- C. Conductors:
  - 1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.
  - 2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
  - 3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
  - 4. Existing Conductors:
    - a. Cut back and pigtail, or replace all damaged conductors.
    - b. Straighten conductors that remain and remove corrosion and foreign matter.
    - c. Pigtailling existing conductors is permitted, provided the outlet box is large enough.
- D. Device Installation:
  - 1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
  - 2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
  - 3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
  - 4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
  - 5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
  - 6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
  - 7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
  - 8. Tighten unused terminal screws on the device.



## SECTION 262726 - WIRING DEVICES

9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.
- E. Receptacle Orientation:
1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the right.
  2. Install hospital-grade receptacles in patient-care areas with the ground pin or neutral blade at the top.
- F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.
- G. Dimmers:
1. Install dimmers within terms of their listing.
  2. Verify that dimmers used for fan speed control are listed for that application.
  3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device listing conditions in the written instructions.
- H. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.
- I. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

### 3.2 GFCI RECEPTACLES

- A. Install non-feed-through-type GFCI receptacles where protection of downstream receptacles is not required.

### 3.3 IDENTIFICATION

- A. Comply with Section 260553 "Identification for Electrical Systems."
- B. Identify each receptacle with panelboard identification and circuit number. Use hot, stamped, or engraved machine printing with black -filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

### 3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
1. In healthcare facilities, prepare reports that comply with recommendations in NFPA 99.
  2. Test Instruments: Use instruments that comply with UL 1436.
  3. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.

## SECTION 262726 - WIRING DEVICES

- B. Tests for Convenience Receptacles:
  - 1. Line Voltage: Acceptable range is 105 to 132 V.
  - 2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is unacceptable.
  - 3. Ground Impedance: Values of up to 2 ohms are acceptable.
  - 4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
  - 5. Using the test plug, verify that the device and its outlet box are securely mounted.
  - 6. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.
  
- C. Test straight-blade convenience outlets in patient-care area and hospital-grade convenience outlets for the retention force of the grounding blade according to NFPA 99. Retention force shall be not less than 4 oz.
  
- D. Wiring device will be considered defective if it does not pass tests and inspections.
  
- E. Prepare test and inspection reports.

END OF SECTION 262726

## SECTION 262813 - FUSES

### 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. Cartridge fuses rated 600 V ac and less for use in the following:
  - a. Control circuits.
  - b. Motor-control centers.
  - c. Panelboards.
  - d. Switchboards.
  - e. Enclosed controllers.
  - f. Enclosed switches.
2. Spare-fuse cabinets.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for spare-fuse cabinets. Include the following for each fuse type indicated:
  1. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.
    - a. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
    - b. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.
  2. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
  3. Current-limitation curves for fuses with current-limiting characteristics.
  4. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse. Submit in electronic format suitable for use in coordination software and in PDF format.
  5. Coordination charts and tables and related data.
  6. Fuse sizes for elevator feeders and elevator disconnect switches.

## SECTION 262813 - FUSES

### 1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017700 "Closeout Procedures," and or Section 017823 "Operation and Maintenance Data," include the following:
  - 1. Ambient temperature adjustment information.
  - 2. Current-limitation curves for fuses with current-limiting characteristics.
  - 3. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse used on the Project. Submit in PDF format.
  - 4. Coordination charts and tables and related data.

### 1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

### 1.6 FIELD CONDITIONS

- A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F or more than 100 deg F, apply manufacturer's ambient temperature adjustment factors to fuse ratings.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Cooper Industries, Inc.; Bussmann Div.
  - 2. Mersen
- B. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.

### 2.2 CARTRIDGE FUSES

- A. Characteristics: NEMA FU 1, current-limiting, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.
- 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.

## SECTION 262813 - FUSES

- C. Comply with NEMA FU 1 for cartridge fuses.
- D. Comply with NFPA 70.
- E. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

### 2.3 FUSE COVER

- A. Fuse cover shall be BUSSMAN "SAMI"

### 2.4 SPARE-FUSE CABINET

- A. Characteristics: Wall-mounted steel unit with full-length, recessed piano-hinged door and key-coded cam lock and pull.
  - 1. Size: Adequate for storage of spare fuses specified with 15 percent spare capacity minimum.
  - 2. Finish: Gray, baked enamel.
  - 3. Identification: "SPARE FUSES" in 1-1/2-inch- high letters on exterior of door.
  - 4. Fuse Pullers: For each size of fuse, where applicable and available, from fuse manufacturer.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.
- B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.
- C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.
- D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 FUSE APPLICATIONS

- A. Cartridge Fuses:
  - 1. Main Service: Class RK1, time delay, current limiting Bussman HI-CAP KRP-C.
  - 2. Main Feeders: Class RK1, time delay.
    - a. 250volts - Bussman LOW-PEAK LPN-RK dual element.

## SECTION 262813 - FUSES

- b. 600volts – Bussman LOW-PEAK LPS-RK dual element.
3. Motor Branch Circuits: Class RK1, time delay.
  - a. 250volts - Bussman LOW-PEAK LPN-RK dual element.
  - b. 600volts – Bussman LOW-PEAK LPS-RK dual element.
4. Large Motor Branch (601-4000 A): Class L, time delay.
5. Power Electronics Circuits: Class J, high speed.
6. Other Branch Circuits: Class RK1, time delay.
7. Control Transformer Circuits: Class CC, time delay, and control transformer duty.
8. Provide open-fuse indicator fuses or fuse covers with open fuse indication.

### 3.3 INSTALLATION

- A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.
- B. Install spare-fuse cabinet(s) in location shown on the Drawings or as indicated in the field by Architect.

### 3.4 IDENTIFICATION

- A. Install labels complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems" and indicating fuse replacement information inside of door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION 262813

## SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

### 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. Fusible switches.
  - 2. Nonfusible switches.
  - 3. Enclosures.

#### 1.3 DEFINITIONS

- A. NC: Normally closed.
- B. NO: Normally open.
- C. SPDT: Single pole, double throw.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
  - 1. Enclosure types and details for types other than NEMA 250, Type 1.
  - 2. Current and voltage ratings.
  - 3. Short-circuit current ratings (interrupting and withstand, as appropriate).
  - 4. Include evidence of NRTL listing for series rating of installed devices.
  - 5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
  - 6. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.
- B. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work.
  - 1. Wiring Diagrams: For power, signal, and control wiring.

## SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

### 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified testing agency.
- B. Seismic Qualification Certificates: For enclosed switches and circuit breakers, 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.
- C. Field quality-control reports.
  - 1. Test procedures used.
  - 2. Test results that comply with requirements.
  - 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
- D. Manufacturer's field service report.

### 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
  - 1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
  - 2. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device. Submit on translucent log-log graph paper.

### 1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
  - 2. Fuse Pullers: Two for each size and type.

### 1.8 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member Company of NETA or an NRTL.



## SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.
- B. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.
- C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- D. 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.
- E. Comply with NFPA 70.

### 1.9 PROJECT CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
  1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
  2. Altitude: Not exceeding 6600 feet.
- B. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
  1. Notify Architect and or Construction Manager no fewer than seven days in advance of proposed interruption of electric service.
  2. Indicate method of providing temporary electric service.
  3. Do not proceed with interruption of electric service without Architect's or Construction Manager's written permission.
  4. Comply with NFPA 70E.

### 1.10 COORDINATION

- A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS:

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

## SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

1. Square D Co.
2. Eaton Corporation.
3. Siemens
4. General Electric

### 2.2 FUSIBLE SWITCHES

- A. Type HD, Heavy Duty, Single Throw, 240 or 600-V ac (as per connected voltage), 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- B. Accessories:
  1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
  2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
  3. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
  4. Hookstick Handle: Allows use of a hookstick to operate the handle.
  5. Lugs: Mechanical type, suitable for number, size, and conductor material.
  6. Service-Rated Switches: Labeled for use as service equipment.

### 2.3 NONFUSIBLE SWITCHES

- A. Type HD, Heavy Duty, Single Throw, 240 or 600-V ac (as per connected voltage), 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- B. Accessories:
  1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
  2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
  3. Hookstick Handle: Allows use of a hookstick to operate the handle.
  4. Lugs: Mechanical type, suitable for number, size, and conductor material.

### 2.4 ENCLOSURES

- A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
  1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
  2. Outdoor Locations: NEMA 250, Type 3R OR 4XSS (as noted on drawings).
  3. Kitchen Areas: NEMA 250, Type 4X, stainless steel.
  4. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.

## SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 INSTALLATION

- A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
- B. Comply with mounting and anchoring requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- D. Install fuses in fusible devices.
- E. Comply with NECA 1.

#### 3.3 IDENTIFICATION

- A. Comply with requirements in Section 260553 "Identification for Electrical Systems."
  1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
  2. Label each enclosure with engraved metal or laminated-plastic nameplate.

#### 3.4 FIELD QUALITY CONTROL

- A. 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.
- B. Acceptance Testing Preparation:
  1. Test insulation resistance for each enclosed switch and circuit breaker, component, connecting supply, feeder, and control circuit.

## SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

2. Test continuity of each circuit.

### C. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
3. Perform the following infrared scan tests and inspections and prepare reports:
  - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each enclosed switch and circuit breaker. Remove front panels so joints and connections are accessible to portable scanner.
  - b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each enclosed switch and circuit breaker 11 months after date of Substantial Completion.
  - c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
4. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

- D. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

- E. Prepare test and inspection reports, including a certified report that identifies enclosed switches and circuit breakers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

### 3.5 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges as specified in Section 260573 "Overcurrent Protective Device Coordination Study."

END OF SECTION 262816

## SECTION 262913 - ENCLOSED CONTROLLERS

### 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 the following enclosed controllers rated 600 V and less:
  - 1. Full-voltage manual.
  - 1. Full-voltage magnetic.
  - 2. Multispeed.
- B. Related Section:
  - 1. Section 262923 "Variable-Frequency Motor Controllers" for general-purpose, ac, adjustable-frequency, pulse-width-modulated controllers for use on variable torque loads in ranges up to 200 hp.

#### 1.3 DEFINITIONS

- A. CPT: Control power transformer.
- B. MCCB: Molded-case circuit breaker.
- C. MCP: Motor circuit protector.
- D. N.C.: Normally closed.
- E. N.O.: Normally open.
- F. OCPD: Overcurrent protective device.
- G. SCR: Silicon-controlled rectifier.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of enclosed controller. Include manufacturer's technical data on features, performance, electrical characteristics, ratings, and enclosure types and finishes.
- B. Shop Drawings: For each enclosed controller. Include dimensioned plans, elevations, sections, details, and required clearances and service spaces around controller enclosures.
  - 1. Show tabulations of the following:

## SECTION 262913 - ENCLOSED CONTROLLERS

- a. Each installed unit's type and details.
  - b. Factory-installed devices.
  - c. Nameplate legends.
  - d. Short-circuit current rating of integrated unit.
  - e. Listed and labeled for integrated short-circuit current (withstand) rating of OCPDs in combination controllers by an NRTL acceptable to authorities having jurisdiction.
  - f. Features, characteristics, ratings, and factory settings of individual OCPDs in combination controllers.
2. Wiring Diagrams: For power, signal, and control wiring.

### 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified testing agency.
- B. Field quality-control reports.
- C. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed, and arrange to demonstrate that switch settings for motor running overload protection suit actual motors to be protected.

### 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For enclosed controllers to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
  1. Routine maintenance requirements for enclosed controllers and installed components.
  2. Manufacturer's written instructions for testing and adjusting circuit breaker and MCP trip settings.
  3. Manufacturer's written instructions for setting field-adjustable overload relays.
  4. Manufacturer's written instructions for testing, adjusting, and reprogramming reduced-voltage solid-state controllers.

### 1.7 MATERIALS MAINTENANCE SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  1. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
  2. Control Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
  3. Indicating Lights: Two of each type and color installed.
  4. Auxiliary Contacts: Furnish one spare(s) for each size and type of magnetic controller installed.

## SECTION 262913 - ENCLOSED CONTROLLERS

5. Power Contacts: Furnish three spares for each size and type of magnetic contactor installed.

### 1.8 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member company of NETA or an NRTL.
  1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.
- 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. Comply with NFPA 70.
- D. IEEE Compliance: Fabricate and test enclosed controllers according to IEEE 344 to withstand seismic forces defined in Section 260548.16 "Seismic Controls for Electrical Systems."

### 1.9 DELIVERY, STORAGE, AND HANDLING

- A. Store enclosed controllers indoors in clean, dry space with uniform temperature to prevent condensation. Protect enclosed controllers from exposure to dirt, fumes, water, corrosive substances, and physical damage.
- B. If stored in areas subject to weather, cover enclosed controllers to protect them from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside controllers.

### 1.10 PROJECT CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
  1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
  2. Altitude: Not exceeding 6600 feet.
- B. Interruption of Existing Electrical Systems: Do not interrupt electrical systems in facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:
  1. Notify Architect and or Construction Manager no fewer than seven days in advance of proposed interruption of electrical systems.
  2. Indicate method of providing temporary utilities.
  3. Do not proceed with interruption of electrical systems without Architect's and or Construction Manager's written permission.
  4. Comply with NFPA 70E.

## SECTION 262913 - ENCLOSED CONTROLLERS

### 1.11 COORDINATION

- A. Coordinate layout and installation of enclosed controllers with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.
- C. Coordinate installation of roof curbs, equipment supports, and roof penetrations.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Square D Co.
  - 2. Siemens.
  - 3. Eaton Corporation.
  - 4. General Electric.

### 2.2 FULL-VOLTAGE CONTROLLERS

- A. General Requirements for Full-Voltage Controllers: Comply with NEMA ICS 2, general purpose, Class A.
- B. Motor-Starting Switches: "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off or on.
  - 1. Configuration: Non-reversing or two speed (as noted on drawings).
  - 2. Surface mounting.
  - 3. Red and Green pilot light.
  - 4. Additional Nameplates: HIGH and LOW for two-speed switches.
- C. Fractional Horsepower Manual Controllers: "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off, on, or tripped.
  - 1. Configuration: Non-reversing.
  - 2. Overload Relays: Inverse-time-current characteristics; NEMA ICS 2, Class 10 tripping characteristics; heaters matched to nameplate full-load current of actual protected motor; external reset push button melting alloy type.
  - 3. Surface mounting.
  - 4. Red pilot light.
- D. Integral Horsepower Manual Controllers: "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off, on, or tripped.
  - 1. Configuration: Non-reversing.



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2. Overload Relays: Inverse-time-current characteristics; NEMA ICS 2, Class 10 tripping characteristics; heaters and sensors in each phase, matched to nameplate full-load current of actual protected motor and having appropriate adjustment for duty cycle; external reset push button melting alloy type.
  3. Surface] mounting.
  4. Red pilot light.
  5. N.C. auxiliary contact.
- E. Magnetic Controllers: Full voltage, across the line, electrically held.
1. Configuration: Non-reversing.
  2. Contactor Coils: Pressure-encapsulated type with coil transient suppressors.
    - a. Operating Voltage: Depending on contactor NEMA size and line-voltage rating, manufacturer's standard matching control power or line voltage.
  3. Power Contacts: Totally enclosed, double-break, silver-cadmium oxide; assembled to allow inspection and replacement without disturbing line or load wiring.
  4. Control Circuits: 24 V ac; obtained from integral CPT, with primary and secondary fuses, with control power source of sufficient capacity to operate integral devices and remotely located pilot, indicating, and control devices.
    - a. CPT Spare Capacity: 100 VA.
  5. Solid-State Overload Relay:
    - a. Switch or dial selectable for motor running overload protection.
    - b. Sensors in each phase.
    - c. Class 10/20 selectable tripping characteristic selected to protect motor against voltage and current unbalance and single phasing.
    - d. Class II ground-fault protection, with start and run delays to prevent nuisance trip on starting.
    - e. Analog communication module.
  6. N.C. and N.O., isolated overload alarm contact.
  7. External overload reset push button.
- F. Combination Magnetic Controller: Factory-assembled combination of magnetic controller, OCPD, and disconnecting means.
1. Fusible Disconnecting Means:
    - a. NEMA KS 1, heavy-duty, horsepower-rated, fusible switch with clips or bolt pads to accommodate indicated fuses.
    - b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
  2. Auxiliary Contacts: N.O./N.C., arranged to activate before switch blades open.
  3. Nonfusible Disconnecting Means:
    - a. NEMA KS 1, heavy-duty, horsepower-rated, non-fusible switch.

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- b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
  - c. Auxiliary Contacts: N.O. /N.C., arranged to activate before switch blades open.
4. MCP Disconnecting Means:
- a. UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents, instantaneous-only circuit breaker with front-mounted, field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.
  - b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
  - c. Auxiliary contacts "a" and "b" arranged to activate with MCP handle.
  - d. N.C. and N.O. alarm contact that operates only when MCP has tripped.
  - e. Current-limiting module to increase controller short-circuit current (withstand) rating to 100 kA.
5. MCCB Disconnecting Means:
- a. UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents; thermal-magnetic MCCB, with inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits.
  - b. Front-mounted, adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
  - c. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
  - d. Auxiliary contacts "a" and "b" arranged to activate with MCCB handle.
  - e. N.C. and N.O. alarm contact that operates only when MCCB has tripped.

### 2.3 MULTISPEED MAGNETIC CONTROLLERS

- A. General Requirements for Multispeed Magnetic Controllers: Comply with NEMA ICS 2, general purpose, Class A.
- B. Multispeed Magnetic Controllers: Two speed, full voltage, across the line, electrically held.
  - 1. Configuration: Non-reversing; two winding.
  - 2. Contactor Coils: Pressure-encapsulated type with coil transient suppressors.
    - a. Operating Voltage: Depending on contactor NEMA size and line-voltage rating, manufacturer's standard matching control power or line voltage.
  - 3. Power Contacts: Totally enclosed, double break, silver-cadmium oxide; assembled to allow inspection and replacement without disturbing line or load wiring.
  - 4. Control Circuits: 24-V ac; obtained from integral CPT, with primary and secondary fuses, with control power source of sufficient capacity to operate integral devices and remotely located pilot, indicating, and control devices.
    - a. CPT Spare Capacity: **100 VA**.

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5. Compelling relays shall ensure that motor will start only at low speed.
  6. Accelerating timer relays shall ensure properly timed acceleration through speeds lower than that selected.
  7. Decelerating timer relays shall ensure automatically timed deceleration through each speed.
  8. Antiplugging timer relays shall ensure a time delay when transferring from FORWARD to REVERSE and back.
  9. Solid-State Overload Relay:
    - a. Switch or dial selectable for motor running overload protection.
    - b. Sensors in each phase.
    - c. Class 10/20 selectable] tripping characteristic selected to protect motor against voltage and current unbalance and single phasing.
    - d. Class II ground-fault protection, with start and run delays to prevent nuisance trip on starting.
    - e. Analog communication module.
  10. N.C. and N.O., isolated overload alarm contact.
  11. External overload reset push button.
- C. Combination Multispeed Magnetic Controller: Factory-assembled combination of reduced-voltage magnetic controller, OCPD, and disconnecting means.
1. Fusible Disconnecting Means:
    - a. NEMA KS 1, heavy-duty, horsepower-rated, fusible switch with clips or bolt pads to accommodate indicated fuses.
    - b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
    - c. Auxiliary Contacts: N.O./N.C., arranged to activate before switch blades open.
  2. Nonfusible Disconnecting Means:
    - a. NEMA KS 1, heavy-duty, horsepower-rated, non-fusible switch.
    - b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
    - c. Auxiliary Contacts: N.O./N.C., arranged to activate before switch blades open.
  3. MCP Disconnecting Means:
    - a. UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents, instantaneous-only circuit breaker with front-mounted, field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.
    - b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
    - c. Auxiliary contacts "a" and "b" arranged to activate with MCP handle.
    - d. N.C. or N.O. alarm contact that operates only when MCP has tripped.
    - e. Current-limiting module to increase controller short-circuit current (withstand) rating to 100 kA.

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4. MCCB Disconnecting Means:
  - a. UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents; thermal-magnetic MCCB, with inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits.
  - b. Front-mounted, adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
  - c. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
  - d. Auxiliary contacts "a" and "b" arranged to activate with MCCB handle. N.C. or N.O. alarm contact that operates only when MCCB has tripped.

### 2.4 ENCLOSURES

- A. Enclosed Controllers: NEMA ICS 6, to comply with environmental conditions at installed location.
  1. Dry and Clean Indoor Locations: Type 1.
  2. Outdoor Locations: Type 3R or Type 4XSS (as indicated on drawings).
  3. Kitchen Areas: Type 4X, stainless steel.
  4. Other Wet or Damp Indoor Locations: Type 4.
  5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: Type 12.
  6. Hazardous Areas Indicated on Drawings: Type 7 or Type 9 (as indicated on drawings).

### 2.5 ACCESSORIES

- A. General Requirements for Control Circuit and Pilot Devices: NEMA ICS 5; factory installed in controller enclosure cover unless otherwise indicated.
  1. Push Buttons, Pilot Lights, and Selector Switches: Heavy type.
    - a. Push Buttons: Shielded types; momentary as indicated.
    - b. Pilot Lights: LED types; colors as indicated; push to test.
    - c. Selector Switches: Rotary type.
  2. Elapsed Time Meters: Heavy duty with digital readout in hours.
  3. Meters: Panel type, 2-1/2-inch minimum size with 90- or 120-degree scale and plus or minus two percent accuracy. Where indicated, provide selector switches with an off position.
- B. Reversible N.C./N.O. auxiliary contact(s).
- C. Control Relays: Auxiliary and adjustable solid-state time-delay relays.
- D. Phase-Failure, Phase-Reversal, and Undervoltage and Overvoltage Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connections. Provide adjustable undervoltage, overvoltage, and time-delay settings.

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- E. Breather and drain assemblies, to maintain interior pressure and release condensation in Type 4, Type 4X, Type 7, and Type 9 enclosures installed outdoors or in unconditioned interior spaces subject to humidity and temperature swings.
- F. Sun shields installed on fronts, sides, and tops of enclosures installed outdoors and subject to direct and extended sun exposure.
- G. Cover gaskets for Type 1 enclosures.
- H. Terminals for connecting power factor correction capacitors to the load side of overload relays.
- I. Spare control wiring terminal blocks, quantity as indicated wired.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas and surfaces to receive enclosed controllers, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
- B. Examine enclosed controllers before installation. Reject enclosed controllers that are wet, moisture damaged, or mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Wall-Mounted Controllers: Install enclosed controllers on walls with tops at uniform height unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For controllers not at walls, provide freestanding racks complying with Section 260529 "Hangers and Supports for Electrical Systems."
- B. Floor-Mounted Controllers: Install enclosed controllers on 4-inch nominal-thickness concrete base. Comply with requirements for concrete base specified in Section 033000 "Cast-in-Place Concrete" and or Section 033053 "Miscellaneous Cast-in-Place Concrete."
  - 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
  - 2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
  - 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 4. Install anchor bolts to elevations required for proper attachment to supported equipment.
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- D. Install fuses in each fusible-switch enclosed controller.

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- E. Install fuses in control circuits if not factory installed. Comply with requirements in Section 262813 "Fuses."
- F. Install heaters in thermal overload relays. Select heaters based on actual nameplate full-load amperes after motors have been installed.
- G. Install, connect, and fuse thermal-protector monitoring relays furnished with motor-driven equipment.
- H. Install power factor correction capacitors. Connect to the load side of overload relays. If connected to the load side of overload relays, adjust overload heater sizes to accommodate the reduced motor full-load currents.
- I. Comply with NECA 1.

### 3.3 IDENTIFICATION

- A. Identify enclosed controllers, components, and control wiring. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
  - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
  - 2. Label each enclosure with engraved nameplate.
  - 3. Label each enclosure-mounted control and pilot device.

### 3.4 CONTROL WIRING INSTALLATION

- A. Install wiring between enclosed controllers and remote devices. Comply with requirements in Section 260523 "Control-Voltage Electrical Power Cables."
- B. Bundle, train, and support wiring in enclosures.
- C. Connect selector switches and other automatic-control selection devices where applicable.
  - 1. Connect selector switches to bypass only those manual- and automatic-control devices that have no safety functions when switch is in manual-control position.
  - 2. Connect selector switches with enclosed-controller circuit in both manual and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

### 3.5 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections.

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1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- C. Acceptance Testing Preparation:
1. Test insulation resistance for each enclosed controller, component, connecting supply, feeder, and control circuit.
  2. Test continuity of each circuit.
- D. Tests and Inspections:
1. Inspect controllers, wiring, components, connections, and equipment installation. Test and adjust controllers, components, and equipment.
  2. Test insulation resistance for each enclosed-controller element, component, connecting motor supply, feeder, and control circuits.
  3. Test continuity of each circuit.
  4. Verify that voltages at controller locations are within plus or minus 10 percent of motor nameplate rated voltages. If outside this range for any motor, notify Architect/Construction Manager before starting the motor(s).
  5. Test each motor for proper phase rotation.
  6. Perform each electrical test and visual and mechanical inspection stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
  7. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
  8. Perform the following infrared (thermographic) scan tests and inspections and prepare reports:
    - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each multi-pole enclosed controller. Remove front panels so joints and connections are accessible to portable scanner.
    - b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each multi-pole enclosed controller 11 months after date of Substantial Completion.
    - c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
  9. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- E. Enclosed controllers will be considered defective if they do not pass tests and inspections.
- F. Prepare test and inspection reports including a certified report that identifies enclosed controllers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

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### 3.6 ADJUSTING

- A. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload-relay pickup and trip ranges.
- B. Adjust overload-relay heaters or settings if power factor correction capacitors are connected to the load side of the overload relays.
- C. Adjust the trip settings of MCPs and thermal-magnetic circuit breakers with adjustable instantaneous trip elements. Initially adjust to six times the motor nameplate full-load ampere ratings and attempt to start motors several times, allowing for motor cooldown between starts. If tripping occurs on motor inrush, adjust settings in increments until motors start without tripping. Do not exceed eight times the motor full-load amperes (or 11 times for NEMA Premium Efficient motors if required). Where these maximum settings do not allow starting of a motor, notify Architect/Construction Manager before increasing settings.
- D. Set field-adjustable circuit-breaker trip ranges as specified in Section 260573 "Overcurrent Protective Device Coordination Study."

### 3.7 PROTECTION

- A. Replace controllers whose interiors have been exposed to water or other liquids prior to Substantial Completion.

### 3.8 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain enclosed controllers.

END OF SECTION 262913



## SECTION 264313 - SURGE PROTECTION FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

### 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 field-mounted SPDs for low-voltage (120 to 600 V) power distribution and control equipment.
- B. The Surge Protection Device (SPD) covered under this section includes all service entrance type surge protection devices suitable for use as Type 1(Service Entrance) or Type 2 (Distribution Panels) devices per UL1449 3rd Edition, applied to the line or load side of the utility feed inside the facility.
- C. Contractor shall provide all labor, materials, equipment and incidentals as shown, specified and required to finish and install surge protection devices.

#### 1.3 DEFINITIONS

- A. Inominal: Nominal discharge current.
- B. MCOV: Maximum continuous operating voltage.
- C. Mode(s), also Modes of Protection: The pair of electrical connections where the VPR applies.
- D. MOV: Metal-oxide varistor; an electronic component with a significant non-ohmic current-voltage characteristic.
- E. OCPD: Overcurrent protective device.
- F. SCCR: Short-circuit current rating.
- G. SPD: Surge protective device.
- H. VPR: Voltage protection rating.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

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2. Copy of UL Category Code VZCA certification, as a minimum, listing the tested values for VPRs, Inominal ratings, MCOVs, type designations, OCPD requirements, model numbers, system voltages, and modes of protection.

### 1.5 INFORMATIONAL SUBMITTALS

- A. Package must include shop drawings complete with all technical information, unit dimensions, detailed installation instructions, maintenance manual, recommended replacement parts list and wiring configuration.
- B. Copies of Manufacturer's catalog data, technical information and specifications on equipment proposed for use.
- C. Copies of documentation stating that the Surge Protection Device is listed by UL to UL1449 3rd Edition, category code VZCA.
- D. Copies of actual let through voltage data in the form of oscillograph results for both ANSI/IEEE C62.41 Category C3 (combination wave) and B3 (Ring wave) tested in accordance with ANSI/IEEE C6245.
- E. Copies of Noise Rejection testing as outlined in NEMA LS1-1992 (R2000) Section 3.11. Noise rejection is to be measured between 50 kHz and 100 MHz verifying the devices noise attenuation. Must show multiple attenuation levels over a range of frequencies.
- F. Copies of test reports from a recognized independent testing laboratory, capable of producing 200kA surge current waveforms, verifying the suppressor components can survive published surge current rating on a per mode basis using the ANSI/IEEE C62.41 impulse waveform C3 (8 x 20 microsecond, 20kV/10kA). Test data on an individual module is not acceptable.
- G. Copy of warranty statement clearly establishing the terms and conditions to the building/facility owner/operator.
- H. Field quality-control reports.
- I. Sample Warranty: For manufacturer's special warranty.

### 1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For SPDs to include in maintenance manuals.

### 1.7 QUALITY ASSURANCE

- A. Reference Standard: Comply with the latest edition of the applicable provisions and recommendations of the following, except as otherwise stated in this document:
  1. UL 1449 3rd Edition 2009 Revision (effective 9/29/2007).
  2. UL 1283.
  3. ANSI/IEEE C62.41, Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits.

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4. ANSI/IEEE C62.45, Guide for Surge Testing for equipment connected to Low-Voltage AC Power Circuits.
5. UL96A
6. IEEE 1100 Emerald Book.
7. National Fire Protection Association (NFPA 70: National Electrical Code).

### 1.8 WARRANTY

- A. **Manufacturer's Warranty:** Manufacturer agrees to replace or replace SPDs that fail in materials or workmanship within specified warranty period.

1. **Warranty Period:** Fifteen years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS:

- A. **Manufacturers:**

1. ACT Communications
2. Others prior approval required before bid.

### 2.2 GENERAL SPD REQUIREMENTS

- A. **SPD with Accessories:** Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.
- C. Comply with UL 1449.
- D. Comply with UL 1283.
- E. MCOV of the SPD shall be the nominal system voltage.
- F. **Declared Maximum Continuous Operating Voltage (MCOV)** shall be greater than 115 percent of the nominal system operating voltage and in compliance with test and evaluation procedures outlined in the nominal discharge surge current test of UL1449 3rd Edition, section 37.7.3. MCOV values claimed based on the component's value or on the 30-minute 115% operational voltage test, section 38 in UL1449 will not be accepted.
- G. **Electrical Noise Filter-** each unit shall include a high performance EMI/RFI noise rejection filter with a maximum attenuation of 54dB per MIL-STD-220B.
1. SPD shall include an EMI/RFI noise rejection filter for all L-N modes as well as a removable filter in the N-G mode.
- H. The UL1449 Voltage Protective Rating (VPR) shall be permanently affixed to the SPD unit.

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- I. The UL1449 Nominal Discharge Surge Current Rating shall be 20kA
- J. The SCCR rating of the SPD shall be 200kAIC without the need for upstream over current protection.
- K. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per phase shall be no less than noted on plans The peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.
- L. The SPD shall have the following monitoring options through the M3 Mastermind monitoring system.
  - 1. Time Date stamp, duration and magnitude for the following power quality events (sags, swells, surges, dropouts, outages, THD, frequency, Volts RMS per phase)
  - 2. SPD monitoring shall track surge protection and display it as a percentage of remaining protection.
  - 3. SPD shall provide a surge counter with three categories to be defined as
  - 4. Low Level surge (100A-500A) Medium Level surge (500A-3,000A) High Level surge (>3,000A)
  - 5. Remote communications via Ethernet using the M4E Monitoring Option
  - 6. Unit shall be equipped with an integral Test Port Compliant with the DTS-2 Testing Unit.
  - 7. Indicator light display for protection status.
- M. ENCLOSURES
  - 1. Indoor Enclosures: NEMA 250, Type 1.
  - 2. Outdoor Enclosures: NEMA 250, Type 4.

### 2.3 SERVICE ENTRANCE SUPPRESSOR

- A. SPDs: Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 1449, Type 1.
  - 1. SPDs with the following features and accessories:
    - a. Integral disconnect switch.
    - b. Internal thermal protection that disconnects the SPD before damaging internal suppressor components.
- B. Unit shall have no more than 10% deterioration or degradation of the UL1449 3<sup>rd</sup> Edition Voltage Protection Rating (VPR) when exposed to a minimum of 14,000 repeated categories C3 (20kV/10kA) surges. The SPD manufacturer must provide a test report validating the repetitive surge test was performed.
- C. Protection Modes UL1449 3<sup>rd</sup> Edition VPR(6kV, 3kA) for grounded WYE/delta and High Leg Delta circuits with voltages of (480Y/277), (208Y/120), (600Y/347). 3-Phase, 4 wire circuits, (120/240) split phase shall be as follows and comply with test procedures outlined in UL1449 3<sup>rd</sup> Edition section 37.6:

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System Voltage	Mode	MCOV	B3	C3 Comb.	UL 1449
			Ringwave 6kV, 500A	Wave 20kV, 10kA	Third Edition VPR Rating
120/240, 120/208	L-N	150	490	980	700
	L-G	150	570	980	700
	N-G	150	640	1170	700
	L-L	300	500	1600	1200
277/480	L-N	320	450	1420	1200
	L-G	320	540	1540	1200
	N-G	320	570	1600	1000
	L-L	552	530	2600	2000

- D. The unit shall be able to prevent common temporary overvoltages and high impedance faults from damaging the MOVs, increasing their longevity and ability to protect the critical load. Limited and Intermediate current TOVs (as specified in UL 1449 article 39.3 and 39.4) can be caused by a loss of the neutral conductor in a split phase or three phase power system. The available fault current will be determined by the impedance of the loads connected to the phases opposite the SPD and are typically in the range of 30A to 1000A. The Selenium elements must limit voltage to the MOV as a percent of nominal as outlined below:

Overvoltage seen by MOVs as % of Nominal				
time	available current			
	30A	100A	500A	1000A
1 cycle	120%	130%	150%	160%
10 cycles	130%	150%	160%	160%
30 cycles	140%	150%	160%	160%

\*To verify damage to the MOVs has been mitigated, the percent overvoltage seen at the MOV must be less than 200% for split-phase applications or 173% for three-phase applications (100% is nominal).

- E. The unit shall be able to withstand multiple TOVs without damage to the MOVs by shunting current away from the MOVs during the overvoltage. SPD must have the ability to withstand >100 TOVs with a source current of 30A, duration of 30 cycles, with 10s between TOV events.
- F. The service entrance protector shall incorporate a combination of TPMOV and Selenium technology allowing for transient surge and temporary over voltage protection.
- G. Integral Disconnect Switch (REQUIRED)
- The device shall have an optional NEMA compliant safety interlocked integral disconnect switch with an externally mounted metal manual operator.
  - The switch shall disconnect all ungrounded circuit conductors from the distribution system to enable testing and maintenance without interruption to the facility's distribution system.
  - The switch shall be rated for 600Vac.
  - The SPD device shall be tested to UL1449 3rd Edition listed with the integral disconnect switch and the UL1449 VPR ratings shall be provided.

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5. The integral disconnect switch shall be capable of withstanding, without failure, the published maximum surge current magnitude without failure or damage to the switch.
6. The line side of the integral disconnect shall be blocked off so that when the SPD is opened there is no direct access to the voltage present on the line side of the disconnect.

2.4 PANEL SUPPRESSORS

- A. SPDs: Comply with UL 1449, Type 2.
  1. Internal thermal protection that disconnects the SPD before damaging internal suppressor components.
- B. Unit shall have no more than 10% deterioration or degradation of the UL1449 3<sup>rd</sup> Edition Voltage Protection Rating (VPR) when exposed to a minimum of 5,000 repeated categories C3 (20kV/10kA) surges. The SPD manufacturer must provide a test report validating the repetitive surge test was performed.
- C. Protection Modes UL1449 3<sup>rd</sup> Edition VPR(6kV, 3kA) for grounded WYE/delta and High Leg Delta circuits with voltages of (480Y/277), (208Y/120), (600Y/347). 3-Phase, 4 wire circuits, (120/240) split phase shall be as follows and comply with test procedures outlined in UL1449 3<sup>rd</sup> Edition section 37.6:

System Voltage	Mode	MCOV	B3 Ringwave 6kV, 500A	C3 Comb. Wave 20kV, 10kA	UL 1449 Third Edition VPR Rating
120/240, 120/208	L-N	150	760	2020	900
	L-G	150	800	1890	900
	N-G	150	930	2330	1200
	L-L	300	790	250	900
277/480	L-N	320	740	2460	1200
	L-G	320	790	2460	1500
	N-G	320	900	2640	1200
	L-L	552	870	3390	2000

2.5 CONDUCTORS AND CABLES

- A. Power Wiring: Same size as SPD leads, complying with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. If installed lead length exceeds 5' installer shall use a low impedance (HPI) cable to reduce the lead lengths effect on the installed performance of the SPD.
- C. Class 2 Control Cables: Multiconductor cable with copper conductors not smaller than No. 18 AWG, complying with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

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### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Comply with NECA 1.
- B. Install an OCPD or disconnect as required to comply with the UL listing of the SPD.
- C. Install SPDs with conductors between suppressor and points of attachment as short and straight as possible, and adjust circuit-breaker positions to achieve shortest and straightest leads. Do not splice and extend SPD leads unless specifically permitted by manufacturer. Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground.
- D. Use crimped connectors and splices only. Wire nuts are unacceptable.
- E. Wiring:
  - 1. Power Wiring: Comply with wiring methods in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
  - 2. Controls: Comply with wiring methods in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

#### 3.2 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections with the assistance of a factory-authorized service representative.
  - 1. Compare equipment nameplate data for compliance with Drawings and Specifications.
  - 2. Inspect anchorage, alignment, grounding, and clearances.
  - 3. Verify that electrical wiring installation complies with manufacturer's written installation requirements.
- B. An SPD will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

#### 3.3 STARTUP SERVICE

- A. Complete startup checks according to manufacturer's written instructions.
- B. Do not perform insulation-resistance tests of the distribution wiring equipment with SPDs installed. Disconnect SPDs before conducting insulation-resistance tests, and reconnect them immediately after the testing is over.
- C. Energize SPDs after power system has been energized, stabilized, and tested.

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3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to operate and maintain SPDs.

END OF SECTION 264313



## SECTION 265116 - INTERIOR LIGHTING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:

- 1. Interior LED luminaires and drivers.
- 2. Luminaire supports.

- B. Related Requirements:

- 1. Section 260923 "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.

#### 1.3 DEFINITIONS

- A. BIM: Building information model.
- B. CAD: Computer-aided design.
- C. CCT: Correlated color temperature.
- D. CRI: Color Rendering Index.
- E. LED: Light-emitting diode.
- F. Fixture: See "Luminaire."
- G. IP: International Protection or Ingress Protection Rating
- H. Lumen: Measured output of lamp and luminaire, or both.
- I. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Arrange in order of luminaire designation.
  - 2. Include data on features, accessories, and finishes.

## SECTION 265116 - INTERIOR LIGHTING

3. Include physical description and dimensions of luminaires.
  4. Include life, output (lumens, CCT, and CRI), and energy efficiency data.
  5. Include photometric data and adjustment factors based on laboratory tests, complying with IESNA Lighting Measurements Testing and Calculation Guides, of each luminaire type. The adjustment factors shall be for lamps, ballasts, and accessories identical to those indicated for the luminaire as applied in this Project. For LED light fixtures the adjustment factors shall be for lamps and accessories identical to those indicated for the lighting fixture as applied in this Project IES LM-79 and IES LM-80
    - a. Retain or "Manufacturers' Certified Data" or "Testing Agency Certified Data" Subparagraph below. Retain first subparagraph if photometric data, based on testing by accredited manufacturers' laboratories, is considered adequate for luminaires in this Project. Retain second subparagraph if photometric data for one or more luminaires are based on independent laboratory tests; coordinate with the Interior Lighting Fixture Schedule on Drawings to indicate which units shall meet this requirement. See the Evaluations. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program (NVLAP) for Energy Efficient Lighting Products.
    - b. Testing Agency Certified Data: For indicated luminaires, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.
  6. Include documentation verifying light fixture efficiency by providing one of the following:
    - a. Screenshot of DLC website listing the light fixture. Can be found at <https://www.designlights.org>
    - b. Screenshot of Energy Star website listing the light fixture. Can be found at <https://www.energystar.gov>
    - c. Part efficiency documentation in the form of 3<sup>rd</sup> party certified lab tested LM-79 or LM-80 documents with additional supporting documents linking the part model to the light fixture model.
- B. Shop Drawings: For nonstandard or custom luminaires.
1. Include plans, elevations, sections, and mounting and attachment details.
  2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, and required clearances, method of field assembly, components, and location and size of each field connection.
  3. Include diagrams for power, signal, and control wiring.
- C. Product Schedule: For luminaires and lamps. Use same designations indicated on Drawings.
- D. Qualification Data: For testing laboratory providing photometric data for luminaires.
- E. Product Certificates: For each type of ballast for bi-level and dimmer-controlled luminaires, from manufacturer.
- F. Product Test Reports: For each luminaire, for tests performed by manufacturer and witnessed by a qualified testing agency.

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- G. Sample warranty.

### 1.5 PRIOR APPROVAL SUBMITTAL REQUESTS

- A. Full submittal data , by type, clearly highlighted and arrowed to identify the specific proposed manufacturer's nomenclature
- B. Full submittal data of lamp and proposed manufacturer.
- C. Full submittal data of ballast/driver (LED) data of proposed manufacturer
- D. LED lumen data will include
  - 1. Lumen output
  - 2. L70 and L90 testing
  - 3. Confirmation of independent test lab data ITL
  - 4. Color temperature and CRI with quantity of McAdam Ellipse steps
    - a. Data shall include sphere and goniometer results for total lumen, total power, luminaire efficacy, CRI and junction temperature for the specified color temperature
  - 5. Make and brand of LED diode should be clearly identified on submittal data
- E. LED dimming shall be equal in range and quality to the specified drivers, Quality of dimming to be defined by dimming range, freedom from perceived flicker or visible stroboscopic flicker, smooth and continuous change in level (no visible steps in transitions), natural square law response to control input, and stable when input voltage conditions fluctuate over what is typically experience in a commercial environment.
- F. All substitutions must meet specified fixtures certifications (UL,ETL,CE,CSA, RoHS, DLC, Energy Star)
- G. Provide lighting calculations with the prior approval request based on reflectance values and light loss factors provided by the engineer and displayed on lighting calculation drawings. (may be unique by area) Calculations shall be shown on one sheet with dimensions as shown on construction set. Data will be submitted electronically in dxf format on a flash drive and with printed calculations on Architectural E size sheets to scale with construction set sheets.
  - 1. Discrepancies between prior approval data calculations and the original design calculations will result in immediate disqualification of review due to time based constraints on the bid process
- H. Prior approval request may require a sample of both the proposed and specified fixtures provided by the alternate manufacturer at NO additional cost to the project. Samples of both specified and proposed must be provided within 10 working days of request.
- I. All data will be submitted electronically and in a bound format
- J. Bound data will be secured in hard binder with 3" rings for ease of review or PDF file.
  - 1. Types will be marked with a tab by type and indexed for ease of reference

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- K. LED warranty information MUST be included by type and marked in RED to clearly identify the manufacturer's warranty terms. Warranty data MUST meet or exceed the specified manufacturers terms
- L. Prior approvals MUST be received and acknowledged to the specifier's office no less than 10 days prior to bid.
- M. ALL prior approval data must be submitted in one package with complete information. Information that is incomplete will be rejected without review.
- N. The prior approval will be returned marked approved or rejected by type with no explanation. If any specification is deemed not equal the review will be stopped, the type rejected with no explanation.
- O. Lumen output for the proposed fixture must be highlighted in yellow for clear identification.
- P. All inverter systems supply power to LED fixtures must have pure PWM sine wave function and work with any type of lighting load.
- Q. LED warranty information must be included by type and marked in red to clearly identify the manufacturer's warranty terms. Warranty data must meet or exceed the specified manufacturer's terms.

### 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For luminaires and lighting systems to include in maintenance manuals.
  - 1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

### 1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Lamps: Ten for every 100 of each type and rating installed. Furnish at least one of each type.
  - 2. Diffusers and Lenses: One for every 100 of each type and rating installed. Furnish at least one of each type.
  - 3. Fluorescent-luminaire-mounted emergency battery pack: One for every 40 emergency lighting unit.
  - 4. Globes and Guards: One for every 20 of each type and rating installed. Furnish at least one of each type.

### 1.8 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturer's laboratory is accredited under the NVLAP for Energy Efficient Lighting Products.

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- B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by 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, accredited under the NVLAP for Energy Efficient Lighting Products, and complying with the applicable IES testing standards.
- A. LED luminaires
  - 1. Provide from a single manufacturer for each luminaire type.
  - 2. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires

### 1.9 DELIVERY, STORAGE, AND HANDLING

- A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

### 1.10 WARRANTY

- A. Warranty: Manufacturer and Installer agree to repair or replace (materials and labor) components of luminaires that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Five year(s) from date of Substantial Completion

## PART 2 - PRODUCTS

### 2.1 LUMINAIRE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.
- C. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.
- D. UL Compliance: Comply with UL 1598.
- E. Lamp base complying with ANSI C81.61 or IEC 60061-1.
- F. Recessed Luminaires: Comply with NEMA LE 4.
- G. EMI Filters: Factory installed to suppress conducted EMI according to MIL-STD-461E. Fabricate luminaires with one filter on each ballast indicated to require a filter.

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### 2.2 EMERGENCY POWER UNIT

- A. Internal Type: Self-contained, modular, battery-inverter unit, factory mounted within luminaire body and compatible with ballast. Comply with UL 924.
1. Emergency Connection: Operate LED's continuously. Connect unswitched circuit to battery-inverter unit and switched circuit to luminaire driver.
  2. Test Push Button and Indicator Light: Visible and accessible without opening luminaire or entering ceiling space.
    - a. Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
    - b. Indicator Light: LED indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
  3. Battery: Sealed, maintenance-free, nickel-cadmium type.
  4. Charger: Fully automatic, solid-state, constant-current type with sealed power transfer relay.
  5. Remote Test: Switch in hand-held remote device aimed in direction of tested unit initiates coded infrared signal. Signal reception by factory-installed infrared receiver in tested unit triggers simulation of loss of its normal power supply, providing visual confirmation of either proper or failed emergency response.
  6. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.
- B. External Type: Self-contained, modular, battery-inverter unit, suitable for powering one or more fluorescent lamps, remote mounted from luminaire. Comply with UL 924.
1. Emergency Connection: Operate one fluorescent lamp continuously. Connect unswitched circuit to battery-inverter unit and switched circuit to luminaire ballast.
  2. Battery: Sealed, maintenance-free, nickel-cadmium type.
  3. Charger: Fully automatic, solid-state, constant-current type.
  4. Housing: NEMA 250, Type 1 enclosure.
  5. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
  6. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
  7. Remote Test: Switch in hand-held remote device aimed in direction of tested unit initiates coded infrared signal. Signal reception by factory-installed infrared receiver in tested unit triggers simulation of loss of its normal power supply, providing visual confirmation of either proper or failed emergency response.
  8. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.

### 2.3 LED LIGHTING FIXTURES AND LED LAMPS

- A. All LED products must be UL, ETL and/or CSA listed

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- B. All LED products must have LM-79 and LM-80 testing noted on specification sheet by an independent test lab
- C. All LED products should be identified as L70 and/or L90 ratings based on independent test lab data
- D. All outdoor and wet location listed products must clearly state the IP rating carried on the fixture based on independent test lab data
- E. Bulb shape complying with ANSI C79.1.
- F. CRI of Minimum 80. CCT of 4100 K.
- G. Rated lamp life of **50,000** hours.
- H. Lamps dimmable from 100 percent to 0 percent of maximum light output.
- I. Nominal Operating Voltage: as noted on light fixture schedule.
- J. All LED products must be serviceable for accessible for field repair needs
- K. All indoor lighting color rendering should be within a 3 step McAdams ellipse. All indoor lighting should be 4000-4100 kelvin unless specifically noted
- L. All control systems that interface with an LED product will be supported by a project “integrator” until project completion. This includes contact with the installer prior to installation, availability during installation, and final checkout and startup after installation. The quantity of days required for startup will be based on the manufacturer/agents discretion and need.
  - 1. The project integrator must be capable of performing low voltage and dmx terminations. High voltage terminations are performed solely by the electrical subcontractor.
  - 2. Reporting of final startup completion of the controls system back to the engineer is mandatory.
  - 3. Invitation to attend the training with the owners representative should be made to the engineer no less than 5 days prior to training
  - 4. Signature confirmation of training and startup is required within 5 business days after completion back to the engineer’s office.
- M. All LED drivers should be capable of 0-10 volt controls and DMX control and shall dim to 1% of total lumen output. Where specifically specified the dimming driver may be required to dim to .1% of lumen output , otherwise known as “dim to dark”
- N. Driver manufacturers must have a 5 year history producing dimmable electronic LED drivers for the North American market.
- O. Ambient driver temperatures must be within -20 degrees to 50 degrees C (-4 degrees to 122 degrees F)
- P. Driver (internal) must limit inrush current.

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1. Base specification: meet or exceed NEMA 410 driver inrush standard of 430 amp per 10 amps load with a maximum of 370 amps/2 seconds
2. Preferred specification : Meet or exceed 30ma's at 277 VAC for up to 50 watts of load and 75A at 240us att 277 VAC for 100 watts of load
3. Withstand up to a 1,000 volt surge without impairment of performance as defined by ANSI C62.41 Category A
4. No visible change in light output with a variation of plus/minus 10percent line voltage input.
5. Total harmonic distortion less than 20%, and meet ANSI C82.11 maximum allowable THD requirements at full output. THD shall at no point in the dimming curve allow imbalance current to exceed full output THD

### 2.4 CYLINDER

- A. With integral mounting provisions.

### 2.5 DOWNLIGHT

- A. Universal mounting bracket.
- B. Integral junction box with conduit fittings.

### 2.6 LINEAR INDUSTRIAL

- A. Luminaire and housing certified to the following standard[s].
  1. Class 1, Division 2, Group(s) [A] [B] [C] [and] [D].
  2. NEMA 4X.
  3. IP 66.
  4. Wet locations.
  5. CSA C22.2 No 137.

### 2.7 PARKING GARAGE

- A. Low-profile housing and heat sink.
- B. Fully gasketed and sealed.
- C. Stainless-steel latches.
- D. Integral pressure equalizer.

### 2.8 RECESSED LINEAR

- A. Integral junction box with conduit fittings.



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### 2.9 STRIP LIGHT

- A. Integral junction box with conduit fittings.

### 2.10 SURFACE MOUNT, LINEAR

- A. Universal mounting bracket.
- B. Integral junction box with conduit fittings.

### 2.11 SURFACE MOUNT, NONLINEAR

- A. Universal mounting bracket.
- B. Integral junction box with conduit fittings.

### 2.12 SUSPENDED, LINEAR

- A. Ceiling mounted with two 5/32-inch diameter aircraft cable supports adjustable to 120 inches in length.

### 2.13 SUSPENDED, NONLINEAR

- A. Universal mounting bracket.
- B. Integral junction box with conduit fittings.

### 2.14 MATERIALS

- A. Metal Parts:
  - 1. Free of burrs and sharp corners and edges.
  - 2. Sheet metal components shall be steel unless otherwise indicated.
  - 3. Form and support to prevent warping and sagging.
- B. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.
- C. Diffusers and Globes:
  - 1. Tempered Fresnel glass, prismatic glass or prismatic acrylic, refer to light fixture schedule.
  - 2. Glass: Annealed crystal glass unless otherwise indicated.
  - 3. Acrylic Diffusers: One hundred percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

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4. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.
- D. Housings:
1. Extruded-aluminum housing and heat sink or as noted on light fixture schedule.
  2. Powder-coat finish.
- E. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Locate labels where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
1. Label shall include the following lamp characteristics:
    - a. "USE ONLY" and include specific lamp type.
    - b. Lamp diameter, shape, size, wattage, and coating.
    - c. CCT and CRI for all luminaires.

### 2.15 METAL FINISHES

- A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

### 2.16 LUMINAIRE SUPPORT COMPONENTS

- A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.
- B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish shall match luminaire.
- C. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gage.
- D. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.
- E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before fixture installation.

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- C. Examine walls, floors, roofs, and ceilings for suitable conditions where luminaires will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 TEMPORARY LIGHTING

- A. If approved by the Architect, use selected permanent luminaires for temporary lighting. When construction is sufficiently complete, clean luminaires used for temporary lighting and install new lamps.

### 3.3 INSTALLATION

- A. Comply with NECA 1.
- B. Remote Mounting of Ballasts: Distance between the ballast and luminaire shall not exceed that recommended by ballast manufacturer. Verify, with ballast manufacturers, maximum distance between ballast and luminaire.
- C. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.
- D. Install lamps in each luminaire.
- E. Coordinate layout and installation of luminaires and suspension system with other construction that penetrates ceilings or is supported by them.
- F. Supports:
  - 1. Sized and rated for luminaire weight.
  - 2. Able to maintain luminaire position after cleaning and relamping.
  - 3. Provide support for luminaire without causing deflection of ceiling or wall.
  - 4. Luminaire mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and vertical force of 400 percent of luminaire weight.
- G. Ceiling-Grid-Mounted Luminaire Supports: Use grid as a support element.
  - 1. Install ceiling support system rods or wires, independent of the ceiling suspension devices, for each luminaire. Locate not more than 6 inches from luminaire corners.
  - 2. Support Clips: Fasten to luminaires and to ceiling grid members at or near each luminaire corner with clips that are UL listed for the application.
  - 3. Luminaires of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support luminaires independently with at least two 3/4-inch metal channels spanning and secured to ceiling tees.
  - 4. Install at least one independent support rod or wire from structure to a tab on luminaire. Wire or rod shall have breaking strength of the luminaire weight at a safety factor of 3.
- H. Flush-Mounted Luminaire Support:
  - 1. Secured to outlet box.

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2. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.
3. Trim ring flush with finished surface.

### I. Wall-Mounted Luminaire Support:

1. Attached to structural members in walls, or a minimum 20 gauge backing plate attached to wall structural members, or using through bolts and backing plates on either side of wall.
2. Do not attach luminaires directly to gypsum board.

### J. Suspended Luminaire Support:

1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
2. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
3. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and [tubing or rod for suspension for each unit length of luminaire chassis, including one at each end.
4. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.

- K. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" and Section 260533 "Raceways and Boxes for Electrical Systems" for wiring connections and wiring methods.

## 3.4 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

## 3.5 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
- B. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
1. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.
- C. Luminaire will be considered defective if it does not pass operation tests and inspections.
- D. Prepare test and inspection reports.

## 3.6 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied

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conditions. Make up to two visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.

1. During adjustment visits, inspect all luminaires. Replace lamps or luminaires that are defective.
2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
3. Adjust the aim of luminaires in the presence of the Architect.

END OF SECTION 265116

## SECTION 265219 - EMERGENCY AND EXIT LIGHTING

### 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. Emergency lighting units.
  - 2. Exit signs.
  - 3. Luminaire supports.

#### 1.3 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color Rendering Index.
- C. Emergency Lighting Unit: A lighting unit with internal or external emergency battery powered supply and the means for controlling and charging the battery and unit operation.
- D. Fixture: See "Luminaire" Paragraph.
- E. Lumen: Measured output of lamp and luminaire, or both.
- F. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of emergency lighting unit, exit sign, and emergency lighting support.
  - 1. Include data on features, accessories, and finishes.
  - 2. Include physical description of the unit and dimensions.
  - 3. Battery and charger for light units.
  - 4. Include life, output of luminaire (lumens, CCT, and CRI), and energy-efficiency data.
  - 5. Include photometric data and adjustment factors based on laboratory tests, complying with IES LM-45, for each luminaire type.
    - a. Testing Agency Certified Data: For indicated luminaires and signs, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires and signs shall be certified by manufacturer.

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- b. **Manufacturers' Certified Data:** Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
- B. **Shop Drawings:** For nonstandard or custom luminaires.
  - 1. Include plans, elevations, sections, and mounting and attachment details.
  - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, and required clearances, method of field assembly, components, and location and size of each field connection.
  - 3. Include diagrams for power, signal, and control wiring.
- C. **Product Schedule:**
  - 1. For emergency lighting units. Use same designations indicated on Drawings.
  - 2. For exit signs. Use same designations indicated on Drawings.
- D. **Qualification Data:** For testing laboratory providing photometric data for luminaires.
- E. **Product Certificates:** For each type of luminaire.
- F. **Product Test Reports:** For each luminaire for tests performed by manufacturer and witnessed by a qualified testing agency.
- G. **Sample Warranty:** For manufacturer's special warranty.

### 1.5 CLOSEOUT SUBMITTALS

- A. **Operation and Maintenance Data:** For luminaires and lighting systems to include in emergency, operation, and maintenance manuals.
  - 1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

### 1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. **Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.**
  - 1. **Lamps:** 10 for every 100 of each type and rating installed. Furnish at least one of each type.
  - 2. **Luminaire-mounted, emergency battery pack:** One for every 20 emergency lighting units. Furnish at least one of each type.
  - 3. **Diffusers and Lenses:** two for every 100 of each type and rating installed. Furnish at least one of each type.
  - 4. **Globes and Guards:** One for every 20 of each type and rating installed. Furnish at least one of each type.

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### 1.7 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturer's laboratory that is accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.
- B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by 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, accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products, and complying with the applicable IES testing standards.
- C. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.

### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

### 1.9 WARRANTY

- A. Warranty: Manufacturer and Installer agree to repair or replace (materials and labor) components of luminaires that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Two year(s) from date of Substantial Completion.
- B. Special Warranty for Emergency Lighting Batteries: Manufacturer's standard form in which manufacturer of battery-powered emergency lighting unit agrees to repair or replace components of rechargeable batteries that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period for Emergency Power Unit Batteries: **5** years from date of Substantial Completion. Full warranty shall apply for first year and prorated warranty for the remaining four years.
  - 2. Warranty Period for Emergency Fluorescent Ballast and Self-Powered Exit Sign Batteries: Seven years from date of Substantial Completion. Full warranty shall apply for first year and prorated warranty for the remaining six years.

## PART 2 - PRODUCTS

### 2.1 GENERAL REQUIREMENTS FOR EMERGENCY LIGHTING

- 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.



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- B. NRTL Compliance: Fabricate and label emergency lighting units, exit signs, and batteries to comply with UL 924.
- C. Comply with NFPA 70 and NFPA 101.
- D. Comply with NEMA LE 4 for recessed luminaires.
- E. Comply with UL 1598 for fluorescent luminaires.
- F. Lamp Base: Comply with ANSI C81.61 or IEC 60061-1.
- G. Bulb Shape: Complying with ANSI C79.1.
- H. Internal Type Emergency Power Unit: Self-contained, modular, battery-inverter unit, factory mounted within luminaire body and compatible with ballast.
  - 1. Emergency Connection: Operate two lamp(s) continuously at an output of 1100 lumens each upon loss of normal power. Connect unswitched circuit to battery-inverter unit and switched circuit to luminaire ballast.
  - 2. Operation: Relay automatically turns lamp on when power-supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
  - 3. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
    - a. Ambient Temperature: Less than 0 deg F or exceeding 104 deg F, with an average value exceeding 95 deg F over a 24-hour period.
    - b. Ambient Storage Temperature: Not less than minus 4 deg F and not exceeding 140 deg F.
    - c. Humidity: More than 95 percent (condensing).
    - d. Altitude: Exceeding 3300 feet.
  - 4. Nightlight Connection: Operate lamp continuously at 40 percent of rated light output.
  - 5. Test Push-Button and Indicator Light: Visible and accessible without opening luminaire or entering ceiling space.
    - a. Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
    - b. Indicator Light: LED indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
  - 6. Battery: Sealed, maintenance-free, nickel-cadmium type.
  - 7. Charger: Fully automatic, solid-state, constant-current type with sealed power transfer relay.
  - 8. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.

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- I. External Type: Self-contained, modular, battery-inverter unit, suitable for powering one or more lamps, remote mounted from luminaire.
  1. Emergency Connection: Operate fluorescent or LED lamp continuously. Connect unswitched circuit to battery-inverter unit and switched circuit to luminaire ballast.
  2. Operation: Relay automatically turns lamp on when power-supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
  3. Nightlight Connection: Operate lamp in a remote luminaire continuously.
  4. Battery: Sealed, maintenance-free, nickel-cadmium type.
  5. Charger: Fully automatic, solid-state, constant-current type.
  6. Housing: NEMA 250, Type 1 enclosure listed for installation inside, on top of, or remote from luminaire. Remote assembly shall be located no less than half the distance recommended by the ballast/emergency power unit manufacturer, whichever is less.
  7. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
  8. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
  9. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.

### 2.2 EMERGENCY LIGHTING

- A. General Requirements for Emergency Lighting Units: Self-contained units.
- B. Emergency Luminaires:
  1. Emergency Luminaires: as indicated on Drawings, with the following additional features:
    - a. Rated for installation in damp locations, and for sealed and gasketed luminaires in wet locations.
- C. Emergency Lighting Unit:
  1. Emergency Lighting Unit: as indicated on Drawings.
  2. Wall with universal junction box adaptor.
  3. UV stable thermoplastic housing, rated for damp locations.
- D. Remote Emergency Lighting Units:
  1. Emergency Lighting Unit: as indicated on Drawings.
  2. Wall with universal junction box adaptor.
  3. UV stable thermoplastic housing, rated for damp locations.
  4. External emergency power unit.

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### 2.3 EXIT SIGNS

- A. General Requirements for Exit Signs: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.
- B. Internally Lighted Signs:
  - 1. Lamps for AC Operation: Fluorescent, two for each luminaire; 20,000 hours of rated lamp life.
  - 2. Lamps for AC Operation: LEDs; 50,000 hours minimum rated lamp life.
  - 3. Self-Powered Exit Signs (Battery Type): Internal emergency power unit.
- C. Self-Luminous Signs:
  - 1. Powered by tritium gas, with universal bracket for flush-ceiling, wall, or end mounting. Signs shall be guaranteed by manufacturer to maintain the minimum brightness requirements in UL 924 for 20 years.
  - 2. Use strontium oxide aluminate compound to store ambient light and release the stored energy when the light is removed. Include universal bracket for flush-ceiling, wall, or end mounting.

### 2.4 MATERIALS

- A. Metal Parts:
  - 1. Free of burrs and sharp corners and edges.
  - 2. Sheet metal components shall be steel unless otherwise indicated.
  - 3. Form and support to prevent warping and sagging.
- B. Doors, Frames, and Other Internal Access:
  - 1. Smooth operating, free of light leakage under operating conditions.
  - 2. Designed to permit relamping without use of tools.
  - 3. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.
- C. Diffusers and Globes:
  - 1. Glass: Annealed crystal glass unless otherwise indicated.
  - 2. Acrylic: 100 percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
  - 3. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.
- D. Housings:
  - 1. Powder coat finish.

### 2.5 METAL FINISHES

- A. 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.

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### 2.6 LUMINAIRE SUPPORT COMPONENTS

- A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.
- B. Support Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, and 12 gage.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for conditions affecting performance of luminaires.
- B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before luminaire installation.
- C. Examine walls, floors, roofs, and ceilings for suitable conditions where emergency lighting luminaires will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Comply with NECA 1.
- B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.
- C. Install lamps in each luminaire.
- D. Supports:
  - 1. Sized and rated for luminaire and emergency power unit weight.
  - 2. Able to maintain luminaire position when testing emergency power unit.
  - 3. Provide support for luminaire and emergency power unit without causing deflection of ceiling or wall.
  - 4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire and emergency power unit weight and vertical force of 400 percent of luminaire weight.
- E. Wall-Mounted Luminaire Support:
  - 1. Attached to structural members in walls, or a minimum 20 gauge backing plate attached to wall structural members, or using through bolts and backing plates on either side of wall.
  - 2. Do not attach luminaires directly to gypsum board.
- F. Suspended Luminaire Support:

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1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
2. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
3. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of luminaire chassis, including one at each end.
4. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.

### G. Ceiling Grid Mounted Luminaires:

1. Secure to any required outlet box.
2. Secure emergency power unit using approved fasteners in a minimum of four locations, spaced near corners of emergency power unit.
3. Use approved devices and support components to connect luminaire to ceiling grid and building structure in a minimum of four locations, spaced near corners of luminaire.

## 3.3 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

## 3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
  1. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.
- B. Luminaire will be considered defective if it does not pass operation tests and inspections.
- C. Prepare test and inspection reports.

## 3.5 STARTUP SERVICE

- A. Perform startup service:
  1. Charge emergency power units and batteries minimum of 24 hours and conduct one-hour discharge test.

## 3.6 ADJUSTING

- A. Adjustments: Within 12 months of date of Substantial Completion, provide on-site visit to do the following:
  1. Inspect all luminaires. Replace lamps, emergency power units, batteries, signs, or luminaires that are defective.

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- a. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
2. Conduct short-duration tests on all emergency lighting.

END OF SECTION 265219

## SECTION 265613 - LIGHTING POLES AND STANDARDS

### 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. Poles and accessories for support of luminaires.
  - 2. Luminaire-lowering devices.

#### 1.3 DEFINITIONS

- A. EPA: Equivalent projected area.
- B. Luminaire: Complete lighting fixture.
- C. Pole: Luminaire-supporting structure, including tower used for large-area illumination.
- D. Standard: See "Pole."

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each pole, accessory, and luminaire-supporting and -lowering device, arranged as indicated.
  - 1. Include data on construction details, profiles, EPA, cable entrances, materials, dimensions, weight, rated design load, and ultimate strength of individual components.
  - 2. Include finishes for lighting poles and luminaire-supporting devices.
  - 3. Anchor bolts.
  - 4. Manufactured pole foundations.
- B. Shop Drawings:
  - 1. Include plans, elevations, sections, and mounting and attachment details.
  - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, and required clearances, method of field assembly, components, and location and size of each field connection.
  - 3. Detail fabrication and assembly of poles and pole accessories.
  - 4. Foundation construction details, including material descriptions, dimensions, anchor bolts, support devices, and calculations, signed and sealed by a professional engineer licensed in the state of installation.
  - 5. Anchor bolt templates keyed to specific poles and certified by manufacturer.

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6. Method and procedure of pole installation. Include manufacturer's written installations.

C. Samples: For each exposed lighting pole, standard, and luminaire-supporting device and for each color and texture specified.

### 1.5 INFORMATIONAL SUBMITTALS

A. Pole and Support Component Certificates: Signed by manufacturers of poles, certifying that products are designed for indicated load requirements according to AASHTO LTS-6-M and that load imposed by luminaire and attachments has been included in design. The certification shall be based on design calculations signed and sealed by a professional engineer.

B. Qualification Data: For testing agency.

C. Material Test Reports:

1. For each foundation component, by a qualified testing agency.
2. For each pole, by a qualified testing agency.

D. Source quality-control reports.

E. Field quality-control reports.

F. Sample Warranty: Manufacturer's standard warranty.

G. Soil test reports

### 1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For poles to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include pole inspection and repair procedures.

### 1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Pole repair materials.

### 1.8 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM C 1093 for foundation testing.

### 1.9 DELIVERY, STORAGE, AND HANDLING

A. Package aluminum poles for shipping according to ASTM B 660.



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- B. Store poles on decay-resistant skids at least 12 inches above grade and vegetation. Support poles to prevent distortion and arrange to provide free air circulation.
- C. Retain factory-applied pole wrappings on fiberglass and laminated wood poles until right before pole installation. Handle poles with web fabric straps.
- D. Retain factory-applied pole wrappings on metal poles until right before pole installation. Handle poles with web fabric straps.

### 1.10 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of pole(s) that fail in materials or workmanship; that corrode; or that fade, stain, perforate, erode, or chalk due to effects of weather or solar radiation within a specified warranty period. Manufacturer may exclude lightning damage, hail damage, vandalism, abuse, or unauthorized repairs from special warranty period.
  - 1. Warranty Period: Five years from date of Substantial Completion.
  - 2. Warranty Period for Corrosion Resistance: Five years from date of Substantial Completion.
  - 3. Warranty Period for Color Retention: Five years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products as listed on light fixture schedule and plans.

### 2.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design pole foundation and pole power system.
- B. Structural Characteristics: Comply with AASHTO LTS-6-M.
- C. Dead Load: Weight of luminaire and its horizontal and vertical supports, lowering devices, and supporting structure, applied according to AASHTO LTS-6-M.
- D. Live Load: Single load of 500 lbf distributed according to AASHTO LTS-6-M.
- E. Ice Load: Load of 3 lbf/sq. ft., applied according to AASHTO LTS-6-M for applicable areas on the Ice Load Map.
- F. Wind Load: Pressure of wind on pole and luminaire, calculated and applied according to AASHTO LTS-6-M.

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- G. Strength Analysis: For each pole, multiply the actual EPA of luminaires and brackets by a factor of 1.1 to obtain the EPA to be used in pole selection strength analysis.
- H. Luminaire Attachment Provisions: Comply with luminaire manufacturers' mounting requirements. Use stainless-steel fasteners and mounting bolts unless otherwise indicated.

### 2.3 STEEL POLES

- A. Source Limitations: Obtain poles from single manufacturer or producer.
- B. Source Limitations: For poles, obtain each color, grade, finish, type, and variety of pole from single source with resources to provide products of consistent quality in appearance and physical properties.
- C. Poles: Comply with ASTM A 500/A 500M, Grade B carbon steel with a minimum yield of 46,000 psig; one-piece construction up to 40 feet in height with access handhole in pole wall.
  - 1. Shape: round tapered, round, straight, square, straight (as noted on drawings).
  - 2. Mounting Provisions: Butt flange for bolted mounting on foundation or breakaway support.
- D. Steel Mast Arms: Single-arm type, continuously welded to pole attachment plate. Material and finish same as plate.
- E. Brackets for Luminaires: Detachable, cantilever, without underbrace.
  - 1. Adaptor fitting welded to pole, allowing the bracket to be bolted to the pole-mounted adapter, then bolted together with stainless -steel bolts.
  - 2. Cross Section: Tapered oval, with straight tubular end section to accommodate luminaire. Match pole material and finish.
- F. Pole-Top Tenons: Fabricated to support luminaire or luminaires and brackets indicated, and securely fastened to pole top.
- G. Fasteners: Stainless steel, size and type as determined by manufacturer. Corrosion-resistant items compatible with support components.
  - 1. Materials: Compatible with poles and standards as well as the substrates to which poles and standards are fastened and shall not cause galvanic action at contact points.
  - 2. Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers: Hot-dip galvanized after fabrication unless otherwise indicated.
- H. Grounding and Bonding Lugs: Welded 1/2-inch threaded lug, complying with requirements in Section 260526 "Grounding and Bonding for Electrical Systems," listed for attaching grounding and bonding conductors of type and size indicated, and accessible through handhole.
- I. Handhole: Oval shaped, with minimum clear opening of 2-1/2 by 5 inches, with cover secured by stainless-steel captive screws.
- J. Prime-Coat Finish: Manufacturer's standard prime-coat finish ready for field painting.

## SECTION 265613 - LIGHTING POLES AND STANDARDS

- K. Galvanized Finish: After fabrication, hot-dip galvanize according to ASTM A 123/A 123M.
- L. Powder-Coat Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" recommendations for applying and designating finishes.
  - 1. Surface Preparation: Clean surfaces according to SSPC-SP 1 to remove dirt, oil, grease, and other contaminants that could impair powder coat bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, according to SSPC-SP 5/NACE No. 1 or SSPC-SP 8.
  - 2. Powder Coat: Comply with AAMA 2604.
    - a. Electrostatic-applied powder coating; single application and cured to a minimum 2.5- to 3.5-mils dry film thickness. Coat interior and exterior of pole for equal corrosion protection.
    - b. Color: As selected by Architect from manufacturer's full range.

### 2.4 ALUMINUM POLES

- A. Poles: Seamless, extruded structural tube complying with ASTM B 221, Alloy 6061-T6, with access handhole in in pole wall.
  - 1. Shape: round tapered, round, straight, square, straight (as noted on drawings)
  - 2. Mounting Provisions: Butt flange for bolted mounting on foundation or breakaway support.
- B. Mast Arms: Aluminum Single-arm type, continuously welded to pole attachment plate. Material and finish same as plate.
- C. Brackets for Luminaires: Detachable, cantilever, without underbrace.
  - 1. Adaptor fitting welded to pole, allowing the bracket to be bolted to the pole-mounted adapter, then bolted together with stainless steel bolts.
  - 2. Cross Section: Tapered oval, with straight tubular end section to accommodate luminaire. Match pole material and finish.
- D. Pole-Top Tenons: Fabricated to support luminaire or luminaires and brackets indicated, and securely fastened to pole top.
- E. Grounding and Bonding Lugs: Bolted 1/2-inch threaded lug, complying with requirements in Section 260526 "Grounding and Bonding for Electrical Systems," listed for attaching grounding and bonding conductors of type and size listed in that Section, and accessible through handhole.
- F. Fasteners: Stainless steel, size and type as determined by manufacturer. Corrosion-resistant items compatible with support components.
  - 1. Materials: Compatible with poles and standards as well as to substrates to which poles and standards are fastened and shall not cause galvanic action at contact points.
  - 2. Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers: Hot-dip galvanized after fabrication unless otherwise indicated.

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- G. Handhole: Oval shaped, with minimum clear opening of 2-1/2 by 5 inches, with cover secured by stainless-steel captive screws.
- H. Prime-Coat Finish: Manufacturer's standard prime-coat finish ready for field painting.
- I. Aluminum Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" recommendations for applying and designating finishes.
  - 1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
  - 2. Natural Satin Finish: Provide fine, directional, medium satin polish (AA-M32); buff complying with AA-M20 requirements; and seal aluminum surfaces with clear, hard-coat wax.
  - 3. Class I, Clear-Anodic Finish: AA-M32C22A41 (Mechanical Finish: Medium satin; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class I clear coating of 0.018 mm or thicker), complying with AAMA 611.
  - 4. Class I, Color-Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: Medium; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class I integrally colored or electrolytically deposited color coating 0.018 mm or thicker), complying with AAMA 611.
- J. Powder-Coat Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" recommendations for applying and designating finishes.
  - 1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1 to remove dirt, oil, grease, and other contaminants that could impair powder coat bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, according to SSPC-SP 5/NACE No. 1 or SSPC-SP 8.
  - 2. Powder coat shall comply with AAMA 2604.
    - a. Electrostatic applied powder coating; single application with a minimum 2.5- to 3.5-mils dry film thickness; cured according to manufacturer's instructions. Coat interior and exterior of pole for equal corrosion protection.
    - b. Color: As selected by Architect from manufacturer's full range.

### 2.5 POLE ACCESSORIES

- A. Duplex Receptacle: Ground-fault circuit interrupter type, 120 V ac, 20 A in a weatherproof assembly. Comply with requirements in Section 262726 "Wiring Devices."
  - 1. Recessed 12 inches above finished grade.
    - a. NEMA 250, Type 3R, nonmetallic polycarbonate plastic or reinforced fiberglass, enclosure with cover; color to match pole.
    - b. Lockable hasp and latch complying with OSHA lockout and tag-out requirements.
- B. Minimum 1800-W transformer, protected by replaceable fuses, mounted behind access cover.
- C. Base Covers: Manufacturers' standard metal units, finished same as pole, and arranged to cover pole's mounting bolts and nuts.

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### 2.6 MOUNTING HARDWARE

- A. Anchor Bolts: Manufactured to ASTM F 1554, Grade 55, with a minimum yield strength of 55,000 psi.
  - 1. Galvanizing: Hot dip galvanized according to ASTM A 153, Class C.
  - 2. Bent or Headed rods, diameter and length as required by manufacturer.
  - 3. Threading: Uniform National Coarse or Uniform National 8, Class 2A.
- B. Nuts: ASTM A 563, Grade A, Heavy-Hex
  - 1. Galvanizing: Hot dip galvanized according to ASTM A 153, Class C.
  - 2. Four nuts provided per anchor bolt, shipped with nuts pre-assembled to the anchor bolts.
- C. Washers: ASTM F 436, Type 1.
  - 1. Galvanizing: Hot dip galvanized according to ASTM A 153, Class C.
  - 2. Two washers provided per anchor bolt.

### 2.7 GENERAL FINISH REQUIREMENTS

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. 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.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine poles, luminaire-mounting devices, lowering devices, and pole accessories before installation. Components that are scratched, dented, marred, wet, moisture damaged, or visibly damaged are considered defective.
- C. Examine roughing-in for foundation and conduit to verify actual locations of installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 POLE FOUNDATION

- A. Concrete Pole Foundations: Cast in place, with anchor bolts to match pole-base flange. Structural steel complying with ASTM A 36/A 36M and hot-dip galvanized according to ASTM A 123/A 123 M; and with top-plate and mounting bolts to match pole-base flange and

## SECTION 265613 - LIGHTING POLES AND STANDARDS

strength required to support pole, luminaire, and accessories. Concrete, reinforcement, and formwork are specified in Section 033000 "Cast-in-Place Concrete."

- B. Anchor Bolts: Install plumb using manufacturer-supplied plywood template, uniformly spaced.

### 3.3 POLE INSTALLATION

- A. Alignment: Align pole foundations and poles for optimum directional alignment of luminaires and their mounting provisions on pole.
- B. Clearances: Maintain the following minimum horizontal distances of poles from surface and underground features unless otherwise indicated on drawing.
  - 1. Fire Hydrants and Water Piping: 60 inches.
  - 2. Water, Gas, Electric, Communications, and Sewer Lines: 10 feet.
  - 3. Trees: 15 feet from tree trunk.
  - 4. Overhead Utility lines: 15 feet from nearest conductor (confirm with utility company prior to rough in).
- C. Concrete Pole Foundations: Set anchor bolts according to anchor-bolt templates furnished by pole manufacturer. Concrete materials, installation, and finishing requirements are specified in Section 033000 "Cast-in-Place Concrete."
- D. Foundation-Mounted Poles: Mount pole with leveling nuts and tighten top nuts to torque level according to pole manufacturer's written instructions.
  - 1. Grout void between pole base and foundation. Use nonshrink or expanding concrete grout firmly packed to fill space.
  - 2. Install base covers unless otherwise indicated.
  - 3. Use a short piece of 1/2 -inch diameter pipe to make a drain hole through grout. Arrange to drain condensation from interior of pole.
- E. Poles and Pole Foundations Set in Concrete-Paved Areas: Install poles with a minimum 6-inch-wide, unpaved gap between the pole or pole foundation and the edge of the adjacent concrete slab. Fill unpaved ring with pea gravel. Insert material to a level 1 inch below top of concrete slab.
- F. Raise and set pole using web fabric slings (not chain or cable) at locations indicated by manufacturer.

### 3.4 CORROSION PREVENTION

- A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum using insulating fittings or treatment.
- B. Steel Conduits: Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems." In concrete foundations, wrap conduit with **0.010-inch-** thick, pipe-wrapping plastic tape applied with a 50-percent overlap.

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### 3.5 GROUNDING

- A. Ground Metal Poles and Support Structures: Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."
  - 1. Install grounding electrode for each pole unless otherwise indicated.
  - 2. Install grounding conductor pigtail in the base for connecting luminaire to grounding system.

### 3.6 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

### 3.7 FIELD QUALITY CONTROL

- A. Special Inspections: Engage a qualified special inspector to perform the following special inspections:
  - 1. Inspect poles for nicks, mars, dents, scratches, and other damage.
  - 2. System function tests.

END OF SECTION 265613

## SECTION 265621 - EXTERIOR LIGHTING

### 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. Exterior HID and compact fluorescent luminaires, lamps, and ballasts.
2. Exterior solid-state luminaires that are designed for and exclusively use LED lamp technology.
3. Luminaire-mounted photoelectric relays.

##### B. Related Requirements:

1. Section 260923 "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.
2. Section 265613 "Lighting Poles and Standards" for poles and standards used to support exterior lighting equipment.

#### 1.3 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color rendering index.
- C. Fixture: See "Luminaire."
- D. HID: High-intensity discharge.
- E. Lumen: Measured output of lamp and luminaire, or both.
- F. Luminaire: Complete lighting unit, including lamp, reflector, and housing.
- G. Pole: Luminaire support structure, including tower used for large-area illumination.
- H. Standard: See "Pole."

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of luminaire.



## SECTION 265621 - EXTERIOR LIGHTING

1. Arrange in order of luminaire designation.
  2. Include data on features, accessories, and finishes.
  3. Include physical description and dimensions of the luminaires.
  4. Ballast, including BF, UL listing and recognition, ANSI certification, and Energy Independence and Security Act of 2007 compliance.
  5. Lamps, including life, output (lumens, CCT, and CRI), and energy-efficiency data.
  6. Photometric data and adjustment factors based on laboratory tests, complying with IES "Lighting Measurements Testing and Calculation Guides," of each luminaire type. The adjustment factors shall be for lamps, ballasts, and accessories identical to those indicated for the luminaire as applied in this Project.  
For LED luminaires the adjustment factors shall be for lamps and accessories identical to those indicated for the luminaire as applied in this Project IES LM-79 and IES LM-80.
    - a. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the NVLAP for Energy Efficient Lighting Products.
    - b. Testing Agency Certified Data: For indicated luminaires, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.
  7. Photoelectric relays.
  8. Means of attaching luminaires to supports, and indication that attachment is suitable for components involved.
- B. Shop Drawings: For nonstandard or custom luminaires.
1. Include plans, elevations, sections, and mounting and attachment details.
  2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, and required clearances, method of field assembly, components, and location and size of each field connection.
  3. Include diagrams for power, signal, and control wiring.
- C. Include diagrams for power, signal, and control wiring.
- D. Samples: For products designated for sample submission in the Exterior Lighting Fixture Schedule.
- E. Samples for Initial Selection: For each type of luminaire with custom, factory-applied finish.
1. Include Samples of luminaires and accessories involving color and finish selection.
- F. Samples for Verification: For each type of luminaire.
1. Include Samples of luminaires and accessories to verify finish selection.
  2. Lamps and ballasts, installed.
  3. Cords and plugs.
  4. Support system.
- G. Product Schedule: For luminaires and lamps. Use same designations indicated on Drawings.

## SECTION 265621 - EXTERIOR LIGHTING

### 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. Luminaires.
  - 2. Structural members to which equipment and luminaires will be attached.
  - 3. Underground utilities and structures.
  - 4. Existing underground utilities and structures.
  - 5. Above-grade utilities and structures.
  - 6. Existing above grade utilities and structures.
  - 7. Building features.
  - 8. Vertical and horizontal information.
- B. Qualification Data: For testing laboratory providing photometric data for luminaires.
- C. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- D. Product Test Reports: For each luminaire, for tests performed by manufacturer and witnessed by a qualified testing agency.
- E. Sample warranty.

### 1.6 PRIOR APPROVAL SUBMITTAL REQUESTS

- A. Full submittal data, by type, clearly highlighted and arrowed to identify the specific proposed manufacturer's nomenclature
- B. Full submittal data of lamp and proposed manufacturer.
- C. Full submittal data of ballast/driver (LED) data of proposed manufacturer
- D. LED lumen data will include
  - 1. Lumen output
  - 2. L70 and L90 testing
  - 3. Confirmation of independent test lab data ITL
  - 4. Color temperature and CRI with quantity of McAdam Ellipse steps
    - a. Data shall include sphere and goniometer results for total lumen, total power, luminaire efficacy, CRI and junction temperature for the specified color temperature
  - 5. Make and brand of LED diode should be clearly identified on submittal data
- E. LED dimming shall be equal in range and quality to the specified drivers, Quality of dimming to be defined by dimming range, freedom from perceived flicker or visible stroboscopic flicker, smooth and continuous change in level (no visible steps in transitions), natural square law response to control input, and stable when input voltage conditions fluctuate over what is typically experience in a commercial environment.

## SECTION 265621 - EXTERIOR LIGHTING

- F. All substitutions must meet specified fixtures certifications (UL, ETL, CE, CSA, RoHS, DLC, Energy Star)
  - G. Provide lighting calculations with the prior approval request based on reflectance values and light loss factors provided by the engineer and displayed on lighting calculation drawings. (may be unique by area). Calculations shall be shown on one sheet with dimensions as shown on construction set. Data will be submitted electronically in dxf format on a flash drive and with printed calculations on Architectural E size sheets to scale with construction set sheets.
    - 1. Discrepancies between prior approval data calculations and the original design calculations will result in immediate disqualification of review due to time-based constraints on the bid process
  - H. Prior approval request may require a sample of both the proposed and specified fixtures provided by the alternate manufacturer at NO additional cost to the project. Samples of both specified and proposed must be provided within 10 working days of request.
  - I. All data will be submitted electronically and in a bound format
  - J. Bound data will be secured in hard binder with 3” rings for ease of review or PDF file.
    - 1. Types will be marked with a tab by type and indexed for ease of reference
  - K. LED warranty information MUST be included by type and marked in RED to clearly identify the manufacturer’s warranty terms. Warranty data MUST meet or exceed the specified manufacturers terms
  - L. Prior approvals MUST be received and acknowledged to the specifiers office no less than 10 days prior to bid.
  - M. ALL prior approval data must be submitted in one package with complete information. Information that is incomplete will be rejected without review.
  - N. The prior approval will be returned marked approved or rejected by type with no explanation. If any specification is deemed not equal the review will be stopped, the type rejected with no explanation.
  - O. Lumen output for the proposed fixture must be highlighted in yellow for clear identification.
  - P. All inverter systems supply power to LED fixtures must have pure PWM sine wave function and work with any type of lighting load.
  - Q. LED warranty information must be included by type and marked in red to clearly identify the manufacturer’s warranty terms. Warranty data must meet or exceed the specified manufacturers terms.
- 1.7 CLOSEOUT SUBMITTALS
- A. Operation and Maintenance Data: For luminaires to include in [**operation**] and maintenance manuals.

## SECTION 265621 - EXTERIOR LIGHTING

1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

### 1.8 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  1. Lamps: Ten for every 100 of each type and rating installed. Furnish at least one of each type.
  2. Glass, Acrylic, and Plastic Lenses Covers and Other Optical Parts: One for every 100 of each type and rating installed. Furnish at least one of each type.
  3. Diffusers and Lenses: One for every 100 of each type and rating installed. Furnish at least one of each type.
  4. Globes and Guards: One for every 20 of each type and rating installed. Furnish at least one of each type.
  5. Ballasts: One for every 100 f each type and rating installed. Furnish at least one of each type.

### 1.9 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturers' laboratory accredited under the NVLAP for Energy Efficient Lighting Products.
- B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by 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, accredited under the NVLAP for Energy Efficient Lighting Products and complying with applicable IES testing standards.

### 1.10 DELIVERY, STORAGE, AND HANDLING

- A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

### 1.11 FIELD CONDITIONS

- A. Verify existing and proposed utility structures prior to the start of work associated with luminaire installation.
- B. Mark locations of exterior luminaires for approval by Architect prior to the start of luminaire installation.

### 1.12 WARRANTY

- A. Warranty: Manufacturer and Installer agree to repair or replace (labor and material) components of luminaires that fail in materials or workmanship within specified warranty period.
  1. Failures include, but are not limited to, the following:

## SECTION 265621 - EXTERIOR LIGHTING

- a. Structural failures including luminaire support components.
  - b. Faulty operation of luminaires, ballasts, and accessories.
  - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
- B. Warranty Period: Two year(s) from date of Substantial Completion.
- A. LED luminaires Warranty Period: Five year(s) from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 LUMINAIRE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. NRTL Compliance: Luminaires shall comply with UL 1598 and be listed and labeled for indicated class and division of hazard by an NRTL.
- C. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.
- D. Lateral Light Distribution Patterns: Comply with IES RP-8 for parameters of lateral light distribution patterns indicated for luminaires.
- E. UL Compliance: Listed for wet location (UL 1598).
- F. Lamp base complying with ANSI C81.61 or IEC 60061-1.
- G. EMI Filters: Factory installed to suppress conducted EMI as required by MIL-STD-461E. Fabricate luminaires with one filter on each ballast indicated to require a filter.
- H. In-line Fusing: Install on the ballast primary for each luminaire.
- I. Lamp Rating: Lamp marked for outdoor use and in enclosed locations.
- J. Source Limitations: Obtain luminaires from single source from a single manufacturer.
- K. Source Limitations: For luminaires, obtain each color, grade, finish, type, and variety of luminaire from single source with resources to provide products of consistent quality in appearance and physical properties.

### 2.2 LED LIGHTING FIXTURES AND LED LAMPS

- A. All LED products must be UL, ETL and/or CSA listed
- B. All LED products must have LM-79 and LM-80 testing noted on specification sheet by an independent test lab

## SECTION 265621 - EXTERIOR LIGHTING

- C. All LED products should be identified as L70 and/or L90 ratings based on independent test lab data
- D. All outdoor and wet location listed products must clearly state the IP rating carried on the fixture based on independent test lab data
- E. Bulb shape complying with ANSI C79.1.
- F. CRI of Minimum 80. CCT of 4100 K.
- G. Rated lamp life of **50,000** hours.
- H. Lamps dimmable from 100 percent to 0 percent of maximum light output.
- I. Nominal Operating Voltage: as noted on light fixture schedule.
- J. All LED products must be serviceable for accessible for field repair needs.
- K. All outdoor pole mounted products must have surge suppression within each fixture.
- L. All outdoor lighting color rendering should be within a 7 step McAdams Ellipse. All outdoor lighting should be 4000 kelvin unless specifically noted
- M. All control systems that interface with an LED product will be supported by a project “integrator” until project completion. This includes contact with the installer prior to installation, availability during installation, and final checkout and startup after installation. The quantity of days required for startup will be based on the manufacturer/agents discretion and need.
  - 1. The project integrator must be capable of performing low voltage and dmx terminations. High voltage terminations are performed solely by the electrical subcontractor.
  - 2. Reporting of final startup completion of the controls system back to the engineer is mandatory.
  - 3. Invitation to attend the training with the owners representative should be made to the engineer no less than 5 days prior to training
  - 4. Signature confirmation of training and startup is required within 5 business days after completion back to the engineer’s office.
- N. All LED drivers should be capable of 0-10 volt controls and DMX control and shall dim to 1% of total lumen output. Where specifically specified the dimming driver may be required to dim to .1% of lumen output , otherwise known as “dim to dark”
- O. Driver manufacturers must have a 5 year history producing dimmable electronic LED drivers for the North American market.
- P. Ambient driver temperatures must be within -20 degrees to 50 degrees C (-4 degrees to 122 degrees F)
- Q. Driver (internal) must limit inrush current.

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1. Base specification: meet or exceed NEMA 410 driver inrush standard of 430 amps per 10 amps load with a maximum of 370 amps/2 seconds
2. Preferred specification: Meet or exceed 30ma's at 277 VAC for up to 50 watts of load and 75A at 240us att 277 VAC for 100 watts of load
3. Withstand up to a 1,000-volt surge without impairment of performance as defined by ANSI C62.41 Category A
4. No visible change in light output with a variation of plus/minus 10percent line voltage input.
5. Total harmonic distortion less than 20% and meet ANSI C82.11 maximum allowable THD requirements at full output. THD shall at no point in the dimming curve allow imbalance current to exceed full output THD

### 2.3 LUMINAIRE-MOUNTED PHOTOELECTRIC RELAYS

- A. Comply with UL 773 or UL 773A.
- B. Contact Relays: Factory mounted, single throw, designed to fail in the on position, and factory set to turn light unit on at 1.5 to 3 fc and off at 4.5 to 10 fc with 15-second minimum time delay. Relay shall have directional lens in front of photocell to prevent artificial light sources from causing false turnoff.
  1. Relay with locking-type receptacle shall comply with ANSI C136.10.
  2. Adjustable window slide for adjusting on-off set points.

### 2.4 LUMINAIRE TYPES - see light fixture schedule on plans

### 2.5 MATERIALS

- A. Metal Parts: Free of burrs and sharp corners and edges.
- B. Sheet Metal Components: Corrosion-resistant aluminum or Stainless steel unless otherwise indicated. Form and support to prevent warping and sagging.
- C. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
- D. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses. Ballast shall automatically disconnect ballast when door opens.
- E. Exposed Hardware Material: Stainless steel.
- F. Diffusers and Globes:
  1. Acrylic Diffusers: 100 percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

## SECTION 265621 - EXTERIOR LIGHTING

2. Glass: Annealed crystal glass unless otherwise indicated.
  3. Lens Thickness: At least 0.125-inch minimum unless otherwise indicated.
- G. Lens and Refractor Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.
- H. Reflecting surfaces shall have minimum reflectance as follows unless otherwise indicated:
1. White Surfaces: 85 percent.
  2. Specular Surfaces: 83 percent.
  3. Diffusing Specular Surfaces: 75 percent.
- I. Housings:
1. Rigidly formed, weather- and light-tight enclosure that will not warp, sag, or deform in use.
  2. Provide filter/breather for enclosed luminaires.
- J. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
1. Label shall include the following lamp characteristics:
    - a. "USE ONLY," including specific lamp type.
    - b. Lamp type, wattage, bulb type, and coating (clear or coated) for HID luminaires.
    - c. ANSI ballast type (M98, M57, etc.) for HID luminaires.
    - d. CCT and CRI for all luminaires.

### 2.6 METAL FINISHES

- A. Variations in Finishes: Noticeable variations in same piece are unacceptable. 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.
- B. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.
- C. Factory-Applied Finish for Aluminum Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
  2. Natural Satin Finish: Provide fine, directional, medium satin polish (AA-M32); buff complying with AA-M20 requirements; and seal aluminum surfaces with clear, hard-coat wax.



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3. Class I, Clear-Anodic Finish: AA-M32C22A41 (Mechanical Finish: Medium satin; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker), complying with AAMA 611.
4. Class I, Color-Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: Medium satin; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker), complying with AAMA 611.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for luminaire electrical conduit to verify actual locations of conduit connections before luminaire installation.
- C. Examine walls, roofs, and canopy ceilings and overhang ceilings for suitable conditions where luminaires will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 TEMPORARY LIGHTING

- A. If approved by the Architect, use selected permanent luminaires for temporary lighting. When construction is sufficiently complete, clean luminaires used for temporary lighting and install new lamps.

### 3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Comply with NECA 1.
- B. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.
- C. Install lamps in each luminaire.
- D. Remote Mounting of Ballasts: Distance between the ballast and luminaire shall not exceed that recommended by ballast manufacturer. Verify the following with ballast manufacturer:
  1. Maximum distance between ballast and luminaire.
  2. Wire size between ballast and luminaire.
- E. Wiring Method: Install cables in raceways. Conceal raceway and cables.
- F. Fasten luminaire to indicated structural supports.

## SECTION 265621 - EXTERIOR LIGHTING

### G. Supports:

1. Sized and rated for luminaire weight.
2. Able to maintain luminaire position after cleaning and relamping.
3. Support luminaires without causing deflection of finished surface.
4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.

### H. Wall-Mounted Luminaire Support:

1. Attached to structural members in walls, or a minimum 1/8-inch backing plate attached to wall structural members or using through bolts and backing plates on either side of wall.

### I. Install luminaires level, plumb, and square with finished grade unless otherwise indicated. Install luminaires at height indicated on Drawings.

### J. Coordinate layout and installation of luminaires with other construction. Refer to architectural elevations prior to rough-ins.

### K. Adjust luminaires that require field adjustment or aiming. Include adjustment of photoelectric device to prevent false operation of relay by artificial light sources, favoring a north orientation.

### L. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" and Section 260533 "Raceways and Boxes for Electrical Systems;" for wiring connections and wiring methods.

## 3.4 BOLLARD LUMINAIRE INSTALLATION

### A. Align units for optimum directional alignment of light distribution.

1. Install on concrete base with top 4 inches above finished grade or surface at location. Cast conduit into base, and shape base to match shape of bollard base. Finish by troweling and rubbing smooth. Concrete materials, installation, and finishing are specified in Section 033000 "Cast-in-Place Concrete."

## 3.5 INSTALLATION OF INDIVIDUAL GROUND-MOUNTING LUMINAIRES

### A. Install on concrete base with top 4 inches above finished grade or surface at luminaire location. Cast conduit into base, and finish by troweling and rubbing smooth. Concrete materials, installation, and finishing are specified in Section 033000 "Cast-in-Place Concrete."

## 3.6 CORROSION PREVENTION

### A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.

### B. Steel Conduits: Comply with Section 260533 "Raceways and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch- thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

## SECTION 265621 - EXTERIOR LIGHTING

### 3.7 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

### 3.8 FIELD QUALITY CONTROL

- A. Inspect each installed luminaire for damage. Replace damaged luminaires and components.
- B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
  - 1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
  - 2. Photoelectric Control Operation: Verify operation of photoelectric controls.
- C. Illumination Tests:
  - 1. Measure light intensities at night. Use photometers with calibration referenced to NIST standards. Comply with the following IES testing guide(s):
    - a. IES LM-5.
    - b. IES LM-50.
    - c. IES LM-52.
    - d. IES LM-64.
    - e. IES LM-72.
- D. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

### 3.9 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain luminaires and photocell relays.

### 3.10 STARTUP SERVICE

- A. Burn-in all lamps that require specific aging period to operate properly, prior to occupancy by Owner.

### 3.11 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to two visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.

## SECTION 265621 - EXTERIOR LIGHTING

1. During adjustment visits, inspect all luminaires. Replace lamps or luminaires that are defective.
2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
3. Adjust the aim of luminaires in the presence of the Architect.

END OF SECTION 265621

## SECTION 266659 - LABORATORY SAFETY DEVICE SYSTEM

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions, Division 1 Specifications.

#### 1.2 SECTION INCLUDES

- A. Furnishing and installation of the Laboratory Safety Device System as shown on the Drawings, as herein specified.

#### 1.3 CODES AND REGULATIONS:

- A. NFPA 70, National Electrical Code
- B. NFPA 72, National Fire Alarm Code
- C. NFPA 90A, Installation of Air Conditioning and Ventilation Systems).
- D. Americans with Disabilities Act
- E. Local and State Building Codes
- F. NFPA 54 Natural Gas Code 2018
- G. International Fuel Gas Code 2018
- H. UL508A
- I. NFPA 45
- J. All requirements of the local Authority Having Jurisdiction.
- K. TEA Texas Education Agency

#### 1.4 WARRANTY

- A. Provide a 5 year minimum warranty from date of acceptance of project. Factory Authorized Start-up Required.

#### 1.5 MANUFACTURER

Lab Automation Control Systems (LACS) by E&I or approved equal.

#### 1.6 SUBMITTALS

- A. Submittal procedures: See Section 260050.

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- B. Product Data:
  - Manufacturer
  - Model Number
  - Indicate all options and accessories
  - Engineered specific cut sheets
- C. Submit complete submittal package within 30 calendar days after award of this work for approval. Equipment is not to be ordered without approval and signed submittals. Submittals to include cut sheets indicating the exact size of all panels, list of building materials, solenoid valves, piping sizes, and all electrical schematics for each panel.

### PART 2 - PRODUCTS

- 2.1 It is the intent of this specification to provide a complete and operational system, to include all necessary products and devices, power and controls wiring installed in accordance with Division 26, and all necessary interlocks

#### A.1 Lab Control Panel:

A. At each science classroom as shown on Drawings, provide a LACS by EI Series Lab Control Panel (LCP). Panel shall be UL Certified 508A and NEMA 1 flush mounted with concealed wall box. System shall include Power Supply 120VAC with circuit protection. Wiring to the input power terminals shall be per the drawings. Panel shall also consist of Illuminated LED Switches for all utilities as detailed, Power ON Selector Switch. Switch located in an internal junction box with removable cover, Discrete Inputs, Relay Outputs, Terminal Blocks with Ground TB. System shall also include (2) 2 position keyed selector switch to enable, disable, system power. Additional circuits will be provided for monitoring of alarms as per drawings.

B. Panel shall have integral micro controller with Siemens Smart logic (logo power) device to provide relay output circuits to activate utilities as shown on drawings to include gas, hot and cold water, and electric output circuits located at the student work stations and as indicated on drawings; system shall also have the ability to shut down all utilities upon activation of the fire alarm. Lab Control Panel shall have provisions for each student and teacher area by a means of a normally open contact within the Lab Control Panel. Activation shall be enabled only by switch ON and then enabling each utility service button. Panel shall also include a pre-determined run time feature of 6 - 10 hours once panel is enabled each day.

C. The Panel shall be equipped with an illuminated switch for each output circuit and a momentary enabling key switch. Deactivation of output circuits' shall not require engagement of enabling key. Panel shall be provided with N/O push/pull emergency operator to deactivate output circuits in case of emergency and shall include a clear drop down non keyed cover to prevent student tampering. Reset after panic shall occur by re-keying. Wiring connections shall be provided by Division 26 contractor.

#### A.2 Solenoid Panels

##### A. LACS by E&I (VP)

Furnish and install Valve Panel (VP) as indicated per drawings. The panel shall be NEMA 1 white powder coated with a concealed wall box provided. All water Solenoid Valves shall be ASCO Red Hat "Next Generation" series normally closed general service, zero differential solenoids as indicated on drawings, line size as shown on drawings Solenoid coil shall be

## SECTION 266659 - LABORATORY SAFETY DEVICE SYSTEM

120VAC. All gas Solenoid Valves shall be ASCO Red Hat “Next Generation” aluminum body as indicated on drawings, line size as shown on drawings, Solenoid coil shall be 120VAC. Solenoids and ball valves shall be UL listed and approved for services intended. Solenoids shall close upon loss of operating power or alarm and require re-keying for reactivation of service. Wye Strainers shall be included on all water services and located in piping within the panel. Valve Panel shall be installed by Division 22 Contactor, wiring connections shall be provided by Division 26 Contractor.

### **A.3 Electric Contactor Panels**

#### **A. LACS by E&I (ECP)**

Furnish and install UL508A Electrical Contactor Panel (ECP) as indicated per drawings. The panel shall be NEMA 1 Gray Powder Coated and located as shown on drawings. The panel shall consist of all required 4 pole contactors and required wiring to enable/disable all electrical outlets as indicated on drawings. All Circuits shall Close upon loss of operating power and require re-keying for reactivation of service. Wiring connections shall be provided by Division 26 Contractor.

### **A.4 Remote Emergency Operator:**

#### **A. LACS by E&I (REO)**

Furnish and install a line of sight Remote Emergency Operator (REO). Operator shall be provided with push/pull mushroom button assembly to deactivate output circuits in case of emergency. Remote operator shall also be provided with a clear cover to prevent accidental operation. Wiring connections shall be provided by Division 26 Contractor.

### **3.1 INSTALLATION:**

- A. Install in accordance with manufacturer’s recommendations and instructions. Verify manufacturer’s mounting heights to comply with ADA or other standards.
- B. Furnish and install all devices as shown on Drawings and as specified herein.
- C. Furnish, install and make final connections to monitoring and remote panic assembly panels. Ensure proper integration with the Energy Management Control and fire alarms if present.

### **3.2 CONDUIT:**

- A. Provide conduits for control and integration wiring from point of connection to each device to accessible point above ceiling. Provide separate conduit for each device that is controlled and integrated with Controller. Conduits for monitoring panels, arrays and panic assemblies shall be separate from line voltage, control wiring and integrated systems wiring.

### **3.3 WIRING**

- A. Operating Power: Shall be provided by Division 26.

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- B. Wiring:  
Provide wiring from Lab Control Panel (LCP) to each controlled utility or device. Make connections at controlled device and terminate at output terminal on control panel.
- C. Integrated Systems:  
Provide wiring for integration to other systems as shown on Drawings. Verify voltage and wire sizes to comply with requirements of each system.
- D. System Monitoring Panels and Arrays:  
Provide wiring from Lab Control Panel (LCP) to each monitoring panel or array. Make connections at monitoring device and terminate at output terminal on control panel.
- E. Remote Emergency Operator:  
Provide control wiring from Lab Control Panel (LCP) to each Remote Emergency Operator within the classroom. Where Drawings indicate two or more operators, connect each in parallel.

### 3.4 SYSTEM TEST AND START-UP

- A. Prior to placing the Lab Control Panel System into service, a Certified Start-up must be performed by an authorized LACSS' start-up agent.
- B. Verify that all components and control devices comply with manufacturer's requirements and recommendations, and that all devices and installations conform to Drawings and Specification requirements.
  - 1. Verify that all piping systems have been thoroughly cleaned.
  - 2. Verify that all controlled devices and circuits are ON.
  - 3. Verify that connections to all integrated systems are complete.
  - 4. Verify that all monitoring systems respond to Panic.
  - 5. Verify that remote panic assemblies activate the Panic State.
  - 6. Verify that service to emergency showers and eyewashes are not affected by operation of system if applicable.
- C. Upon completion of ALL Start-up tests, place the system into service. Complete all warranty registration documents. Submit originals with other project related closeout and O & M documentation. Review all operating procedures and maintenance schedules with a representative of the Owner. Provide all System keys (2 Sets) to the Owner's representative.

END OF SECTION 266659



## SECTION 267210 - FIRE ALARM

### 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. Related Sections:
  - 1. Division 01 General Requirements
  - 2. Division 07 Thermal and Moisture Protection, Section 078413 Penetration Firestopping
  - 3. Division 08 Openings, Section 087100 Door Hardware
  - 4. Division 21 Fire Suppression
  - 5. Division 23 Heating Ventilating and Air Conditioning Monitoring & Control (HVAC).
  - 6. Division 26 Electrical, Section 260500 Common Work Results for Electrical
  - 7. Division 28 Electronic Safety and Security

#### 1.2. SUMMARY

- A. Section Includes:
  - 1. Delegated-Design Submittal: For fire alarm system indicated, contractor is responsible for providing and obtaining an approved system by the local Authority Having Jurisdiction. The devices shown on plans are diagrammatic in nature.
  - 2. This specification describes an addressable Fire Detection and alarm signaling system. The control panel shall be intelligent device addressable, analog detecting, low voltage and modular, with digital communication techniques. The features and capacities described in this specification are required as a minimum for this project and shall be furnished by the successful contractor.
  - 3. All equipment furnished shall be new and the latest state of the art products of a single experienced manufacturer, engaged in the manufacturing and sale of analog fire detection devices.
  - 4. Provide an addressable control panel with voice evacuation, manual and automatic initiation devices plus 100% expansion in the future and associated raceways and power connection for power supplies for a complete installation. Indicating devices shall also be provided to comply with TDLR. Including with all hardware/components necessary for an IP and cellular alarm communications.
  - 5. Fully coordinate with Elevator Contractor for the Fire Alarm interfacing.
  - 6. Fully coordinate with the food service contractor for the kitchen hood fire suppression interfacing.
  - 7. Fully coordinate with the Fire Sprinkler System Tamper and Flow Switches for the Fire Alarm interfacing.
  - 8. Fully coordinate with the HVAC contractor for the Fire Alarm HVAC equipment (over 2,000 cfm's) duct smoke detectors interfacing.
  - 9. Related Sections: The following Sections contain requirements that relate to this Section:
  - 10. HVAC Controls - "Electric Control Systems for duct smoke detectors. HVAC down relay. (AHU shut down relay furnished by Fire Alarm Contractor).

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### 1.3. DEFINITIONS

- A. ASME: American Society of Mechanical Engineers.
- B. Broadcast Media: The speakers, radio, cell phone, and other media that will carry the selected message to the selected audience.
- C. FACP: Fire alarm control panel.
- D. NAC: Notification Appliance Circuit. A circuit used to monitor and activate notification appliances or devices.
- E. FM: FM Global (Factory Mutual).
- F. Furnish: To supply the stated equipment or materials.
- G. Install: To set in position and connect or adjust for use.
- H. LED: Light-emitting diode.
- I. NFPA: National Fire Protection Association. Definitions in NFPA 72 apply to fire alarm terms used in this Section.
- J. NICET: National Institute for Certification in Engineering Technologies.
- K. Provide: To furnish and install the stated equipment or materials.
- L. UL: Underwriters Laboratories.
- M. AHJ: Authority Having Jurisdiction. Local authority (such as a fire marshal), presiding over the occupancy of the building(s).

### 1.4. SYSTEM DESCRIPTION

- A. Basic Cerberus® PRO Fire Safety – The system shall be a complete, electrically supervised fire detection and notification system, with a microprocessor-based operating system having the following capabilities, features, and capacities:
  - 1. The local system shall provide status indicators and control switches for all of the following functions:
    - 1) Audible and visual notification alarm circuit zone control.
    - 2) Status indicators for sprinkler system water-flow and valve supervisory devices.
    - 3) Any additional status or control functions as indicated on the drawings, including but not limited to; emergency generator functions, fire pump functions, door unlocking and security with bypass capabilities.
- B. Cerberus® PRO Fire Safety Intelligent Voice Communication -- The system shall be complete, electrically supervised evacuation system using one-way communication with microprocessor-based operating system having the following capabilities, features and capacities:
  - 1. Listed for emergency and non-emergency use.
  - 2. Listed for MNS from any control point to 'Request/Grant/Deny' and integrated with FC922-924 and FV922-924 (no separate MNS panel)
  - 3. Ability to support up to two microphones per FV922-924 control panel for one-way paging, and up to 64 microphones in a voice network.
  - 4. Ability to provide manual voice control.

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5. Two channel message player supporting 300 messages (38 pre-recorded). The system supports MP3 and WAV files.
6. Three simultaneous audio channels for each networked panel.
7. Amplifiers shall be rated for 25V or 70.7V RMS, 50 watts. Voice amplification shall be supervised and backed up with like amplifiers. Back up shall be one or two per node.
8. Ability to provide separate booster amplifier. Amplifiers shall be rated for 25V or 70.7V RMS, 100 watts.
9. Multiple nodes shall provide peer-to-peer voice capability in order to eliminate a single point of failure.
10. Audio shall be synchronized between nodes in order to take into account common areas.
11. Speakers shall have the ability to play coded audio tones.
12. The system shall provide status indicators and control switches for all of the following functions:
  - 1) Audible and visual notification alarm circuit zone control.
  - 2) Speaker circuit zone control.
  - 3) Status indicators for sprinkler system water flow and valve supervisory devices.
  - 4) Any additional status or control functions as indicated on the drawings, including but not limited to: emergency generator functions, fire pump functions, door unlocking and security with bypass capabilities.

### 1.5. PERFORMANCE REQUIREMENTS

- A. General Performance: Comply with NFPA 72 and all contract documents and specification requirements.
- B. All interconnections between this system and the monitoring system shall be arranged so that the entire system can be UL-Certificated.
- C. System shall be a complete, supervised, non-coded, addressable multiplex fire alarm system conforming to NFPA 72.
- D. The system shall have Class B circuits for each floor. The system shall operate in the alarm mode upon actuation of any alarm initiating device. The system shall remain in the alarm mode until all initiating device(s) are reset and the fire alarm control panel is manually reset and restored to normal.
- E. The system shall be capable of the following configurations. Both configurations are permitted on the same network.
  1. The system shall support up to 252 addressable devices, which may be divided in any ratio on one, two, three, or four separate, isolated Class B circuits.
  2. The system shall support two loops of 252 addressable devices, each of which may be divided in any ratio on one, two, three, or four separate, isolated Class B circuits.
- F. The system shall support H-series devices and Cerberus® PRO series devices
- G. The system shall have an optional digital alarm communication transmitter.
- H. The system shall provide an off-normal warning prior to reset for all active devices.
- I. The system shall be capable of remote monitoring via Cerberus Remote, a proprietary software system that provides a graphical representation of the fire alarm control panel at a remote PC when connected via Ethernet to the system. The display will show the exact state of the panel, including blinking LEDs, and with menu buttons for control.

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- J. The system shall be capable of being configured via a PC Tool.
- K. The system shall provide the following functions and operating features:
  - 1. The FACP and auxiliary power panels shall provide power, annunciation, supervision and control for the system.
  - 2. Provide Class B initiating device circuits.
  - 3. Provide two Class B notification appliance circuits. Arrange circuits to allow individual, selective, and visual notification by zone. Notification appliance circuits shall be zoned to correspond with the building fire barriers and other building features.
  - 4. NACs shall be synchronized throughout the entire building.
  - 5. Provide electrical supervision of the primary power (AC) supply, presence of the battery, battery voltage, and placement of system modules within the control panel.
- L. The system shall provide a field test function where one person can test the complete system or a specific area while maintaining full operational function of other areas not being tested. Alarms, supervisory signals, trouble signals shall be logged in system history during the walk-test.
- M. Alarm functions shall override trouble or supervisory functions. Supervisory functions shall override trouble functions.
- N. Fire alarm signal initiation shall be by one or more of the following devices:
  - 1. Manual pull station
  - 2. Heat detector
  - 3. Addressable area smoke detectors
  - 4. Projected beam detector
  - 5. Automatic sprinkler system water flow switch.
- O. Activation of any system fire, security, supervisory, trouble, or status initiating device shall cause the following actions and indications at all network Person Machine Interfaces using an LCD display with multiple detail screens.
  - 1. Fire Alarm Condition:
    - 1) Sound an audible alarm and display a custom message defining the building in alarm and the specific alarm point initiating the alarm on an LCD display.
    - 2) Log into the system history archives all activity pertaining to the alarm condition.
    - 3) Sound the ANSI 117-1 signal with synchronized audible notification appliances and synchronized strobes throughout the facility.
    - 4) Audible signals shall be silenced from the fire alarm control panel by an alarm silence switch. Visual signals shall be programmable to flash until system reset or alarm silencing, as required.
    - 5) A signal dedicated to sprinkler system water flow alarm shall not be silenced while the sprinkler system is flowing at a rate of flow equal to a single head.
    - 6) Activation of any smoke detector in a single elevator lobby or an elevator equipment room shall, in addition to the actions described, cause the recall of that bank of elevators to the 1st floor and the lockout of controls. In the event of recall initiation by a detector in the first floor lobby, the recall shall be to the alternate floor as determined by the AHJ.
    - 7) Where indicated on drawings heat detectors in elevator shaft and machine rooms shall activate an elevator power shunt trip breaker. The heat detectors shall be rated at a temperature below the ratings of the sprinkler heads in

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- respective locations to insure that the power shall be shut off before activation of sprinkler system.
- 8) Door closure devices shall operate by floor or by local requirements.
2. Supervisory Condition:
    - 1) Display the origin of the supervisory condition report at the local fire alarm control panel LCD display.
    - 2) Activate supervisory audible and dedicated visual signal.
    - 3) Audible signals shall be silenced from the control panel by the supervisory acknowledge switch.
    - 4) Record within system history the initiating device and time of occurrence of the event.
  3. Trouble Condition
    - 1) Display at the local fire alarm control panel LCD display, the origin of the trouble condition report.
    - 2) Activate trouble audible and visual signals at the control panel and as indicated on the drawings.
    - 3) Audible signals shall be silenced from the fire alarm control panel by a trouble acknowledge switch.
    - 4) Trouble conditions that have been restored to normal shall be automatically removed from the trouble display queue and not require operator intervention. This feature shall be software selectable and shall not preclude the logging of trouble events to the historical file.
    - 5) Trouble reports for primary system power failure to the master control shall be automatically delayed for a period of time equal to 25% of the system standby battery capacity to eliminate spurious reports as a result of power fluctuations.
    - 6) Record within system history, the occurrence of the event, the time of occurrence and the device initiating the event.
- P. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
- Q. AHU SHUT DOWN
1. When a fire alarm condition is detected by AHU duct smoke detector and reported, the following functions shall immediately occur:
    - 1) The system alarm LED on the FACP shall flash.
    - 2) A local piezo electric signal in the control panel shall sound.
    - 3) A backlit 80-character LCD display on the FACP shall indicate all information associated with the fire alarm condition, including the type of alarm point and its location within the protected premises.
    - 4) This particular AHU shall be shut down only; the remaining AHU's shall remain operational.

### 1.6. SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories. Complete manufacturer's catalog data including supervisory power usage, alarm power usage, physical dimensions, and finish and mounting requirements.

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- B. Power calculations. Battery capacity calculations. Battery size shall be a minimum of 125% of the calculated requirement. Provide the following supporting information:
- C. Shop Drawings: Include plans, elevations, details, and attachments to other work.
  - 1. Wiring Diagrams: For power, signal, and control wiring.
  - 2. Complete drawings covering the following shall be submitted by the contractor for the proposed system:
    - 1) Floor plans in a CAD compatible format at a scale of 1/8"=1'-0" showing all equipment.
- D. Operation and Maintenance Data: For all fire alarm equipment, to include in operation and maintenance manuals.
- E. Documentation:
  - 1. Approval and Acceptance: Provide the "Record of Completion" form according to NFPA 72 to Owner, Architect, and authorities having jurisdiction.
  - 2. Record of Completion Documents: Provide the "Permanent Records" according to NFPA 72 to Owner, Architect, and authorities having jurisdiction. Format of the written sequence of operation shall be the optional input/output matrix.
    - 1) Hard copies on paper to Owner, Architect, and authorities having jurisdiction.
    - 2) Electronic media may be provided to Architect and authorities having jurisdiction.
- F. Submittals to Authorities Having Jurisdiction: In addition to distribution requirements for submittals specified in Division 1 Section "Submittals," make an identical submittal to authorities having jurisdiction. To facilitate review, include copies of annotated Contract Drawings as needed to depict component locations. Resubmit if required to make clarifications or revisions to obtain approval. On receipt of comments from authorities having jurisdiction, submit them to Architect for review.

### 1.7. QUALITY ASSURANCE

- A. Manufacturer Qualifications: The publications listed below form a part of this publication to the extent referenced. The publications are referenced in the text by the basic designation only. The latest version of each listed publication shall be used as a guide unless the authority having jurisdiction has adopted an earlier version.
  - 1. FM Global (Factory Mutual (FM)):FM Approval Guide
  - 2. National Fire Protection Association (NFPA)
    - 1) NFPA 70 National Electrical Code
    - 2) NFPA 72 National Fire Alarm Code
    - 3) NFPA 90A Standard for The Installation of Air Conditioning and Ventilating Systems
    - 4) NFPA 101 Life Safety Code
  - 3. Underwriters' Laboratories, Inc. (UL) equipment standards, Latest Edition
    - 1) UL Fire Protection Equipment Directory
    - 2) UL Electrical Construction Materials Directory
    - 3) UL 38 – Manually Actuated Signaling Boxes for Use with Fire Protection Signaling Systems
    - 4) UL 228 – Door Holding Devices
    - 5) UL 268 - Smoke Detectors for Fire Protective Signaling Systems

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- 6) UL 464 - Audible Signal Appliances
  - 7) UL 497A – Secondary Protectors for Communications Circuits
  - 8) UL 521 - Heat Detectors for Fire Protective Signaling Systems
  - 9) UL 864 - Control Units for Fire Protective Signaling Systems
  - 10) UL 1283 – Electromagnetic Interference Filters
  - 11) UL 1449 - Transient Voltage Surge Suppressors
  - 12) UL 1971 - Signaling Devices for the Hearing Impaired
  - 13) UL 2075 – Gas and Vapor Detectors and Sensors
  - 14) UL 2572 – Mass Notification Systems
4. International Code Council
    - 1) International Building Code
    - 2) International Fire Code.
  5. State and Local Building Codes as adopted and/or amended by The Authority Having Jurisdiction, ADA, and/or State and local equivalency standards as adopted by The Authority Having Jurisdiction.

### B. Installer Qualifications:

1. Installer shall provide proof of their qualifications as Factory Authorized and Factory Trained for the product(s) specified herein. These documents shall be included in the submittal package. A letter from the manufacturer stating that the Contractor is the Factory Authorized Distributor for the submitted equipment shall be included in the submittal package.
  2. The installing Contractor (Company) shall have completed a minimum of five projects of similar size and scope within the past five years. Provide a list of completed projects to include names and phone numbers of the Owner's representative and the General Contractor for the project.
  3. Contractor Personnel Requirements:
    - 1) One full time employee with a current Texas Fire Alarm Planning Superintendents License.
    - 2) One full time employee with NICET Level III certification.
    - 3) A minimum of two technicians with Factory Training for the submitted product(s).  
Copies of License, NICET Certification, and Factory Training shall be included in the submittals.
    - 4) The installation shall be performed by licensed full-time employees of the Factory Authorized Distributor.
- C. 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.
- D. A factory-authorized Installer is to perform the Work of this Section. Installer is to be licensed by Texas Commission on Fire Protection as Fire Alarm Technician or Fire Alarm Planning Superintendent. Texas Commission on Fire Protection shall license installing company. Provide copies of licensing with submittal.
- E. Compliance with Local Requirements: Comply with the applicable building code, local ordinances, and regulations, and the requirements of the authority having jurisdiction.
- F. Comply with Article 5.43-2 Insurance code and fire alarm rules as required by Texas Commission on Fire Protection.

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- G. Comply with Article 5.43-2 Insurance code and fire alarm rules as required by Texas Commission on Fire Protection.
  - H. NFPA Compliance: Provide fire alarm and detection systems conforming to the requirements of the following publications:
    - 1. NFPA 72, "Installation, Maintenance, and Use of Protective Signaling Systems."
    - 2. NFPA 72E, "Automatic Fire Detectors."
    - 3. NFPA 72G, "Guide for the Installation, Maintenance and Use of Notification Appliances for Protective Signaling Systems."
  - I. NRTL Listing: Provide systems and equipment that are listed and labeled.
    - 1. Terms "Listed" and "Labeled": As defined in the "National Electrical Code," Article 100.
    - 2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.
  - J. UL Compliance: All devices are to be UL listed for Fire, Security, and Access Control.
  - K. Single-Source Responsibility: Obtain fire alarm components from a single source who assumes responsibility for compatibility for system components.
  - L. Installer Qualifications:
    - 1. Before commencing work, submit data showing that the manufacturer has successfully installed fire alarm systems of the same scope, type and design as specified.
    - 2. The contractor shall submit copies of all required Licenses and Bonds as required in the State having jurisdiction.
    - 3. The contractor shall employ on staff a minimum of one NICET level III APS.
- 1.8. DELIVERY, STORAGE, AND HANDLING
- A. Deliver products to project site in original, unopened packages with intact and legible manufacturers' labels identifying product and manufacturer, date of manufacture, and shelf life if applicable.
  - B. Store materials inside, under cover, above ground, and kept dry and protected from physical damage until ready for use. Remove from site and discard wet or damaged materials.
- 1.9. PROJECT CONDITIONS
- A. Installed products or materials shall be free from any damage including, but not limited to, physical insult, dirt and debris, moisture, and mold damage.
  - B. Environmental Limitations: Do not deliver or install products or materials until spaces are enclosed and weather-tight, wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
- 1.10. WARRANTY
- A. Provide for a period of five (5) years commencing from the date of final system acceptance, including annual inspections of the system.



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- B. During the warranty period report to the site and repair or replace any defective materials or workmanship without cost to the Owner. Warranty service shall be rendered within 24 hours after request by Owner. Equivalent replacement equipment shall be temporarily provided when immediate on-site repairs cannot be made.

### PART 2 - PRODUCTS

#### 2.1. MANUFACTURERS

- A. Silent Knight 5820XL-EVS
- B. No substitutions

#### 2.2. CONTROL PANEL

- A. The fire alarm control panel shall be microprocessor based using multiple microprocessors throughout the system providing rapid processing of smoke detector and other initiation device information to control system output functions.
- B. There shall be a watchdog circuit, which shall verify the system processors and the software program. Problems with either the processors or the system program the panel shall activate a trouble signal, and reset the panel.
- C. The system modules shall communicate with an RS 485 network communications protocol. All module wiring shall be to terminal blocks.
- D. The Cerberus® PRO Fire Safety FC and FV 922 system shall be capable of the following configurations. Both configurations are permitted on the same network.
  - 1. The system shall support up to 252 addressable devices, which may be divided in any ratio on one, two, three, or four separate, isolated Class B circuits.
  - 2. The system shall support two loops of 252 addressable devices, each of which may be divided in any ratio on one, two, three, or four separate, isolated Class B circuits.
- E. The Cerberus® PRO Fire Safety FC and FV 924 system shall be capable of supporting the 252 device configuration listed above, as well as, an additional 252 device circuit. Both configurations are permitted on the same network.
  - 1. The system shall support up to 504 addressable devices, which includes a second SLC configuration and each may be divided in any ratio on one, two, three, or four separate, isolated Class B circuits.
  - 2. The system shall support two loops of 504 addressable devices, each of which may be divided in any ratio on one, two, three, or four separate, isolated Class B circuits.
- F. The system shall be capable of supporting unshielded wiring applications.
- G. System Components:
  - 1. The System Periphery board shall be capable of 252 intelligent devices distributed between one, two, three, or four Class B SLC circuits. Any trouble on one circuit shall not affect the other circuit. This module controls the signaling from the initiation devices reporting alarms and troubles to the control panel. This module shall also provide the signaling to the field devices for the controlling the output of specific initiation devices. The on board microprocessor provides the periphery board with the ability to function even if the main microprocessor fails. LED's on the board shall provide annunciation for the following;

- Power, Gnd. Fault, Alarm, Trouble. This board is integral to the system. The board shall be model number FCI2016-U1.
2. The system periphery board shall be capable of supporting two system drivers of 252 intelligent devices distributed between one, two, three, or four Class B SLC circuits for each driver, for a total panel capacity of 504 addressable devices. Any trouble on one circuit shall not affect the other circuit. This module controls the signaling from the initiation devices reporting alarms and troubles to the control panel. This module shall also provide the signaling to the field devices for the controlling the output of specific initiation devices. The on-board microprocessor provides the periphery board with the ability to function even if the main microprocessor fails. LED's on the board shall provide annunciation for the following: Power, Gnd. Fault, Alarm, and Trouble. This board is integral to the system. The board shall be model number FCI2017-U1.
  3. The voice-system card cage (Model VCA2002-A1) supports the mounting and field wiring for cards used on a Model FV922 / FV924 FACP.
  4. The voice system CPU card (Model VCC2001-A1) is a central-processing unit (CPU) card that controls and monitors all modules and functions for Cerberus® PRO Fire Safety intelligent voice-communication FACPs.
  5. The In/Out Voice System Card (Model VCC2002-A1) is the Input / Output card for the Cerberus® PRO Fire Safety intelligent voice-communication system.
  6. The Voice Amplifier (25 / 70 V) Card used in 'real time', emergency communication, the 50W amplifier card (Model VCI2001-U1) provides AC power between a Model FV922 / FV924 panel and a site's speaker system. Up to four (4) Model VCI2001 amplifiers are supported in a 3-to-1 backup, or 1-to-1 backup schematic on a single Cerberus® PRO Fire Safety intelligent voice-communication system: configured as one (1), two (2) or three (3) main amplifiers, and one (1) or two (2) optional backup amplifiers.
  - 7.
  8. The Microphone Option Module (Model VTO2004-U3) is used to provide live, non-pre-recorded voice communication on a Cerberus® PRO Fire Safety intelligent voice communication panel. Model VTO2004-U3 can serve either as a main microphone installed in the main-system enclosure, or as a remote microphone in a remote enclosure. Up to two (2) Model VTO2004-U3 microphones are supported for each Model FV922 / FV924 FACP.
  - 9.
  10. The Switch Option Module (Model VTO2001-U3) is a series of front-end, illuminated and programmable pushbuttons primarily mounted in the middle inner door of each Cerberus® PRO Fire Safety intelligent voice-communication FACP. Each Model VTO2001-U3 module has 24 group-switches, thus totaling 48 LEDs, and consists of up to 96 multi-color LED-status indicators. Each LED switch-group is assigned specific functionality during the configuration process. Furthermore, a pushbutton [for each affected zone] will illuminate to acknowledge the command has been received at the Voice System CPU Card, Model VCC2001-A1. Additionally, if no microphone is used, up to eight (8) Model VTO2001-U3 switch-option modules can be used in a given three-eight-unit (3HU) enclosure (Model FHD2007-U3/R3).
  - 11.
  12. As an option, the Model EBA2004-A1 Booster Amplifier is a main board that allows for expansion of speaker zones for additional power to a Cerberus® PRO Fire Safety intelligent voice communication system.
  13. The Signal Line Circuits (SLC) shall be tested for opens, shorts and communications with all addressable devices installed before connection to the control panel. Systems without this capability shall have a test panel installed for initial testing to eliminate any possible

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- damage short term or long term to the control panel. After initial testing replace the test panel and proceed with complete testing.
14. The standard Operator Interface shall have the ability to view events, acknowledge, silence, and reset the system and any networked Cerberus® PRO Fire Safety control panels, when configured as a global PMI. The standard operator interface can acknowledge, silence, and reset all panels via Global PMI.
  15. The LED Operator Interface shall have the ability to view events, acknowledge, silence, and reset the system and any networked Cerberus® PRO Fire Safety control panels, when configured as a global PMI. Additionally, the operator interface provides twelve multicolored configurable LEDs for annunciating system status
  16. The System Periphery Board shall contain 2 Class B NAC circuits rated at 3 amps each with power-limited outputs. The zones shall be isolated and independently supervised. There shall be at least 6 unique codes/signals for each circuit based on system logic. These signals shall be Temporal Code 3 (Evacuation), Steady, Temporal Code 4 (for CO alarms), March Time 120ppm, March Time 60ppm, and March Time 30ppm. The card shall have the following LED's to provide trouble shooting and annunciation; Power, Gnd. Fault, Zone Activation or Trouble. This functionality shall be integral to the system. The card shall be model number FCI2016-U1/FCI2017-U1.
  17. The control panel shall be equipped with four Form C relays for alarm, trouble, supervisory, and programmable output. The system shall provide the mounting of all system cards, field wiring, and panel's inter-card wiring. All power limited field wiring shall be separated from all non-power limited internal wiring. The card shall be model number FCI2016-U1/FCI2017-U1.
- H. System response time from alarm to output shall be an average of three (3) seconds.
- I. All system cards and modules shall have Flash memory for downloading the latest module firmware.
- J. Passwords:
1. Technician Level Password - There shall be a 4-character password that a user must enter into the control panel in order to perform such maintenance- and control-related functions at the panel as:
    2. Arming and disarming devices.
    3. Activating, deactivating or modifying detector ASD and sensitivity settings.
    4. Activating and deactivating the History Log function and deleting obsolete entries.
    5. Changing the system time and date.
  6. Maintenance Level Password - There shall be a 4 character password that a user must enter into the control panel in order to access the panel's reporting functions and walktest functions.
  7. Acknowledge Silenceable Reset Access - There shall be a key required to open a locked cabinet that a system user must use in order to acknowledge events, turn silenceable audibles and visuals on and off, and perform panel resets.
- K. History: The system shall store 2000 events in history. Trouble warnings will occur when the History buffer is full.
- L. Reports:
1. The system shall have the ability to provide configuration, status, queue and history reports.
  2. Configuration reports shall provide the following information:
    - 1) Custom Messages
    - 2) Database Information

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- 3) Entity Type
- 4) Zone usage
- 5) Device Category
- 6) Firmware revision
3. Status reports shall provide the following information:
  - 1) Disarmed cards and devices
  - 2) ASD settings
  - 3) Sensitivity in %/foot
  - 4) Alarm threshold in %/foot
  - 5) Temperature in degrees F.
  - 6) Walktest
4. Queue reports shall provide the following information:
  - 1) Alarm events with custom message and event time
  - 2) Gas alarm events with custom message and event time
  - 3) Supervisory events with custom message and event time
  - 4) Trouble events with custom message and event time
  - 5) Status events with custom message and event time
  - 6) Information events
5. History reports shall provide Address, History Type, Description, Time & Date and Custom Message. The following event types shall be reported:
  - 1) Alarm events
  - 2) Gas alarm events
  - 3) Supervisory events
  - 4) Status changes
  - 5) Alarm verification
  - 6) Output activation from logic
  - 7) System Reset
  - 8) Event Acknowledgements
  - 9) Block Acknowledgements
  - 10) Audible Silence System Flag Changes
  - 11) Sensitivity Changes
  - 12) Arm / Disarm Commands
  - 13) Arm / Disarm By Logic
  - 14) Manual Output Overrides
  - 15) Output Overrides By Logic
  - 16) Time Changes
  - 17) Menu Logins
  - 18) ASD Changes
  - 19) Walktest
  - 20) Device Input to Logic Activations/Deactivations

### 2.3. POWER SUPPLY

- A. The system Power Supply shall be a 170 Watt, 6.5-amp that provides 24VDC power for system operation. The power supply shall be filtered and regulated. The power supply provides power for all system operation, including signaling line circuits, notification appliance circuits, auxiliary power, battery charger, and all optional modules. The power supply shall be rated for 120/240 VAC 50/60 Hz. The module shall be model number FP2011-U1

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- B. The system Power Supply FP2012-U1 shall be a 300 Watt, 11.5-amp that provides 24 VDC power for system operation. The power supply provides power for all system operation, including signaling line circuits, notification appliance circuits, auxiliary power, battery charger, and all optional modules. The power supply shall be rated for 120/240 VAC 50/60 Hz. The module shall be model number FP2012-U1.
- C. For applications requiring greater than 300W of power, the Model FP2013-U1 power supply can optionally power a Model FV922 or FV924 system. Model FP2013-U1 consists of two (2) power supply units and one (1) interconnection cable, in order to balance the power from Model FP2013-U1. Consequently, this power-supply configuration can provide up to 600W at 24VDC.
- D. The battery charger shall be able to charge the system batteries up to 100 AH. Battery charging shall be microprocessor controlled and programmed to select battery sizes.
- E. Transfer from AC to battery power shall be instantaneous when AC voltage drops to a point where it is not sufficient for normal operation.

### 2.4. SYSTEM ENCLOSURE

- A. Provide the enclosure as specified. Provide the color to comply with local AHJ requirements.
- B. Provide three-height-unit backbox as part of the Cerberus® PRO Fire Safety intelligent - communication system hardware for use with 3HU system enclosures. Specifically, each backbox is used to fasten with a 3HU outer door.

### 2.5. REMOTE ANNUNCIATOR

- A. LCD Annunciator Panel: Provide FT2014/FT2015 LCD remote annunciator(s) as indicated on the drawings. The remote annunciator shall provide visual indication of all system status changes including alarm, supervisory, trouble, and system status. Display shall include text descriptions as programmed at the main panel for all device status and system status. The FT2015 remote annunciator shall provide key-lock switch protected functionality including reset, signal silence/un-silence, and acknowledge. The FT2014/FT2015 shall be available in both red and black housings.

### 2.6. INTELLIGENT INITIATING DEVICES

- A. General
  - 1. All initiation devices shall be insensitive to initiating loop polarity. Specifically, the devices shall be insensitive to plus/minus voltage connections.
- B. Smoke Detectors – Standard Addressable Detectors:
  - 1. The smoke detectors must provide at least 3 environmental parameter sets to assist in device sensitivity configuration.
  - 2. The detectors shall have a tri-color LED to streamline system maintenance/inspection by plainly indicating detector status as follows: green for normal operation, amber for maintenance required, red for alarm.
  - 3. The detector shall be RoHS-compliant: it shall meet standards for Reduction of Hazardous Substances (RoHS) by reduction in lead content and other restricted substances.

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4. The detectors shall be UL listed for operation in a 95% relative humidity (RH) environment.
5. The detectors shall be designed to eliminate calibration errors associated with field cleaning of the chamber.
6. The detectors shall support the use of a relay, or LED remote indicator without requiring an additional software address. Low profile, white case shall not exceed 2.5 inches of extension below the finish ceiling.
7. For the detectors where required, there shall be available a locking kit and detector guard to prevent unauthorized detector removal.
8. Available models:
  - 1) OH921. Multi-Criteria incorporating 1 Optical sensor and 1 Thermal sensor with an operating temperature range of 32°F to 100°F. Available in four parameter sets. Polarity insensitive installation wiring. Three color LED.
  - 2) OP921. Photoelectric Smoke detector with an operating temperature range of 32°F to 120°F. Available in three parameter sets. Polarity insensitive installation wiring. Three color LED.

### C. Heat Detectors – Addressable

1. Thermal Detectors shall be rated at 135 degrees fixed temperature and 15 degrees per minute rate of rise. Detectors shall be constructed to compensate for the thermal lag inherent in conventional type detectors due to the thermal mass, and alarm at the set point of 135 degrees Fahrenheit. The choice of alarm reporting as a fixed temperature detector or a combination of fixed and rate of rise shall be made in system software and be changeable at any time without the necessity of hardware replacement.
2. The detectors furnished shall have a listed spacing for coverage up to 2,500 square feet and shall be installed according to the requirements of NFPA 72 for open area coverage. The thermal detector shall be model number HFPT-11.
3. Model HI921 heat detector shall have the following temperature settings:
  - 1) Fixed temperature at 135°F, 145°F, 155°F, 165°F, 174°F
  - 2) Rate of Rise at 15°F/ min (8.3°C) at 135°F (57°C)
  - 3) Rate of Rise at 15°F/ min (8.3°C) at 174°F (79°C)
  - 4) Low temperature warning at 40°F (4.4°C)

### D. Detector Bases – Addressable

1. Detector bases shall be low profile twist lock type with screw clamp terminals and self-wiping contacts. Bases shall be installed on an industry standard, 4" square or octagonal electrical outlet box.
2. The model number for the standard base shall be DB-11 - 6" Version.
3. The model number for the standard base shall be DB-11E - 4" Version.

### E. Manual Pull Stations – Addressable

1. Provide addressable manual stations where shown on the drawings, to be flush or surface mounted as required. Manual stations shall contain the intelligence for reporting address, identity, alarm and trouble to the fire alarm control panel. The manual station communications shall allow the station to provide alarm input to the system and alarm output from the system within less than four (4) seconds.
2. The manual station shall be equipped with terminal strip and pressure style screw terminals for the connection of field wiring. Surface mounted stations where indicated on the

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drawings shall be mounted using a manufacturer's prescribed matching red enamel outlet box.

3. The double action pull station shall be model number HMS-D.
4. Where required, there shall also be available pull stations with break glass, capable of explosion proof installation, capable of weatherproof installation, reset key operation, and metal housings.

### F. Addressable Interface Devices

1. Addressable Interface Devices shall be provided to monitor contacts for such items as water-flow, tamper, and PIV switches connected to the fire alarm system. These interface devices shall be able to monitor a single or dual contact. An address will be provided for each contact. Where remote supervised relay is required the interface shall be equipped with a SPDT relay rated for 4 amps resistive and 3.5 amps inductive. The addressable interface modules shall be model number HTRI or FDCIO Series.
2. Where needed, a Conventional Zone Module shall connect to the Signal Line Circuit, which will allow the use of conventional initiation devices. This module shall have the ability to support up to 15 conventional smoke detectors and an unlimited number of contact devices. This module shall also be capable of monitoring Linear Beam detectors and conventional Flame detectors. Where required, there shall be an intrinsically safe detection solution for NEMA defined intrinsically safe installations (model DI-3IS with ISI-1) compatible with the conventional zone module. The module shall be model HZM.
3. Single Device Damper Monitoring and Control: A single HTRI switch input shall be able to monitor all 3 states of a damper – open, closed, and in transit. A single HTRI-R shall be able to fully control a damper (through the relay connected to the motor control) while also using its switch input for monitoring all 3 states of the damper.
4. Model HCP addressable control point shall provide remote, independent control of any of the following:
  - 1) A notification appliance circuit (NAC)
  - 2) A telephone zone
  - 3) A speaker zone.

### 2.7. DEVICE PROGRAMMING UNIT

- A. Device Programming Unit: The programming tool shall program the intelligent devices with addresses. The unit shall test the device to respond to its address. Dipswitches and rotary switches shall not be acceptable. The programmer shall be model DPU with carrying case.

### 2.8. NOTIFICATION APPLIANCES

- A. All notification appliances shall be listed for Special Applications: Strobes are designed to flash at 1-flash-per-second minimum over their “Regulated Input Voltage Range.
- B. Equipped for mounting as indicated and with screw terminals for system connections.
  1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly.
  2. All appliances that are supplied for the requirements of this specification shall be UL Listed for Fire Protective Service, and shall be capable of providing the "equivalent facilitation" which is allowed under the Americans with Disabilities Act Accessibilities Guidelines (ADAAG)), and shall be UL 1971 Listed.

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3. All appliances shall be of the same manufacturer as the fire alarm control panel specified to ensure absolute compatibility between the appliances and the control panels, and to ensure that the application of the appliances are done in accordance with the single manufacturer's instructions.
  4. Any appliances that do not meet the above requirements and are submitted for use must show written proof of their compatibility for the purpose intended. Such proof shall be in the form of documentation from all manufacturers that clearly states that their equipment (as submitted) is 100% compatible with each other for the purpose intended. All strobes shall be provided with lens markings oriented for wall mounting.
  5. Notification appliances shall be synchronized in hallways and in any area where two more appliances are visible.
  6. All notification appliances shall be white unless noted otherwise on the drawings.
- C. **Speaker-Strobes:** Provide 4" white speakers/strobes at the locations shown on the drawings. Speakers shall have a 4" mylar cone, paper cones are not acceptable. The rear of the speakers shall be completely sealed protecting the cone during and after installation. In and out screw terminals shall be provided for wiring. Speakers shall provide 1/4w, 1/2w, 1w, and 2w power taps for use with 25V or 70V systems. At the 2-watt setting, the speaker shall provide an 87-dBA sound output over a frequency range of 400-4000 Hz. when measured in reverberation room per UL-1480. Strobes shall provide synchronized flash. Strobe output shall be determined as required by its specific location and application from a family of 15/75cd, 30cd, & 110cd devices.
- D. **Low Profile Horns:** Provide low profile wall mount horns at the locations shown on the drawings. The horn shall provide an 84-dBA sound output at 10 ft. when measured in reverberation room per UL-464. The horn shall have a selectable steady or synchronized temporal output. In and out screw terminals shall be provided for wiring. The horn shall mount in a North American 1-gang box.
- E. **Low Profile Strobes Horns:** Provide low profile wall mount horn/strobes at the locations shown on the drawings. The horn/strobe shall provide an audible output of 84 dBA at 10 ft. when measured in reverberation room per UL-464. Strobes shall provide synchronized flash outputs. The strobe output shall be determined as required by its specific location and application from a family of 15cd, 30cd, 60cd, 75cd & 110cd devices. The horn shall have a selectable steady or synchronized temporal output. In and out screw terminals shall be provided for wiring. Low profile horn/strobes shall mount in a North American 1-gang box.
- F. **Low profile strobes:** Xenon strobe lights listed under UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch- high letters on the lens.
- 2.9. **IP FIRE ALARM COMMUNICATOR TRANSMITTER**
- A. UL 864 listed for signaling under Other Transmission Technologies and comply with NFPA 72 requirements
  - B. Metal enclosure to mount next to a UL listed fire alarm control panel.
  - C. Two supervised inputs and two additional outputs.



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- D. Functional Performance: Unit receives an alarm, supervisory, or trouble signal from the FACP, and automatically captures the cellular alarm communicator (Telguard TG-7) dials a preset number for a remote central station.
- E. Supports both dynamic (DHCP) or Public and Private Static IP address.
- F. Supports dual-destination IP receiver address for high redundancy configurations.
- G. RJ45X Ethernet Termination

### 2.10. CELLULAR ALARM COMMUNICATOR FOR 3G/4G NETWORKS

- A. UL Listings 864
- B. Full data reporting
- C. Automatic self-test
- D. Locking metal enclosure
- E. Telguard TG-7

### 2.11. DIGITAL COMMUNICATOR

- A. The Multi-Point Digital Alarm Communicator FCA2015-U1 shall be UL864 listed to provide point identification of alarm, supervisory, security and trouble events to a Central or Remote Receiving Station. The DACT shall support the following:
  - 1. Ademco Contact ID or SIA protocol
  - 2. Ademco Contact ID selection shall provide the ability to transmit events for up to 999 individual zones
  - 3. SIA selection shall provide the ability to transmit events for up to 10000 individual points
  - 4. Programming of accounts and phone numbers
  - 5. Dual phone line interface
  - 6. Line fault monitoring.
  - 7. Automatic 24-hour test
  - 8. The DACT supports configurable alarm, alarm restoral, trouble, trouble restoral, supervisory, supervisory restoral, and reset events.
  - 9. The DACT supports Ademco Contact ID alarm event codes for general alarm, smoke detector alarm, waterflow alarm, duct alarm, and manual alarm events.
  - 10. Optionally, the DACT can be programmed to report events by event queue only.

### 2.12. WIRE AND CABLE

- A. Wire and cable for fire alarm systems shall be UL listed and labeled as complying with NFPA 70, Article 760.
- B. Signaling Line Circuits: Twisted, shielded pair, not less than No. 18 AWG size as recommended by system manufacturer.

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1. Circuit Integrity Cable: Twisted shielded pair, NFPA 70 Article 760, Classification CI, for power-limited fire alarm signal service. UL listed as Type FPL, and complying with requirements in UL 1424 and in UL 2196 for a 2-hour rating.
- C. Non-Power-Limited Circuits: Solid-copper conductors with 600-V rated, 75 deg C, color-coded insulation.
  1. Low-Voltage Circuits: No. 16 AWG, minimum.
  2. Line-Voltage Circuits: No. 12 AWG, minimum.
- D. Underground cabling: Please provide water resistant/water blocking type, equal to West Penn "Aquaseal".

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Examine areas and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Perform work in accordance with the requirements of NFPA 70, NFPA 72 and NECA 1-2006, Standard of Good Workmanship in Electrical Contracting.
- B. Fasten equipment to structural members of building or metal supports attached to structure, or to concrete surfaces.
- C. In the event that limited energy cable installation is allowed, all cable runs shall be run at right angles to building walls, supported from structure at intervals not exceeding 3 feet and where installed in environmental air plenums, be rated for such use and tied/supported by components listed for environmental air plenums installation.
- D. Wiring Method:
  1. Stub up raceways into accessible ceiling space.
  2. Public areas with exposed structure, all wiring shall be concealed in raceway.
  3. Stub up raceways into accessible ceiling space.
  4. Install wiring in raceways except in accessible indoor ceiling spaces. Secure wiring from building structure steel (no walls) by means of J-hooks. Where available lay out cables in cable tray.
  5. Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces and in gypsum board partitions where unenclosed wiring method may be used. Conceal raceway and cables except in unfinished spaces.
  6. Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
  7. Conceal raceways and wiring except in unfinished spaces and as indicated.
  8. Minimum conduit size shall be ¾" inch.
  9. Control and data transmission wiring shall not share conduit with other building wiring systems.

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10. Fire alarm circuits and equipment control wiring associated with the fire alarm system shall be installed in a dedicated raceway system.
  11. This system shall not be used for any other wire or cable.
- E. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.
  - F. Provide primary power for each panel from normal/ emergency panels as indicated on the Electrical Power Plans. Power shall be 120 VAC service, transformed through a two-winding, isolation type transformer and rectified to low voltage DC for operation of all circuits and devices.
  - G. Color-Coding: Color-code fire alarm conductors differently from the normal building power wiring. Use one color-code for alarm circuit wiring and a different color-code for supervisory circuits. Color-code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire alarm system junction boxes and covers red.
  - H. Wiring to Remote Alarm Transmitting Device: 1-inch conduit between the FACP and the transmitter. Install number of conductors and electrical supervision for connecting wiring as needed to suit monitoring function

### 3.3 BOXES, ENCLOSURES AND WIRING DEVICES

- A. Boxes shall be installed plumb and firmly in position.
- B. Extension rings with blank covers shall be installed on junction boxes where required.
- C. Junction boxes served by concealed conduit shall be flush mounted.
- D. Upon initial installation, all wiring outlets, junction, pull and outlet boxes shall have dust covers installed. Dust covers shall not be removed until wiring installation when permanent dust covers or devices are installed.
- E. "Fire alarm system" decal or silk-screened label shall be applied to all junction box covers.

### 3.4 CONDUCTORS

- A. Each conductor shall be identified as shown on the drawings at each with wire markers at terminal points. Attach permanent wire markers within 2 inches of the wire termination. Marker legends shall be visible.
- B. All wiring shall be supplied and installed in compliance with the requirements of the National Electric Code, NFPA 70, Article 760, and that of the manufacturer.
- C. Wiring for strobe and audible circuits shall be a minimum 14 AWG, signal line circuits minimum 18 AWG twisted.
- D. All splices shall be made using solder-less connectors. All connectors shall be installed in conformance with the manufacturer recommendations.
- E. Wiring within sub panels shall be arranged and routed to allow accessibility to equipment for adjustment and maintenance.

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### 3.5 GROUNDING

- A. Ground the FACP and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to the FACP.

### 3.6 DEVICES

- A. All devices and appliances shall be mounted to or in an approved electrical box.

### 3.7 IDENTIFICATION

- A. Permanently label or mark each conductor at both ends with permanent alphanumeric wire markers.
- B. Identify system components, wiring, cabling, and terminals according to Division 26 Section "Electrical Identification."
- C. Install instructions frame in a location visible from the FACP.
- D. Paint power-supply disconnect switch red and label "FIRE ALARM."

### 3.8 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

### 3.9 MONITORING

- A. Include in bid proposal the cost for 1-year remote monitoring. Monitoring station shall UL listed and 24-hour 365 days operation.

### 3.10 ACCEPTANCE TESTING

- A. A written acceptance test procedure (ATP) for testing the fire alarm system components and installation will be prepared in accordance with NFPA 72 and this specification. The contractor shall be responsible for the performance of the ATP, demonstrating the function of the system and verifying the correct operation of all system components, circuits, and programming.
- B. The installing contractor prior to the ATP shall prepare a complete listing of all device labels for alphanumeric annunciator displays.
- C. Preliminary Testing: Conduct preliminary tests to ensure that all devices and circuits are functioning properly. After preliminary testing is complete, the Contractor and an authorized representative from each supplier of equipment shall be in attendance at the preliminary testing to make necessary adjustments.
- D. Final Acceptance Test: Notify the owner in writing when the system is ready for final acceptance testing. Submit request for test at least 7 calendar days prior to the test date. Test the system in accordance with the procedures outlined in NFPA 72.

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- E. The acceptance inspector shall use the system record drawings in combination with the documents specified in this specification during the testing procedure to verify operation as programmed. In conducting the ATP, the acceptance inspector shall request demonstration of any or all input and output functions.

### 3.11 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project outside normal occupancy hours for this purpose.
- B. Semiannual Test and Inspection: Six months after date of Substantial Completion and for the following three years, test the fire alarm system complying with the testing and visual inspection requirements in NFPA 72. Perform tests and inspections listed for monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.

### 3.12 DOCUMENTATION

- A. System documentation shall be furnished to the owner and shall include but not be limited to the following:
  - 1. System record drawings and wiring details including one set of reproducible drawings.
  - 2. System operation, installation and maintenance manuals.

### 3.13 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain the fire alarm system, appliances, and devices. Refer to Division 1 Section "Closeout Procedures."
- B. Instructor: Include in the project the services of an instructor, who shall have received specific training from the manufacturer for the training of other persons regarding the inspection, testing and maintenance of the system provided. The instructor shall train the employees designated by the owner, in the care, adjustment, maintenance, and operation of the fire alarm system.
- C. Training sessions shall cover all aspects of system performance, including system architecture, signaling line circuit configurations, sensor and other initiating device types, locations, and addresses, fire alarm control panel function key operation, and other functions as designated by the owner.

END OF SECTION 267210

## SECTION 267230 – SCHOOL INTERCOM

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. The scope of work of this section consists of the design, installation, and programming of all materials to be furnished under this section, and without limiting the generality thereof, consists of providing all labor, materials, equipment, plant, transportation, appurtenances, and services necessary and/or incidental to properly complete all work as shown on the drawings, as described in the specifications, or as reasonable inferred from either or, in the opinion of the Architect and Owner, as being required
- B. School intercom systems will be installed in a professional manner using standard industry practices. Loudspeaker systems are distributed throughout the facility to provide a constant sound level in the desired zones or locations.
- C. The system has been designed to utilize the Valcom IP-based processor and logic control.
- D. The system will also incorporate the Valcom clock and chime system.

#### 1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

#### 1.3 CODES

- A. Execute work in accordance with best intercom system installation practices, National Electrical Code, and applicable state and local codes.

#### 1.4 REGULATIONS

- A. Comply with terms and conditions of Americans with Disabilities Act, especially regarding provisions for the hearing impaired.

#### 1.5 SUBMITTALS

- A. General
  - 1. Refer to Division 1.
  - 2. Submit in quantities, format and timetable as required by General Conditions.
- B. Product Data Binders
  - 1. Minimum number of Sets: four (4).
  - 2. Timetable
    - a. Submit within thirty (30) days after award of contract.
    - b. Submit simultaneously with Shop Drawings.

- c. Allow minimum of ten (10) business days for review. All sets minus one (1) will be returned with review comments. If a resubmit is required, resubmit total quantity of complete sets. If second resubmit is required, Contractor shall reimburse Owner for expenses incurred during additional review process.
- d. Review and approval of Product Data is required before equipment purchase and installation.
- e. Bind product data sheets together either in GBC or 3-ring type binders.

C. Shop Drawings

1. Minimum Number of Sets: four (4).
2. Timetable
  - a. Submit within thirty (30) days after award of contract.
  - b. Submit simultaneously with Product Data Binders.
  - c. Allow minimum of ten (10) business days for review. All sets minus one (1) will be returned with review comments. If a resubmit is required, Contractor shall reimburse Owner for expenses incurred during additional review process.
3. Description:
  - a. Shop Drawings shall be used for coordination between trades and updated as final record drawings.
  - b. Bind all Shop Drawings together to form set. Loose drawings will not be accepted.
  - c. Each drawing shall include: Project, Building, Location, Contractor Name, Architect, intercom Consultant, Date and Revision Number.
  - d. Number and title each drawing in logical manner as a set.
  - e. Include cover sheet with listing of all drawings included in bound set.
  - f. Ensure that labeling on Shop Drawings match labeling on equipment.
  - g. Minimum Scale:
    - 1) Floor Plans: 1/8 inch = 1 foot.
    - 2) Rack Elevations: 1-1/2 inch = 1 foot.
    - 3) Plate/Panel Details: 6 inches = 1 foot.
    - 4) Loudspeaker Details: 1 inch = 1 foot.
  - h. Include as a minimum:
    - 1) Floor plans indicating locations of all intercom devices, vertical risers, pull boxes, and exposed wiring. Include Device ID (Power supplies, volume controls, etc., as referenced in design contract documents), as appropriate for projectors, screens, racks, floor boxes, intercom plates in walls, etc.
    - 2) Schematic diagram showing all primary and secondary devices, interconnectivity and signal flow.
    - 3) Plate details showing size, material, finish, connectors, engraving, etc.
    - 4) Mounting detail drawings of loudspeakers, racks, and overhead equipment. Hire services of professional structural engineer, licensed

by the appropriate governing authority, to review shop drawings, building structural drawings, and any existing structures from which equipment is to be suspended. Include Structural Engineer's stamped report with shop drawing submittal. Report shall include:

- a) Itemization of items reviewed by the Structural Engineer.
  - b) Confirmation that proposed methods of suspending equipment as shown on the shop drawings conform to required safety factors.
  - c) Confirmation that building structure from which equipment is to be suspended will support equipment including required safety factors.
- 5) Rack elevations.
  - 6) Complete schematic diagram. One-line diagram with detailed descriptions of product inputs and outputs is acceptable. Include terminal strip details and cable label information. If wiring diagram spans more than three (3) sheets, additionally provide simplified block diagram of entire system on one (1) sheet.
  - 7) Electrical power wiring diagram. Include circuit, switching, and control details.
  - 8) Wiring diagram of grounding and shielding scheme.
  - 9) Drawings for custom-fabricated items (i.e., plates, panels, cables, and assemblies).
  - 10) General construction drawings necessary for completion of work.

D. Operation and Maintenance Manuals

1. Minimum number of Sets: four (4).
2. Bind Operation and Maintenance Manuals using either GBC or 3-ring binders.
3. Format and Minimum Information below:
  - a. Section 1 - System Operation.
    - 1) Introduction/overview to system components and their functions and locations. Include a brief listing of basic system functions.
    - 2) Complete but simple system operating instructions to accomplish basic system functions, written for non-technical personnel.
    - 3) Certificate indicating names of Owner personnel trained by intercom Contactor, date of training, name of intercom Contractor representative that provided training, and name of project.
  - b. Section 2 - System Documentation.
    - 1) Simplified system one-line schematic diagram showing changes made during construction.
    - 2) Complete inventory of system components including serial numbers. Identify location (equipment rack, over stage, stored in control room, etc.) of each component.
    - 3) Cable and terminal strip documentation including cable numbers, functions, originating locations, terminating locations, and signal levels.
    - 4) All Shop Drawings corrected to reflect as-built conditions.
    - 5) Other data and drawings required during construction.
    - 6) Initial Tests and Adjustments data.



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- 7) Final Tests and Adjustments data.
  - 8) CD-ROM discs including all utilized manufacturer's software and saved copies of software configurations (configurations as established during Final Tests and Adjustments).
- c. Section 3 - Manufacturer's Documentation.
- 1) For each equipment model at no additional costs to Owner, even if manufacturer does not include costs of such documentation with purchase of equipment item.
  - 2) Manufacturer's Product Data.
  - 3) Operating instructions.
  - 4) Installation instructions.
  - 5) Service information.
  - 6) Schematic diagrams.
  - 7) Replacement parts list.
  - 8) Section 4 - Maintenance Information.
  - 9) Preventive maintenance schedule letter clearly stating target dates of six month and end-of-warranty preventative maintenance inspections, and list of maintenance tasks performed.
  - 10) Maintenance instructions including manufacturer's recommended maintenance, recommended maintenance schedule and information concerning proper inspection, testing, and replacement of components.
  - 11) Troubleshooting information complete with instructions for procedures during equipment failure.
- d. Section 5 – Warranty Information
- 1) System warranty letter.
4. Provide three (3) sets on CD-R disc that include all material in Operation and Maintenance Manuals in PDF format except for copyrighted material.
  5. Submit one (1) set of Operation and Maintenance Manuals at least ten (10) days before Final Tests and Adjustments procedures (minus data from Final Tests and Adjustments). This set will be reviewed by Owner and returned to Contractor. Re- submit after Final Tests and Adjustments and include data. NOTE: Do not schedule Final Tests and Adjustments or perform training of Owner personnel before submitting Operation and Maintenance Manual.
  6. Submit remaining number of complete manuals as required by General Conditions within ten (10) days after return of reviewed set(s). Include Final Tests and Adjustment data, warranty period letter, and any other data not included in first submission.
- E. Samples.
1. Request for Samples - Upon request, furnish samples (at no additional cost) to Owner and/or General Contractor of submitted items proposed as substitutes for specified items. Products will be reviewed to determine if proposed substitute items meet required function and quality.
  2. Product Tests

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- a. Products submitted as samples may require testing by independent laboratory. Testing at expense of Contractor.
- b. Obtain written approval of tested products before incorporating into system.

### 1.6 QUALITY ASSURANCE

#### A. Intercom Contractor Qualifications.

1. Be established intercom System Contractor, regularly engaged in furnishing and installing intercom systems. NOTE: Electrical or general contracting firms responsible for completion of this work, but not meeting above requirement, shall employ services of approved intercom Contractor as subcontractor to perform work described herein.
2. Be experienced in installations of similar size and scope within last five (5) years. Submit list of four (4) (minimum) installed jobs of similar magnitude, completed within last five years. For verification, submit complete information, including project name, project address, contact person, daytime telephone number plus month and year of project completion. At Owner's request, accompany Owner or Owner's representative on visit to any or all example completed projects submitted.
3. Be Authorized Dealer for all major lines of equipment listed in Part 2 (Valcom, etc.). Must have at least one permanent staff member who is factory trained in the installation and maintenance of each major product line offered.
4. Employ personnel (at all levels of work) experienced in projects of similar size and scope. Provide list of key personnel to be responsible for each of the following aspects of work: Project Management, Technical Documentation, Control System programming, DSP programming and Leadership of Field Work (one who is present for all field work). For each identified employee, indicate number of years employed by contractor, number of years experience in assigned responsibilities, and list of previously completed projects where similar responsibilities were required.
5. Project manager assigned to this project must have a minimum of five (5) years experience in installing and integrating intercom systems of similar scale.

### 1.7 WARRANTY

- A. Provide for a period of three (3) years commencing from the date of final system acceptance, including annual inspections of the system.
- B. During the warranty period report to the site and repair or replace any defective materials or workmanship without cost to the Owner. Warranty service shall be rendered within 24 hours after request by Owner. Equivalent replacement equipment shall be temporarily provided when immediate on-site repairs cannot be made.

## PART 2 - PRODUCTS

2.1 Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- A. Valcom – basis of design
- B. Others prior approval required from the Owner.

2.2 GUIDELINES

- A. All active intercom equipment shall be provided by intercom Contractor. All active electronics shall be contractor furnished; contractor installed (CFCI).
- B. Infrastructure Products – All conduits, basket tray/cable tray, pull boxes and associated parts required for infrastructure shall be installed by the electrical contractor unless specifically excluded in these specifications or drawings.
- C. Performance - Regardless of completeness of descriptive paragraphs herein, each device shall meet its manufacturer’s published specifications. Verify performance.
- D. Contract Documents - Drawings and specifications are to be used in conjunction with one another and to supplement one another. In general the specifications determine the nature and quality of the materials, and the drawings establish the quantities, details, and give characteristics of performance that should be adhered to in the installation of the intercom system components. If there is an apparent conflict between the drawings and specifications, the items with the greater quantity or quality shall be provided and installed. Clarification with the owner about these items shall be made prior to the ordering and installation.
- E. Quantities – All quantities are indicated on intercom drawings or in Part 2 AV Products list. Confirm quantities on final Contract Documents. If Contract Documents do not include quantities necessary to deliver complete working system, provide notification of disparity, and install required quantity of devices for complete working system.
- F. Small Parts - Systems are described in terms of major products. Even if not specifically mentioned, provide and install patch cables, connectors, hardware, converters, power supplies, labels, terminals, mounting accessories etc. necessary for complete and working system meeting design intent of specifications.
- G. Balanced Lines – Unless specifically directed otherwise, wire all line and microphone level circuits as balanced with respect to signal ground. For products without balanced inputs or outputs, provide high quality balancing transformers with proper level, shielding, and impedance characteristics. Assure all audio levels arriving and leaving matrix and routing switchers are equal to the manufacture’s recommended input audio level. If required, use Radio Design Labs, Inc. products or equivalent for level matching.
- H. Keys - Provide five (5) sets of keys for any intercom system product requiring keys.
- I. Condition - Provide and install products listed in this section in factory new condition, conforming to applicable provisions of American National Standards Institute.
- J. Designations - Each major product item is given unique designation (such as MIX1 for mixer number 1). The product designations are unique in this section only and may be repeated in other specification sections.

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- K. Security Screws - Use Middle Atlantic HSK Guardian series screws and bits to secure rack components, LCD mounts, Projector mounts and any other location deemed necessary by Owner. Use nylon washers to protect equipment surfaces. Account for appropriate tip wear when ordering quantity and do not use a bit beyond the manufacturer's recommendations. Provide ten (10) additional unused driver bits and deliver to the customer after completion.
- L. Intercom Electrical Power - Coordinate with Electrical Contractor regarding proper placement of isolated-ground duplex outlets for any AV equipment. Electrical circuits should be connected (and outlets wired) by the Electrical Contractor to the intercom system circuit breaker panel (N.I.C.). Ensure that "Star" ground configuration is properly implemented by the Electrical Contractor. Ensure that ground wires from each outlet are isolated from conduit, neutrals, and each other.
- M. Intercom System Programming - Owner shall coordinate layout and logical branching of DSP audio system. Include screen layout and menu branching drawings in intercom submittal. After intercom system is approved, all audio control system code and programming will become property of Owner. AV Contractor shall provide Owner both raw and compiled code on CD-R disc.
- N. Intercom Racks:
  - 1. Provide blank faceplate in any area marked BLANK in drawings.
  - 2. Provide shelf for mounting of any device for which rack mount kit is not available.
  - 3. Provide one (1) Panelcrafters DATCO-XXXXXX-RHIM-01 designer/integrator information plate or approved alternate per rack. Install information plate at the top of each rack unless 1RU space is not available. Contact Panelcrafters sales department to add intercom Contractor graphic to the "integrator" section (approximately 8.5" x 1.75" of the right-hand side). All alternates must include AV Consultant graphic. Submit to AV designer for approval of final plate design prior to purchasing and installation.
- O. Intercom Design Bid & Substitutions:
  - 1. Valcom Basis of design
  - 2. System design is around products listed in Part 2. Intent of product specification is to provide standard of quality and function for installed materials. Certain performance specifications are given to clarify job requirements.
  - 3. Bid intercom system with products specified in Base Bid section below unless noted otherwise from Owner.
  - 4. No substitutions will be allowed without prior approval from Owner specific to proposed manufacturer and model numbers.
  - 5. Equipment listed in Part 2 is based on performance criteria to meet Owner design requirements.
  - 6. All requested substitutions need to meet or exceed performance of devices listed in Part 2. For each request provide manufacturer's published specifications to verify performance and explain functional and cost impact.
  - 7. Evaluation and approval of substitution requests will be performed by Owner.

### 2.3 SCHOOL INTERCOM SYSTEM PRODUCTS

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- A. Intercom System Central Processor (PCP) – Valcom VEIP6K-1 platform/processor with VE6030-1 application server UPS, VE8090 SIP/FXS Phone interface, 8 port IP I/O and 4 port IP Audio. (Quantity: As shown).
- B. Page Zone Expander (PZE) – Valcom VE8004BR IP audio gateway.
- C. Gateway – Valcom #VE8045 audio gateway.
- D. Mixer Amplifier – Clarity/Valcom #SMA-35.
- E. Ceiling Intercom Loudspeaker – Valcom VE422A-2 loudspeaker system for lay-in tile ceilings.
- F. Wall Intercom Loudspeaker – Valcom #V-9871 loudspeaker system.
- G. Ceiling Intercom Loudspeaker – Valcom #S-500 loudspeaker system for hard ceilings.
- H. Outdoor Wall-mounted Horn Loudspeaker – Valcom #V-9830.
- I. Indoor Intercom Call Switch - Valcom #V-2972.
- J. Wall-Mount Rack/Cabinet - Chatsworth #11900-X24.
- K. Administrative Control Handset - Valcom #VEADP4.

### 2.1 CABLES

- A. Interconnect Wiring – All intercom cables will be plenum rated per NEC.
  - 1. Analog Audio Plenum Rated Cable - West Penn 25291, or similar.
  - 2. Digital Audio Plenum Rated Cable: Belden 1801B plenum-rated AES/EBU compliant equivalent.
  - 3. Analog Composite Video Plenum Rated Cable: West Penn 25806 or Belden 89120.
  - 4. RGBHV Plenum Rated Cable: Belden 1283S5, or West Penn 258195.
  - 5. Control Plenum Rated Cable: West Penn D25350.
  - 6. Loudspeaker Plenum Rated Cable: West Penn 25226B & 25227B.

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7. Category 6A Cable: Belden 2413F DataTwist
  8. Fiber 62.5  $\mu$ m Cable: Corning 62.5/125.
- B. Connectors – All intercom (including microphone) connectors shall be made by Canare or Neutrik. Connectors shall be of the quantity and type as required for proper and durable operation, and signal transmission of the electrical characteristics for associated circuitry.
1. Microphone connectors: 3-conductor XLR AES/EBU compliant (for microphones in tables/lecterns, use Neutrik RF shielded connectors).
  2. Control panels: XLR type with number of conductors as required.
  3. Line level and left/right audio connectors: tip/ring/sleeve 1/4" phone jacks with insulated bushings.
  4. Composite video and RGBHV connectors: BNC dual crimp true 75 ohm BCP-C.
  5. BNC shall be made by ADC or Kings and be HD-SDI compliant to 3 GHz.
  6. Fiber: UniCam LC connectors.
  7. Loudspeaker shall be Neutrik Speakon type.
  8. Provide strain relief for each and every connector.

## PART 3 – EXECUTION

### 3.1 INSTALLATION

#### A. General Guidelines

1. Quality of Work - Perform labor to accepted industry standards and state and local codes to accomplish complete and working system.
2. Material and Labor - Provide specified products and other incidental materials, appliances, tools, and transportation required for complete and functioning systems. Provide personnel to perform labor who are skilled in techniques and can demonstrate technical knowledge intercom infrastructure system installations.
3. Documents at Job Site - Keep following documents at job site during entire construction period:
  - a. Complete Specifications and Drawings.
  - b. Approved Shop Drawings.
  - c. Approved Product Data.
  - d. Progress Set of Project Record Documents.
4. Mounting - Mount equipment and enclosures plumb and square. Ensure that permanently installed equipment is firmly and safely held in place. Design equipment supports to support loads imposed with project safety factor of five (5) or greater. For devices hung overhead, obtain review by Structural Engineer licensed by the appropriate governing authority prior to installation.
5. Dimension Verification - Verify dimensions and space requirements to assure that proper mounting, clearance, and maintenance access space is available for system components.
6. Clean-Up - Leave project clean each day. Place debris where designated by General Contractor. Debris includes but not limited to: solder splatter, cable ends, stripped insulation, spent crimp connectors, gypsum board and ceiling tile dust, and product wrappings and cartons. After completion of installation, thoroughly clean areas worked, including non-visible areas such as equipment rack interiors, rack top panels, and inside lockable floor and wall boxes.

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7. Coordinate installation of intercom infrastructure and equipment with other trades in order to follow project schedule.
8. Maintain any licensing required by the appropriate governing authority to install and terminate low voltage systems.

### B. Labeling

1. Equipment Labels - intercom Contractor shall provide engraved lamicoïd labels on front and rear of rack-mounted equipment. Mount labels plumb and square. Include schematic reference design, item name, and system or area controlled by labeled component. On program preamps and mixers, provide label for each input indicating which source is controlled by labeled channel. Unless otherwise indicated, provide permanently-mounted black labels engraved with 1/8-inch white block characters. Handwritten, self-laminating, or embossed plastic (Dymo) labels are not acceptable. Provide labels for major equipment with two (2) lines (minimum) of engraving, coded as follows:
  - a. Line 1: Generic name of device, such as MIXER AMPLIFIER.
  - b. Line 2: Schematic designation of device, such as AV-MSW-1.
2. Control Labels – intercom Contractor shall provide engraved label over each user-operated control that describes the function or purpose of control. Provide label of proper size to fit available space.
3. Terminal Strip Labels - intercom Contractor shall label each terminal strip with unique identification code in addition to numerical label (Cinch MS series) for each terminal. Show terminal strip codes on system schematic drawings included with Project Record Documents.
4. Rear Equipment Labels - intercom Contractor shall provide adhesive label on rear of equipment where cables attach, to indicate designation of cable connected at each point.
5. Cable and Wire Labels - Label cables and wiring logically, legibly and permanently for easy identification. Labels on cables shall be adhesive strip type, covered with clear heat shrink tubing. Factory stamped heat shrink tubing may be used. Hand-written or self-laminating type labels are not acceptable.
6. Cable Label Codes and Locations - Label each cable with unique alpha-numeric code. Locate cable designation at start and end of each cable run, within three (3) inches of termination point. For cable runs that have intermediate splice points, label cable with same designation throughout, with additional suffix to indicate each segment of run. Provide cable designation codes to schematic drawings included with Project Record Documents and Operation and Maintenance Manuals.

### C. Power and Grounding

1. Power Coordination – Coordinate final connection of power and ground wiring to rack. Electrical contractor will provide power to audio visual systems. Before installation, verify load requirements for systems as accepted.
2. Bus Bars - Install 1-inch by ¼-inch copper ground bus bar, top to bottom in floor mounted intercom racks. Ground and bond equipment chassis of each rack-mounted component without three-pin grounding plug to bus bars with #12 AWG insulated green wire using 6-32 or larger nuts, bolts, lock-washers, and appropriate NEMA connectors. Electrical Contractor (Division 16) shall provide and connect #4 AWG green insulated wire from Bus Bars to ground point in intercom technical electrical panel.

### D. Equipment Racks

1. Ventilation - Provide ventilation adequate to keep temperature in rack below 85 degrees Fahrenheit. Use “whisper” type ventilation fans in racks, adjusted to come on when temperature in rack rises above 85 degrees Fahrenheit, only if adequate cooling cannot be provided by Owner.

E. Wiring

1. Wiring Standards - Execute wiring in strict adherence to best AV engineering practices.
2. Field Connection Devices - Connect cable to active components through screw terminal connections and spade lugs when appropriate. For BNC connections use three-piece, dual crimp BNC properly sized for cable with insulating bushings. Wire nut or “Skotchlock” connectors are not acceptable. Do not wrap audio cable splices or connections with adhesive backed tape. Punch connectors or telephone-style punch blocks are not acceptable anywhere in the installation unless specifically authorized by Owner.
3. Run cable in ceiling plenums neatly parallel to building walls, supported every three feet to structure with plenum rated ties.
4. Raceways - Run vertical wiring inside rack in Panduit (or equivalent) plastic raceways with snap-on covers, sized to allow at least 50% future wiring. Mount raceways on full length  $\frac{3}{4}$ -inch flat black plywood backboards, attached to rack sides. If between-rack wiring chases are provided, Panduit raceways are not required. Horizontal wiring in rack shall be neatly tied in manageable bundles with cable lengths cut to minimize excess cable slack, but still allow for service and testing. Provide horizontal support bars if cable bundles sag. Individually bundle excess AC power cable away from rack mounted equipment with plastic cable ties. Electrical tape and adhesive backed cable tie anchors are not acceptable.
5. Accessibility - Ensure that wiring and connections are completely visible and labeled in rack. Mount termination resistors, if required, on terminal strips, fully visible and not concealed within equipment or connectors.
6. Loudspeaker Polarity - Connect loudspeakers electrically in phase, using same wire color for loudspeaker wiring throughout project.
7. Physical Damage Prevention - Take necessary precautions to prevent physical damage to cables and equipment. Damaged cables or equipment will not be accepted. Separate, organize, and route cables to restrict channel crosstalk and feedback oscillation.
8. Racks - Looking into the rack from the rear, locate AC power, control, data and speaker wiring on the left; line level audio, control, video, and RF wiring on the right. Keep several inches of space between power cables and other signals.
9. Hum Prevention - Ensure that electromagnetic and electrostatic hum is at inaudible levels. For line level signals, float cable shields at the output of the source device. Do not cut or remove shield conductors; fold back unconnected shields over cable jacket and cover with clear heat-shrink tubing. Do not obstruct cable labels.
10. Other Connections - Make connections using rosin core solder or approved mechanical connectors. Where spade lugs are used, crimp properly with ratchet type crimping tool. Solder spade lugs mounted on #22 AWG or smaller cable after crimping.

3.2 STORAGE AND HANDLING

- A. Power up any electronic equipment to ensure its proper functioning before its arrival onsite.



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- B. Ensure that materials (especially electronic and electro-acoustic devices) are protected against physical, environmental, and electronic damage until final acceptance by Owner.
- C. Schedule delivery to minimize delays in the project.
- D. Provide storage protection against temperature and humidity extremes, theft, vandalism, physical damage, and environmental damage.

### 3.3 WARRANTY

- A. Refer to 1.7.
- B. Warranty - Submit letter providing warranty covering labor and materials supplied under this contract. Bind in Operation and Maintenance Manuals. Terms as described in General Conditions. Minimum terms as follows:
  - 1. System - Systems shall be free of manufacturing or installation defects for a minimum period of one (1) year from the date of final acceptance. Clearly designate begin and end dates of system warranty period.
  - 2. Parts and Labor - Provide parts and labor to repair defects in materials and workmanship during system warranty period.
  - 3. Response Time - Within system warranty period, provide initial on-site service response within one (1) business day of service call. Provide resolution to any system defects within 72 hours or within 48 hours of receipt of repaired or replaced product from manufacturer.
  - 4. Replacement Products - If any item must be removed for repair during system warranty period, provide replacement item of similar quality at no charge.
  - 5. Repair Limit - Do not repair any piece of equipment found defective during installation or system warranty period more than two (2) times. After second repair, replace defective item with similar approved item at no additional cost to Owner.
  - 6. Extended Manufacturer's Warranties – Identify products with manufacturer's warranties extending beyond one (1) year. Provide terms and conditions of such warranties.
  - 7. Service Personnel Information - Provide name(s) and telephone number(s) of service personnel to be contacted regarding repair and maintenance.
- C. Extended Warranty - Provide cost to extend complete intercom system warranty from one (1) year to three (3) years. Included a list of all provided services including maintenance schedules.

### 3.4 GROUNDING

- A. Ground cable shields and equipment to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments.
- B. Signal Ground Terminal: Locate at main equipment cabinet. Isolate from power system and equipment grounding.
- C. Install grounding electrodes as specified in Division 16 Section "Grounding."

3.5 INITIAL TESTS

- A. Purpose – These tests are to ensure that the AV system is installed and functioning as specified, and to ensure the system is ready for Final Tests and Adjustments (described later).
- B. Testing Standards – Perform testing in accordance with ANSI standards.
- C. Inspection - Verify prior to beginning actual tests and adjustments on systems:
  - 1. Proper grounding of all electronic components (through third prong of power connector or separate connection between component chassis and ground bus bar).
  - 2. Cables dressed, routed, and labeled, connected with proper polarity.
  - 3. Insulation and shrink tubing in place.
  - 4. Dust, debris, solder splatter, etc. removed.
  - 5. Proper frequency settings (or modules) at crossovers and controllers.
  - 6. All equalizer bands and tone controls set for flat frequency response.
  - 7. Survey temperatures of each piece of equipment after four (4) hours use (minimum). Note and report any hot equipment.
- D. Electrical Power Quality - While all sound and intercom system components are unplugged from electrical power outlets, intercom Contractor shall turn on power to outlets, and confirm proper voltages at each outlet across the following pairs of terminals: hot and neutral, hot and ground, and neutral and ground (zero volts across neutral and ground). intercom Contractor to document measurements.
- E. General Function Tests - Test each piece of equipment to ensure that it performs its intended function. Include all portable equipment in tests. Intent of initial tests is to verify complete, functioning system before Final Tests and Adjustments. Correct problems found during initial testing before beginning Final Tests and Adjustments. Document whether all pieces performed intended functions; note any unresolved malfunctions.
- F. Initial Tests and Adjustments Data - Submit written report of Initial Tests and Adjustments data upon completion to Owner. Include printed name(s) of technician(s) performing tests, date(s) and time(s) of tests, model and serial numbers of test equipment, results of each initial test, descriptions of problems encountered and their solutions, and statement that system is ready for Final Tests and Adjustments. Initial Tests and Adjustments Data to include signatures of technician(s) performing tests.
- G. Acoustic Coverage Test: Feed pink noise into system using octaves centered at 500 and 4000 Hz. Use a sound-level meter with octave-band filters to measure level at five locations in each paging zone. Maximum permissible variation in level is plus or minus 3 dB, and in levels between adjacent zones are plus or minus 5 dB.
- H. Power Output Test: Measure electrical power output of each paging amplifier at normal gain setting at 150, 1000, and 2500 Hz. Maximum variation in power output at these frequencies is plus or minus 3 dB.
- I. Retesting: Correct deficiencies and retest. Prepare written record of tests.

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- J. Inspection: Verify that units and controls are properly labeled and interconnecting wires and terminals are identified. Prepare a list of final tap settings of paging and independent room speaker-line matching transformers.

### 3.6 FINAL TESTS AND ADJUSTMENTS

- A. Purpose – These tests are to be witnessed by intercom Consultant to determine if system is complete and functioning as designed and specified. Also, intercom Consultant will perform listening and viewing tests and witness adjustments of all images for optimum clarity.
- B. Timetable - Coordinate with Owner, General Contractor, and intercom Consultant to schedule Final Tests and Adjustments after submittal of Initial Tests and Adjustments data.
- C. System and Site Conditions – intercom Consultant will witness Final Tests and Adjustments. Have systems fully functional and ready for observation and testing upon AV Consultant’s arrival. Coordinate with all trades for quiet conditions throughout the listening areas and for the duration of the test schedule. If upon intercom Consultant’s arrival, systems do not meet criteria, site is not sufficiently quiet, or if Owner or intercom Consultant is required to make additional trips to job site to witness additional testing or perform additional reviews of installed equipment, Contractor shall reimburse Owner for labor and expenses incurred by having incurred costs deducted from payments to contractor.
- D. Test Labor - Provide technician familiar with this project’s intercom systems and operation of test equipment to perform testing. Provide additional technician to assist in the tests and to perform troubleshooting, repairs, and adjustments. Include labor for these technicians to be present for one (1), eight (8)-hour day during Final Tests and Adjustments.
- E. Tools - Provide standard hand tools including screwdrivers, pliers, wire strippers, nut drivers, soldering iron, and other tools appropriate for troubleshooting system problems.
- F. Ladders and Scaffolds - Provide ladders and scaffolds to inspect/adjust loudspeakers and rigging points.
- G. Verification of Initial Tests and Adjustments - Verify that Initial Tests and Adjustments have been performed and meet criteria. During Final Tests and Adjustments, intercom Consultant may require portions of the Initial Tests and Adjustments to be repeated. Repeat measurements as requested without claim for additional payment.

### 3.7 FINAL ACCEPTANCE BY OWNER

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installations, including connections. Report results in writing.
- B. Programming: Fully brief Owner on available programming options. Record Owners decisions and set up initial system program. Prepare a written record of decisions, implementation methodology, and final results.

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- C. Certificate – Submit Certificate of Final Acceptance form signed by Owner verifying complete installation and proper operation of systems upon fulfillment of all requirements and upon recommendation by Owner.
- D. General Adjustments – Adjust, balance, and align equipment for optimum quality, meeting manufacturers published specifications.
- E. Input/Output Jack Demonstration – Demonstrate proper performance and phase of each system input and output jack (all audio input and output jacks) as received at intercom and network systems.
- F. Inventory – Inventory all installed and portable equipment for correct quantities.
- G. Functional Demonstration – Demonstrate operation of each function of each major piece of equipment.
- H. Other Tests - Perform any other tests on any part of the intercom system as requested by Owner.
- I. Final Equipment Settings – Record final settings of all equalizer bands, tone controls, filters, delays, limiters, etc., including those established through computer software settings. Include descriptions of settings (including software settings) in Operation and Maintenance Manual. Include software copy of configuration file(s) in Operation and Maintenance Manual.
- J. Security Inspection – Inspect equipment for security from tampering (covers, shaft-locks, etc.).
- K. Review of Labels – Review installed labels on cables, equipment, controls, and terminal strips.

### 3.8 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain equipment as specified below:
  - 1. Train Owners maintenance personnel on programming equipment for starting up and shutting down, troubleshooting, servicing, and maintaining equipment.
  - 2. Review data in maintenance manuals. Refer to Division 1 Section "Contract Closeout."
  - 3. Review data in maintenance manuals. Refer to Division 1 Section "Operation and Maintenance Data."
  - 4. Schedule training with Owner, through Architect, with at least seven days' advance notice.
- B. Provide Owner training as described in General Conditions. As a minimum, provide four(4) hours instruction (within two (2) trips to site) regarding intercom Systems operation to Owner-designated personnel. Schedule instruction time(s) with Owner to occur after completion of Final Tests and Adjustments. Coordinate with Owner in advance to schedule instruction time. Document date, time, and attendees of the training session and include documentation in Operation and Maintenance Manuals to serve as record of trained personnel.

### 3.9 SUPPORT DURING OWNER'S FIRST USE OF COMPLETED SYSTEM

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- A. Provide personnel familiar with design, installation, and operation of each system to be present at Owner's first use of each completed system (up to four (4) hours total in a single session). During first use of each system, respond to Owner requests for troubleshooting, adjustments, and additional training. If no one contractor employee or representative can provide expertise in all aspects of the system, provide multiple personnel for the four (4) hours per session as required. Schedule presence of personnel in advance with Owner. Should significant elements of the new system be operational prior to final completion, Owner may elect to schedule contractor presence for Owner function prior to final completion of system. Should Owner exercise this option, contractor presence will not be required at first use following final completion.

END OF SECTION 267230

## SECTION 267240 – INTRUSION AND ACCESS CONTROL

### 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 a Unify system for access control, intrusion detection, CCTV and Video intercom.

#### 1.3 DEFINITION

- A. CCTV: Closed-circuit television.
- B. CPU: Central processing unit.
- C. Credential: Data assigned to an entity and used to identify that entity.
- D. dpi: Dots per inch.
- E. DTS: Digital Termination Service. A microwave-based, line-of-sight communication provided directly to the end user.
- F. GFI: Ground fault interrupter.
- G. Identifier: A credential card; keypad personal identification number; or code, biometric characteristic, or other unique identification entered as data into the entry-control database for the purpose of identifying an individual. Where this term is presented with an initial capital letter, this definition applies.
- H. I/O: Input/Output.
- I. LAN: Local area network.
- J. Location: A Location on the network having a PC-to-controller communications link, with additional controllers at the Location connected to the PC-to-controller link with a TIA 485-A communications loop. Where this term is presented with an initial capital letter, this definition applies.
- K. PC: Personal computer. Applies to the central station, workstations, and file servers.
- L. PCI Bus: Peripheral Component Interconnect. A peripheral bus providing a high-speed data path between the CPU and the peripheral devices such as a monitor, disk drive, or network.

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- M. PDF: Portable Document Format. The file format used by the Acrobat document-exchange-system software from Adobe.
- N. RAS: Remote access services.
- O. RF: Radio frequency.
- P. ROM: Read-only memory. ROM data are maintained through losses of power.
- Q. TCP/IP: Transport control protocol/Internet protocol incorporated into Microsoft Windows.
- R. TWAIN: Technology without an Interesting Name. A programming interface that lets a graphics application, such as an image editing program or desktop publishing program, activate a scanner, frame grabber, or other image-capturing device.
- S. UPS: Uninterruptible power supply.
- T. USB: Universal serial bus.
- U. WAN: Wide area network.
- V. WAV: The digital audio format used in Microsoft Windows.
- W. WMP: Windows media player.
- X. Wiegand: Patented magnetic principle that uses specially treated wires embedded in the credential card.
- Y. Windows: Operating system by Microsoft Corporation.
- Z. Workstation: A PC with software that is configured for specific, limited security-system functions.
- AA. WYSIWYG: What You See Is What You Get. Text and graphics appear on the screen the same as they will in print.

### 1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Reference each product to a location on Drawings. Test and evaluation data presented in Product Data shall comply with SIA BIO-01.
- A. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
  - 1. Diagrams for cable management system.
  - 2. System labeling schedules, including electronic copy of labeling schedules that are part of the cable and asset identification system of the software specified in Parts 2 and 3.
  - 3. Wiring Diagrams. For power, signal, and control wiring. Show typical wiring schematics including the following:

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- a. Workstation outlets, jacks, and jack assemblies.
  - b. Patch cords.
  - c. Patch panels.
4. Cable Administration Drawings: As specified in "Identification" Article.
  5. Battery and charger calculations for central station, workstations, and controllers.
- B. Samples: For workstation outlets, jacks, jack assemblies, and faceplates. For each exposed product and for each color and texture specified.
- C. Other Action Submittals:
1. Project planning documents as specified in Part 3.
- D. Field quality-control reports.

### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For security system to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
1. Microsoft Windows software documentation.
  2. PC installation and operating documentation, manuals, and software for the PC and all installed peripherals. Software shall include system restore, emergency boot diskettes, and drivers for all installed hardware. Provide separately for each PC.
  3. Hard copies of manufacturer's specification sheets, operating specifications, design guides, user's guides for software and hardware, and PDF files on CD-ROM of the hard-copy submittal.
  4. System installation and setup guides with data forms to plan and record options and setup decisions.

### 1.6 PROJECT CONDITIONS

- A. Environmental Conditions: System shall be capable of withstanding the following environmental conditions without mechanical or electrical damage or degradation of operating capability:
- B. Control Station: Rated for continuous operation in ambient conditions of 60 to 85 deg F and a relative humidity of 20 to 80 percent, noncondensing.
- C. Indoor, Controlled Environment: NEMA 250, Type 1 enclosure. System components, except the central-station control unit, installed in air-conditioned temperature-controlled indoor environments shall be rated for continuous operation in ambient conditions of 36 to 122 deg F dry bulb and 20 to 90 percent relative humidity, noncondensing.



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### 1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers trained and approved by manufacturer Gentec, Bosch and Axis.
- B. Installation company must have on staff a (RCDD) registered communication distribution designer certified by Building Industry Consulting Service International, and Genetec certified installer and programmer.
- C. Comply with NFPA 70, "National Electrical Code."
- D. Comply with SIA DC-01 and SIA DC-03 and SIA DC-07.

### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Central Station, Workstations, and Controllers:
  - 1. Store in temperature- and humidity-controlled environment in original manufacturer's sealed containers. Maintain ambient temperature between 50 and 85 deg F, and not more than 80 percent relative humidity, noncondensing.
  - 1. Open each container; verify contents against packing list; and file copy of packing list, complete with container identification, for inclusion in operation and maintenance data.
  - 2. Mark packing list with the same designations assigned to materials and equipment for recording in the system labeling schedules that are generated by software specified in "Cable and Asset Management Software" Article.
  - 3. Save original manufacturer's containers and packing materials and deliver as directed under provisions covering extra materials.

### 1.9 WARRANTY

- A. Provide for a period of two (2) years commencing from the date of final system acceptance, including annual inspections of the system.
- B. During the warranty period report to the site and repair or replace any defective materials or workmanship without cost to the Owner. Warranty service shall be rendered within 24 hours after request by Owner. Equivalent replacement equipment shall be temporarily provided when immediate on-site repairs cannot be made.

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### 1.10 OCCUPANCY ADJUSTMENTS

- A. On-Site Assistance: Engage a factory-authorized service representative to provide on-site assistance in adjusting sound levels, resetting transformer taps, and adjusting controls to meet occupancy conditions. Provide up to three on-site assistance visits within one year of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Genetec, no substitutions
  - 2. Bosch, no substitutions
  - 3. Axis, no substitutions
  - 4. 2N, no substitutions

### 2.2 DESCRIPTION

- A. Intrusion and Access System: Server-based central station and field-installed controllers, connected by a high-speed electronic-data transmission network.
- B. System Software: Based on Genetec Security Center central-station, workstation operating system, server operating system, and application software. Software shall have the following capabilities:
  - 1. Multiuser and multitasking to allow for independent activities and monitoring to occur simultaneously at different workstations.
  - 2. Graphical user interface to show pull-down menus and a menu-tree format that complies with interface guidelines of Microsoft Windows.
  - 3. System license for the entire system including capability for future additions that are within the indicated system size limits specified in this Section.
  - 4. Open-architecture system that allows importing and exporting of data and interfacing with other systems that are compatible with Microsoft Windows.
  - 5. Password-protected operator login and access.
  - 6. Open-database-connectivity compliant.
  - 7. Integration with VMS and Intercom door stations
  - 8. Integration with Bosch Intrusion System
- C. Network connecting the central station and workstations shall be connected using Microsoft Windows-based TCP/IP with a capacity of connecting up to 99 workstations. System shall be portable across multiple communication platforms without changing system software.
- D. Network(s) connecting PCs and controllers shall consist of one or more of the following:

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1. Local area, IEEE 802.3 Fast Ethernet 100 BASE TX with a star topology network based on TCP/IP.
2. Direct-connected, RS-232 cable from the COM port of the central station to the first controller, then RS-485 cable to interconnect the remaining controllers at that Location.
3. Dial-up and cable modem connection using a standard cable or dial-up telephone line.

### PART 3 - OPERATION

- 3.1 Security and Access Control system shall use a single database for access-control, intrusion and credential-creation functions.
- 3.2 Distributed Processing: A fully distributed processing system.
  - A. Access-control information, including time, date, valid codes, access levels, and similar data, shall be downloaded to controllers so each controller can make access-control decisions.
  - B. Intermediate controllers for access control are prohibited.
  - C. In the event that communications with the central controller are lost, controllers shall automatically buffer event transactions until communications are restored, at which time buffered events shall be uploaded to the central station.
- 3.3 Number of Locations:
  - A. Support at least 50 separate Locations using a single PC/server with combinations of direct-connect or TCP/IP LAN connections to each Location.
  - B. Each Location shall have its own database and history in the central station.
  - C. Locations may be combined to share a common database.
- 3.4 Data Capacity:
  - A. Different card-reader formats.
  - B. Graphic file types for importing maps.
- 3.5 Location Capacity:
  - A. 128 reader-controlled doors.
  - B. 50,000 total-access credentials.
  - C. 2048 supervised alarm inputs.
  - D. 2048 programmable outputs.
  - E. 32,000 custom action messages per Location to instruct operator on action required when alarm is received.
  - F. System Network Requirements:

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1. System components shall be interconnected and shall provide automatic communication of status changes, commands, field-initiated interrupts, and other communications required for proper system operation.
  2. Communication shall not require operator initiation or response and shall return to normal after partial- or total-network interruption such as power loss or transient upset.
  3. System shall automatically annunciate communication failures to the operator and shall identify the communications link that has experienced a partial or total failure.
  4. Communications controller may be used as an interface between the central-station display systems and the field device network. Communications controller shall provide functions required to attain the specified network communications performance.
- 3.6 Central station shall provide operator interface, interaction, display, control, and dynamic and real-time monitoring. Central station shall control system networks to interconnect all system components, including workstations and field-installed controllers.
- 3.7 Field equipment shall include controllers, sensors, and controls.
- 3.8 Controllers shall serve as an interface between the central station and sensors and controls.
- 3.9 Data exchange between the central station and the controllers shall include down-line transmission of commands, software, and databases to controllers.
- 3.10 The up-line data exchange from the controller to the central station shall include status data such as intrusion alarms, status reports, and entry-control records.
- 3.11 Controllers are classified as alarm-annunciation or entry-control type.
- 3.12 System Response to Alarms:
1. Field device network shall provide a system end-to-end response time of 4 second(s) or less for every device connected to the system.
  2. Alarms shall be annunciated at the central station within one second of the alarm occurring at a controller or at a device controlled by a local controller, and within 100 ms if the alarm occurs at the central station.
  3. Alarm and status changes shall be displayed within 100 ms after receipt of data by the central station.
  4. All graphics shall be displayed, including graphics-generated map displays, on the console monitor within five seconds of alarm receipt at the security console.
  5. This response time shall be maintained during system heavy load.
  6. False-Alarm Reduction: The design of the central station and controllers shall contain features to reduce false alarms. Equipment and software shall comply with SIA CP-01.
- 3.13 Error Detection:
- A. Use a cyclic code method to detect single- and double-bit errors, burst errors of eight bits or fewer, and at least 99 percent of all other multibit and burst errors between controllers and the central station.
  - B. Interactive or product error-detection codes alone will not be acceptable.

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- C. A message shall be in error if one bit is received incorrectly.
  - D. Retransmit messages with detected errors.
  - E. Allow for an operator-assigned two-digit decimal number to each communications link representing the number of retransmission attempts.
  - F. Central station shall print a communication failure alarm message when the number of consecutive retransmission attempts equals the assigned quantity.
  - G. Monitor the frequency of data transmission failure for display and logging.
- 3.14 Data Line Supervision: System shall initiate an alarm in response to opening, closing, shorting, or grounding of data transmission lines.
- 3.15 Door Hardware Interface:
- A. Comply with requirements in Section 087100 "Door Hardware" and Section 087111 "Door Hardware (Descriptive Specification)" for door hardware required to be monitored or controlled by the security access system.
  - B. Electrical characteristics of controllers shall match the signal and power requirements of door hardware.

## PART 4 - APPLICATION SOFTWARE

- 4.1 System Software: Based on Genetec Security Center central-station and workstation operating system and application software.
- A. Multiuser multitasking shall allow independent activities and monitoring to occur simultaneously at different workstations.
  - B. Graphical user interface shall show pull-down menus and a menu-tree format.
  - C. Capability for future additions within the indicated system size limits.
  - D. Open architecture that allows importing and exporting of data and interfacing with other systems that are compatible with operating system.
  - E. Password-protected operator login and access.
- 4.2 Peer Computer Control Software: Detect a failure of a central computer and cause the other central computer to assume control of all system functions without interruption of operation. Both central computers shall have drivers to support this mode of operation.
- 4.3 Application Software: Interface between the alarm annunciation and entry-control controllers to monitor sensors, operate displays, report alarms, generate reports, and help train system operators.
- A. Reside at the central station, workstations, and controllers as required to perform specified functions.

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- B. Operate and manage peripheral devices.
- C. Manage files for disk I/O, including creating, deleting, and copying files; and automatically maintain a directory of all files, including size and location of each sequential and random-ordered record.
- D. Import custom icons into graphics to represent alarms and I/O devices.
- E. Globally link I/O so that any I/O can link to any other I/O within the same Location without requiring interaction with the host PC. This operation shall be at the controller.
- F. Globally code I/O links so that any access-granted event can link to any I/O with the same Location without requiring interaction with the host PC. This operation shall be at the controller.
- G. Messages from PC to controllers and controllers to controllers shall be on a polled network that utilizes check summing and acknowledgment of each message. Communication shall be automatically verified, buffered, and retransmitted if message is not acknowledged.
- H. Selectable poll frequency and message time-out settings shall handle bandwidth and latency issues for TCP/IP, RF, and other PC-to-controller communications methods by changing the polling frequency and the amount of time the system waits for a response.
- I. Automatic and encrypted backups for database and history backups shall be automatically stored at the Genetec Security Center Server and encrypted with a nine-character alphanumeric password that must be used to restore or read data contained in backup.
- J. Operator audit trail for recording and reporting all changes made to database and system software.
- K. Support network protocol and topology, TCP/IP, Novel Netware, Digital Pathworks, Banyan Vines, LAN/WAN, and RAS.

### 4.4 Workstation Software:

- A. Password levels shall be individually customized at each workstation to allow or disallow operator access to program functions for each Location.
- B. Workstation event filtering shall allow user to define events and alarms that will be displayed at each workstation. If an alarm is unacknowledged (not handled by another workstation) for a preset amount of time, the alarm will automatically appear on the filtered workstation.

### 4.5 Controller Software:

- A. Controllers shall operate as autonomous, intelligent processing units.
  - 1. Controllers shall make decisions about access control, alarm monitoring, linking functions, and door-locking schedules for their operation, independent of other system components.

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2. Controllers shall be part of a fully distributed processing-control network.
  3. The portion of the database associated with a controller, and consisting of parameters, constraints, and the latest value or status of points connected to that controller, shall be maintained in the controller.
- B. The following functions shall be fully implemented and operational within each controller:
1. Monitoring inputs.
  2. Controlling outputs.
  3. Automatically reporting alarms to the central station.
  4. Reporting of sensor and output status to the central station on request.
  5. Maintaining real time, automatically updated by the central station at least once a day.
  6. Communicating with the central station.
  7. Executing controller resident programs.
  8. Diagnosing.
  9. Downloading and uploading data to and from the central station.
- C. Controller Operations at a Location:
1. Up to 10 controllers connected to TIA 485-A communications loop. Globally operating I/O linking and anti-passback functions between controllers within the same Location without central-station or workstation intervention. Linking and anti-passback shall remain fully functional within the same Location even when the central station or workstations are off-line.
  2. In the event of communication failure between the central station and a Location, there shall be no degradation in operations at the controllers at that Location. Controllers at each Location shall be connected to a memory buffer with a capacity to store up to 10,000 events; there shall be no loss of transactions in system history files until the buffer overflows.
  3. Buffered events shall be handled in a first-in-first-out mode of operation.
- D. Individual Controller Operation:
1. Controllers shall transmit alarms, status changes, and other data to the central station when communications circuits are operable. If communications are not available, controllers shall function in a stand-alone mode; operational data, including the status and alarm data normally transmitted to the central station, shall be stored for later transmission to the central station. Storage capacity for the latest 1024 events shall be provided at each controller.
  2. Card-reader ports of a controller shall be custom configurable for at least [120] different card-reader or keypad formats. Multiple reader or keypad formats may be used simultaneously at different controllers or within the same controller.
  3. Controllers shall provide a response to card readers or keypad entries in less than 0.25 seconds, regardless of system size.
  4. Controllers that are reset, or powered up from a nonpowered state, shall automatically request a parameter download and reboot to their proper working state. This shall happen without any operator intervention.
  5. Initial Startup: When controllers are brought on-line, database parameters shall be automatically downloaded to them. After initial download is completed, only database changes shall be downloaded to each controller.

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6. On failure for any reason, controllers shall perform an orderly shutdown and force controller outputs to a predetermined failure-mode state, consistent with the failure modes shown and the associated control device.
7. After power is restored, following a power failure, startup software shall initiate self-test diagnostic routines, after which controllers shall resume normal operation.
8. After controller failure, if the database and application software are no longer resident, controllers shall not restart but shall remain in the failure mode until repaired. If database and application programs are resident, controllers shall immediately resume operation. If not, software shall be restored automatically from the central station.

### 4.6 Communications Monitoring:

- A. System shall monitor and report status of TIA 485-A communications loop of each Location.
- B. Communication status window shall display which controllers are currently communicating, a total count of missed polls since midnight, and which controller last missed a poll.
- C. Communication status window shall show the type of CPU, the type of I/O board, and the amount of RAM for each controller.

### 4.7 Operating systems shall include a real-time clock function that maintains seconds, minutes, hours, day, date, and month. The real-time clock shall be automatically synchronized with the central station at least once a day to plus or minus 10 seconds. The time synchronization shall be automatic, without operator action and without requiring system shutdown.

### 4.8 PC-to-Controller Communications:

- A. Central-station or workstation communications shall use the following:
  1. Direct connection using serial ports of the Server.
  2. TCP/IP LAN interface cards.
- B. Each serial port used for communications shall be individually configurable for "direct communications." Serial ports shall have adjustable data transmission rates and shall be selectable under program control.
- C. Use multiport communications board if more than two serial ports are needed.
  1. Use a 4-, 8-, or 16-serial port configuration that is expandable to 32- or 64-serial ports.
  2. Connect the first board to an internal PCI bus adapter card.
  3. Direct serial, TCP/IP, and dial-up, cable, or satellite communications shall be alike in the monitoring or control of the system except for the connection that must first be made to a dial-up or voice-over IP Location.
  4. TCP/IP network interface card (NIV) shall have an option to set the poll-frequency and message-response time-out settings.
  5. PC-to-controller and controller-to-controller communications (direct, dial-up, or TCP/IP) shall use a polled-communication protocol that checks sum and acknowledges each message. All communications in this subparagraph shall be verified and buffered and retransmitted if not acknowledged.
- D. Direct Serial or TCP/IP PC-to-Controller Communications:



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1. Communication software on the PC shall supervise the PC-to-controller communications link.
2. Loss of communications to any controller shall result in an alarm at all PCs running the communication software.
3. When communications are restored, all buffered events shall automatically upload to the PC, and any database changes shall be automatically sent to the controller.

### E. Controller-to-Controller Communications:

1. TIA 485-A, four-wire, point-to-point, regenerative (repeater) communications network methodology.
2. TIA 485-A communications signal shall be regenerated at each controller.

### 4.9 Database Downloads:

- A. All data transmissions from Server to a Location, and between controllers at a Location, shall include a complete database checksum to check the integrity of the transmission. If the data checksum does not match, a full data download shall be automatically retransmitted.
- B. If a controller is reset for any reason, it shall automatically request and receive a database download from the PC. The download shall restore data stored at the controller to their normal working state and shall take place with no operator intervention.
- C. Software shall provide for setting downloads via dial-up connection to once per 24-hour period, with time selected by the operator.
- D. Software shall provide recording for rise rooms in accordance to Senate Bill 507 .

### 4.10 Operator Interface:

- A. Inputs in system shall have two icon representations, one for the normal state and one for the abnormal state.
- B. When viewing and controlling inputs, displayed icons shall automatically change to the proper icon to display the current system state in real time. Icons shall also display the input's state, whether armed or bypassed, and if the input is in the armed or bypassed state due to a time zone or a manual command.
- C. Outputs in system shall have two icon representations, one for the secure (locked) state and one for the open (unlocked) state.
- D. Icons displaying status of the I/O points shall be constantly updated to show their current real-time condition without prompting by the operator.
- E. The operator shall be able to scroll the list of I/Os and press the appropriate toolbar button, or right click, to command the system to perform the desired function.
- F. Graphic maps or drawings containing inputs, outputs, and override groups shall include the following:

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1. Database to import and store full-color maps or drawings and allow for input, output, and override group icons to be placed on maps.
  2. Maps to provide real-time display animation and allow for control of points assigned to them.
  3. System to allow inputs, outputs, and override groups to be placed on different maps.
  4. Software to allow changing the order or priority in which maps will be displayed.
- G. Override Groups Containing I/Os:
1. System shall incorporate override groups that provide the operator with the status and control over user-defined "sets" of I/Os with a single icon.
  2. Icon shall change automatically to show the live summary status of points in that group.
  3. Override group icon shall provide a method to manually control or set to time-zone points in the group.
  4. Override group icon shall allow the expanding of the group to show icons representing the live status for each point in the group, individual control over each point, and the ability to compress the individual icons back into one summary icon.
- H. Schedule Overrides of I/Os and Override Groups:
1. To accommodate temporary schedule changes that do not fall within the holiday parameters, the operator shall have the ability to override schedules individually for each input, output, or override group.
  2. Each schedule shall be composed of a minimum of two dates with separate times for each date.
  3. The first time and date shall be assigned the override state that the point shall advance to when the time and date become current.
  4. The second time and date shall be assigned the state that the point shall return to when the time and date become current.
- I. Copy command in database shall allow for like data to be copied and then edited for specific requirements, to reduce redundant data entry.
- J. Operator Access Control:
1. Control operator access to system controls through password-protected operator levels. System operators and managers with appropriate password clearances shall be able to change operator levels for operators.
  2. Three successive attempts by an operator to execute functions beyond their defined level during a 24-hour period shall initiate a software tamper alarm.
  3. A minimum of passwords shall be available with the system software. System shall display the operator's name or initials in the console's first field. System shall print the operator's name or initials, action, date, and time on the system printer at login and logoff.
  4. The password shall not be displayed or printed.
  5. Each password shall be definable and assignable for the following:
    - a. Selected commands to be usable.
    - b. Access to system software.
    - c. Access to application software.
    - d. Individual zones that are to be accessed.
    - e. Access to database.

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### 4.11 Operator Commands:

- A. Command Input: Plain-language words and acronyms shall allow operators to use the system without extensive training or data-processing backgrounds. System prompts shall be an image, word, a phrase, or an acronym.
- B. Command inputs shall be acknowledged, and processing shall start in not less than two second(s).
- C. Tasks that are executed by operator's commands shall include the following:
  - 1. Acknowledge Alarms: Used to acknowledge that the operator has observed the alarm message.
  - 2. Place Zone in Access: Used to remotely disable intrusion-alarm circuits emanating from a specific zone. System shall be structured so that console operator cannot disable tamper circuits.
  - 3. Place Zone in Secure: Used to remotely activate intrusion-alarm circuits emanating from a specific zone.
  - 4. System Test: Allows the operator to initiate a system-wide operational test.
  - 5. Zone Test: Allows the operator to initiate an operational test for a specific zone.
  - 6. Print reports.
  - 7. Change Operator: Used for changing operators.
  - 8. Display Graphics: Used to show any graphic displays implemented in the system. Graphic displays shall be completed within 20 seconds from time of operator command.
  - 9. Run system tests.
  - 10. Generate and format reports.
  - 11. Request help with the system operation.
- D. Include in main menus.
- E. Provide unique, descriptive, context-sensitive help for selections and functions with the press of one function key.
- F. Provide navigation to specific topic from within the first help window.
- G. Help shall be accessible outside the application program.

### 4.12 Entry-Control Commands:

- 1. Revise number of times entry control in first four subparagraphs below can be changed to suit Project. Coordinate with options in "Time Zones" and "Access Levels" paragraphs in "System Database" Article.
- 2. Lock (secure) or unlock (open) each controlled entry and exit up to four times a day through time-zone programming.
- 3. Arm or disarm each monitored input up to four times a day through time-zone programming.
- 4. Enable or disable readers or keypads up to two times a day through time-zone programming.
- 5. Enable or disable cards or codes up to four times a day per entry point through access-level programming.

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- 4.13 Command Input Errors: Show operator input assistance when a command cannot be executed because of operator input errors. Assistance screen shall use plain-language words and phrases to explain why the command cannot be executed. Error responses that require an operator to look up a code in a manual or other document are not acceptable. Conditions causing operator assistance messages include the following:
- A. Command entered is incorrect or incomplete.
  - B. Operator is restricted from using that command.
  - C. Command addresses a point that is disabled or out of service.
  - D. Command addresses a point that does not exist.
  - E. Command is outside the system's capacity.
- 4.14 Alarms:
- A. System Setup:
    - 1. Assign manual and automatic responses to incoming-point status change or alarms.
    - 2. Automatically respond to input with a link to other inputs, outputs, or operator-response plans; unique sound with use of WAV files; and maps or images that graphically represent the point location.
    - 3. Sixty-character message field for each alarm.
    - 4. Operator-response-action messages shall allow message length of at least 65,000 characters, with database storage capacity of up to 32,000 messages. Setup shall assign messages to access point and/or burglary zone depending the device triggering it.
    - 5. Secondary messages shall be assignable by the operator for printing to provide further information and shall be editable by the operator.
    - 6. Allow 25 secondary messages with a field of four lines of 60 characters each.
    - 7. Store the most recent 1000 alarms for recall by the operator using the report generator.
  - B. Software Tamper:
    - 1. Annunciate a tamper alarm when unauthorized changes to system database files are attempted. Three consecutive unsuccessful attempts to log onto system shall generate a software tamper alarm.
    - 2. Annunciate a software tamper alarm when an operator or other individual makes three consecutive unsuccessful attempts to invoke functions beyond the authorization level.
    - 3. Maintain a transcript file of the last 5000 commands entered at each central station to serve as an audit trail. System shall not allow write access to system transcript files by any person, regardless of their authorization level.
    - 4. Allow only acknowledgment of software tamper alarms.
      - a. Read access to system transcript files shall be reserved for operators with the highest password authorization level available in system.
      - b. Animated Response Graphics: Highlight alarms with flashing icons on graphic maps; display and constantly update the current status of alarm inputs and outputs in real time through animated icons.
      - c. Multimedia Alarm Annunciation: WAV files to be associated with alarm events for audio annunciation or instructions.

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- d. Alarm Handling: Each input may be configured so that an alarm cannot be cleared unless it has returned to normal, with options of requiring the operator to enter a comment about disposition of alarm. Allow operator to silence alarm sound when alarm is acknowledged.
  - e. Alarm Automation Interface: High-level interface to central-station alarm automation software systems. Allows input alarms to be passed to and handled by automation systems in the same manner as burglar alarms, using a TIA 232-F ASCII interface.
  - f. CCTV Alarm Interface: Allow commands to be sent to CCTV systems during alarms (or input change of state) through serial ports.
  - g. Camera Control: Provides operator ability to select and control cameras from graphic maps.
- C. Alarm Monitoring: Monitor sensors, controllers, and DTS circuits and notify operators of an alarm condition. Display higher-priority alarms first and, within alarm priorities, display the oldest unacknowledged alarm first. Operator acknowledgment of one alarm shall not be considered acknowledgment of other alarms nor shall it inhibit reporting of subsequent alarms.
- D. Displayed alarm data shall include type of alarm, location of alarm, and secondary alarm messages.
- E. Printed alarm data shall include type of alarm, location of alarm, date and time (to nearest second) of occurrence, and operator responses.
- F. Maps shall automatically display the alarm condition for each input assigned to that map if that option is selected for that input location.
- G. Alarms initiate a status of "pending" and require the following two handling steps by operators:
- 1. First Operator Step: "Acknowledged." This action shall silence sounds associated with the alarm. The alarm remains in the system "Acknowledged" but "Un-Resolved."
  - 2. Second Operator Step: Operators enter the resolution or operator comment, giving the disposition of the alarm event. The alarm shall then clear.
- H. Each workstation shall display the total pending alarms and total unresolved alarms.
- I. Each alarm point shall be programmable to disallow the resolution of alarms until the alarm point has returned to its normal state.
- J. Alarms shall transmit to the central station in real time except for allowing connection time for dial-up locations.
- K. Alarms shall be displayed and managed from a minimum of four different windows.
- 1. Input Status Window: Overlay status icon with a large red blinking icon. Selecting the icon will acknowledge the alarm.
  - 2. History Log Transaction Window: Display name, time, and date in red text. Selecting red text will acknowledge the alarm.
  - 3. Alarm Log Transaction Window: Display name, time, and date in red. Selecting red text will acknowledge the alarm.

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4. Graphic Map Display: Display a steady colored icon representing each alarm input location. Change icon to flashing red when the alarm occurs. Change icon from flashing red to steady red when the alarm is acknowledged.
  - L. Once an alarm is acknowledged, the operator shall be prompted to enter comments about the nature of the alarm and actions taken. Operator's comments may be manually entered or selected from a programmed predefined list, or a combination of both.
  - M. For locations where there are regular alarm occurrences, provide programmed comments. Selecting that comment shall clear the alarm.
  - N. The time and name of the operator who acknowledged and resolved the alarm shall be recorded in the database.
  - O. Identical alarms from the same alarm point shall be acknowledged at the same time the operator acknowledges the first alarm. Identical alarms shall be resolved when the first alarm is resolved.
  - P. Alarm functions shall have priority over downloading, retrieving, and updating database from workstations and controllers.
  - Q. When a reader-controlled output (relay) is opened, the corresponding alarm point shall be automatically bypassed.
  - R. Monitor Display: Display text and graphic maps that include zone status integrated into the display. Colors are used for the various components and current data. Colors shall be uniform throughout the system.
  - S. Color Code:
    1. FLASHING RED: Alerts operator that a zone has gone into an alarm or that primary power has failed.
    2. STEADY RED: Alerts operator that a zone is in alarm and alarm has been acknowledged.
    3. YELLOW: Advises operator that a zone is in access.
    4. GREEN: Indicates that a zone is secure and that power is on.
- 4.15 Graphics:
- A. Support 32,000 graphic display maps and allow import of maps from a minimum of 16 standard formats from another drawing or graphics program.
  - B. Allow I/O to be placed on graphic maps by the drag-and-drop method.
  - C. Operators shall be able to view the inputs, outputs, and the point's name by moving the mouse cursor over the point on the graphic map.
  - D. Inputs or outputs may be placed on multiple graphic maps. The operator shall be able to toggle to view graphic maps associated with I/Os.
  - E. Each graphic map shall have a display-order sequence number associated with it to provide a predetermined order when toggled to different views.

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- F. Camera icons shall have the ability to be placed on graphic maps that, when selected by an operator, will open a video window, display the camera associated with that icon, and provide pan-tilt-zoom control.
- G. Input, output, or camera placed on a map shall allow the ability to arm or bypass an input, open or secure an output, or control the pan-tilt-zoom function of the selected camera.
  - 1. System test software enables operators to initiate a test of the entire system or of a particular portion of the system.
- H. Test Report: The results of each test shall be stored for future display or printout. The report shall document the operational status of system components.
  - 1. Report-Generator Software: Include commands to generate reports for displaying, printing, and storing on disk and tape. Reports shall be stored by type, date, and time. Report printing shall be the lowest-priority activity. Report-generation mode shall be operator selectable but set up initially as periodic, automatic, or on request. Include time and date printed and the name of operator generating the report. Report formats may be configured by operators.
- I. Automatic Printing: Setup shall specify, modify, or inhibit the report to be generated; the time the initial report is to be generated; the time interval between reports; the end of the period; and the default printer.
- J. Printing on Request: An operator may request a printout of any report.
- K. Alarm Reports: Reporting shall be automatic as initially set up. Include alarms recorded by system over the selected time and information about the type of alarm [(such as **door alarm, intrusion alarm, tamper alarm, etc.**)], the type of sensor, the location, the time, and the action taken.
- L. Access and Secure Reports: Document zones placed in access, the time placed in access, and the time placed in secure mode.
- M. Custom Reports: Reports tailored to exact requirements of who, what, when, and where. As an option, custom report formats may be stored for future printing.
- N. Automatic History Reports: Named, saved, and scheduled for automatic generation.
- O. Cardholder Reports: Include data, or selected parts of the data, as well as the ability to be sorted by name, card number, imprinted number, or by any of the user-defined fields.
- P. Cardholder by Reader Reports: Based on who has access to a specific reader or group of readers by selecting the readers from a list.
- Q. Cardholder by Access-Level Reports: Display everyone that has been assigned to the specified access level.
- R. Who Is "In" (Muster) Report:
  - 1. Emergency Muster Report: One-click operation on toolbar launches report.

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2. Cardholder Report. Contain a count of persons who are "In" at a selected Location and a detailed listing of name, date, and time of last use, sorted by the last reader used or by the group assignment.
- S. Panel Labels Reports: Printout of control-panel field documentation including the actual location of equipment, programming parameters, and wiring identification. Maintain system installation data within system database so that data are available on-site at all times.
- T. Activity and Alarm On-Line Printing: Activity printers for use at workstations; prints all events, or alarms only.
- U. History Reports: Custom reports that allow the operator to select any date, time, event type, device, output, input, operator, Location, name, or cardholder to be included or excluded from the report.
  1. Initially store history on the hard disk of the host PC.
  2. Permit viewing of the history on workstations or print history to any system printer.
  3. The report shall be definable by a range of dates and times with the ability to have a daily start and stop time over a given date range.
  4. Each report shall depict the date, time, event type, event description, and device; or I/O name, cardholder group assignment, and cardholder name or code number.
  5. Each line of a printed report shall be numbered to ensure that the integrity of the report has not been compromised.
  6. Total number of lines of the report shall be given at the end of the report. If the report is run for a single event such as "Alarms," the total shall reflect how many alarms occurred during that period.
- V. Reports shall have the following four options:
  1. View on screen.
  2. Print to system printer. Include automatic print spooling and "Print To" options if more than one printer is connected to the system.
  3. "Save to File" with full path statement.
  4. System shall have the ability to produce a report indicating status of system inputs and outputs or of inputs and outputs that are abnormal, out of time zone, manually overridden, not reporting, or in alarm.
- W. Custom Code List Subroutine: Allow the access codes of system to be sorted and printed according to the following criteria:
  1. Active, inactive, or future activate or deactivate.
  2. Code number, name, or imprinted card number.
  3. Group, Location access levels.
  4. Start and stop code range.
  5. Codes that have not been used since a selectable number of days.
  6. In, out, or either status.
  7. Codes with trace designation.
- X. The reports of system database shall allow options so that every data field may be printed.



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- Y. The reports of system database shall be constructed so that the actual position of the printed data shall closely match the position of the data on the data-entry windows.
- Z. Anti-Passback:
  - 1. System shall have global and local anti-passback features, selectable by Location. System shall support hard and soft anti-passback.
  - 2. Hard Anti-Passback: Once a credential holder is granted access through a reader with one type of designation (IN or OUT), the credential holder may not pass through that type of reader designation until the credential holder passes through a reader of opposite designation.
  - 3. Soft Anti-Passback: Should a violation of the proper IN or OUT sequence occur, access shall be granted, but a unique alarm shall be transmitted to the control station, reporting the credential holder and the door involved in the violation. A separate report may be run on this event.
  - 4. Timed Anti-Passback: A controller capability that prevents an access code from being used twice at the same device (door) within a user-defined amount of time.
  - 5. Provide four separate zones per Location that can operate without requiring interaction with the host PC (done at controller). Each reader shall be assignable to one or all four anti-passback zones. In addition, each anti-passback reader can be further designated as "Hard," "Soft," or "Timed" in each of the four anti-passback zones. The four anti-passback zones shall operate independently.
  - 6. The anti-passback schemes shall be definable for each individual door.
  - 7. The Master Access Level shall override anti-passback.
  - 8. System shall have the ability to forgive (or reset) an individual credential holder or the entire credential-holder population anti-passback status to a neutral status.
- AA. Visitor Assignment:
- BB. Provide for and allow an operator to be restricted to only working with visitors. The visitor badging subsystem shall assign credentials and enroll visitors. Allow only those access levels that have been designated as approved for visitors.
- CC. Provide an automated log of visitor name, time and doors accessed, and name of person contacted.
- DD. Allow a visitor designation to be assigned to a credential holder.
- EE. Security access system shall be able to restrict the access levels that may be assigned to credentials issued to visitors.
- FF. Allow operator to recall visitors' credential-holder file once a visitor is enrolled in the system.
- GG. The operator may designate any reader as one that deactivates the credential after use at that reader. The history log shall show the return of the credential.
- HH. System shall have the ability to use the visitor designation in searches and reports. Reports shall be able to print all or any visitor activity.
- II. Time and Attendance:

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1. Time and attendance reporting shall be provided to match IN and OUT reads and display cumulative time in for each day and cumulative time in for length designated in the report.
  2. Shall be provided to match IN and OUT reads and display cumulative time in for each day and cumulative time in for length designated in the report.
  3. System software setup shall allow designation of selected access-control readers as time and attendance hardware to gather the clock-in and clock-out times of the users at these readers.
  4. Reports shall show in and out times for each day, total time in for each day, and a total time in for period specified by the user.
  5. Allow the operator to view and print the reports, or save the reports to a file.
  6. Alphabetically sort reports on the person's last name, by Location or location group. Include all credential holders or optionally select individual credential holders for the report.
- 4.16 Training Software: Enables operators to practice system operation, including alarm acknowledgment, alarm assessment, response force deployment, and response force communications. System shall continue normal operation during training exercises and shall terminate exercises when an alarm signal is received at the console.
- 4.17 Entry-Control Enrollment Software: Database management functions that allow operators to add, delete, and modify access data as needed.
- A. The enrollment station shall not have alarm response or acknowledgment functions.
  - B. Provide multiple, password-protected access levels. Database management and modification functions shall require a higher operator access level than personnel enrollment functions.
  - C. The program shall provide means to disable the enrollment station when it is unattended, to prevent unauthorized use.
  - D. The program shall provide a method to enter personnel identifying information into the entry-control database files through enrollment stations. In the case of personnel identity-verification subsystems, this shall include biometric data. Allow entry of personnel identifying information into the system database using menu selections and data fields. The data field names shall be customized during setup to suit user and site needs. Personnel identity-verification subsystems selected for use with the system shall fully support the enrollment function and shall be compatible with the entry-control database files.
  - E. Cardholder Data: Provide 99 user-defined fields. System shall have the ability to run searches and reports using any combination of these fields. Each user-defined field shall be configurable, using any combination of the following features:
    1. MASK: Determines a specific format with which data must comply.
    2. REQUIRED: Operator is required to enter data into field before saving.
    3. UNIQUE: Data entered must be unique.
    4. DEACTIVATE DATE: Data entered will be evaluated as an additional deactivate date for all cards assigned to this cardholder.
    5. NAME ID: Data entered will be considered a unique ID for the cardholder.

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- F. Personnel Search Engine: A report generator with capabilities such as search by last name, first name, group, or any predetermined user-defined data field; by codes not used in definable number of days; by skills; or by seven other methods.
- G. Multiple Deactivate Dates for Cards: User-defined fields to be configured as additional stop dates to deactivate any cards assigned to the cardholder.
- H. Batch card printing.
- I. Default card data can be programmed to speed data entry for sites where most card data are similar.
- J. Enhanced ASCII File Import Utility: Allows the importing of cardholder data and images.
- K. Card Expire Function: Allows readers to be configured to deactivate cards when a card is used at selected devices.

## PART 5 - SYSTEM DATABASE

- 5.1 Database and database management software shall define and modify each point in database using operator commands. Definition shall include parameters and constraints associated with each system device.
- 5.2 Database Operations:
  - A. System data management shall be in a hierarchical menu-tree format, with navigation through expandable menu branches and manipulated with use of menus and icons in a main menu and system toolbar.
  - B. Navigational Aids:
    - 1. Toolbar icons for add, delete, copy, print, capture image, activate, deactivate, and muster report.
    - 2. Point and click feature to facilitate data manipulation.
    - 3. Next and previous command buttons visible when editing database fields to facilitate navigation from one record to the next.
    - 4. Copy command and copy tool in the toolbar to copy data from one record to create a new similar record.
  - C. Data entry shall be automatically checked for duplicate and illegal data and shall be verified for valid format.
  - D. System shall generate a memo or note field for each item that is stored in database, allowing the storing of information about any defining characteristics of the item. Memo field is used for noting the purpose for which the item was entered, reasons for changes that were made, and the like.

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### 5.3 File Management:

- A. File management shall include database backup and restoration system, allowing selection of storage media, including 3.5-inch floppy disk, Zip and Jaz drives, and designated network resources.
- B. Operations shall be both manual and automatic modes. The number of automatic sequential backups before the oldest backup will be overwritten; FIFO mode shall be operator selectable.
- C. Backup program shall provide manual operation from any PC on the LAN and shall operate while system remains operational.

### 5.4 Operator Passwords:

- A. Support up to 50,000 individual system operators, each with a unique password on an alpha numeric format.
- B. Allow passwords to be case sensitive.
- C. Passwords shall not be displayed when entered.
- D. Passwords shall have unique and customizable password profile and allow several operators to share a password profile. Include the following features in the password profile:
  - 1. Predetermine the highest-level password profile for access to all functions and areas of program.
  - 2. Allow or disallow operator access to any program operation, including the functions of View, Add, Edit, and Delete.
  - 3. Restrict doors to which an operator can assign access.
- E. Operators shall use a user name and password to log on to system. This user name and password shall be used to access database areas and programs as determined by the associated profile.
- F. Make provision to allow the operator to log off without fully exiting program. User may be logged off but program will remain running while displaying the login window for the next operator.

### 5.5 Access Card/Code Operation and Management: Access authorization shall be by card, by a manually entered code (PIN), or by a combination of both (card plus PIN).

- A. Access authorization shall verify the facility code first, the card or card-and-PIN validation second, and the access level (time of day, day of week, date), anti-passback status, and number of uses last.
- B. Use data-entry windows to view, edit, and issue access levels. Access-authorization entry-management system shall maintain and coordinate all access levels to prevent duplication or the incorrect creation of levels.
- C. Allow assignment of multiple cards/codes to a cardholder.

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- D. Allow assignment of up to four access levels for each Location to a cardholder. Each access level may contain any combination of doors.
- E. Each door may be assigned four time zones.
- F. Access codes may be up to 11 digits in length.
- G. Software shall allow the grouping of locations so cardholder data can be shared by all locations in the group.
- H. Visitor Access: Issue a visitor badge for data tracking or photo ID purposes without assigning that person a card or code.
- I. Cardholder Tracing: Allow for selection of cardholder for tracing. Make a special audible and visible annunciation at control station when a selected card or code is used at a designated code reader. Annunciation shall include an automatic display of the cardholder image.
- J. Allow each cardholder to be given either an unlimited number of uses or a number from one to 9999 that regulates the number of times the card can be used before it is automatically deactivated.
- K. Provide for cards and codes to be activated and deactivated manually or automatically by date. Provide for multiple deactivate dates to be preprogrammed.

### 5.6 Security Access Integration:

- A. Photo ID badging and photo verification shall use the same database as the security access and may query data from cardholder, group, and other personal information to build a custom ID badge.
- B. Automatic or manual image recall and manual access based on photo verification shall also be a means of access verification and entry.
- C. System shall allow sorting of cardholders together by group or other characteristic for a fast and efficient method of reporting on, and enabling or disabling, cards or codes.

### 5.7 Key control and tracking shall be an integrated function of cardholder data.

- A. Provide the ability to store information about which conventional metal keys are issued and to whom, along with key construction information.
- B. Reports shall be designed to list everyone who possesses a specified key.

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- 5.8 Facility Codes: System shall accommodate up to 2048 facility codes per Location, with the option of allowing facility codes to work at all doors or only at particular doors.
- 5.9 Operator Comments:
- A. With the press of one appropriate button on the toolbar, the user shall be permitted to enter operator comments into the history at any time.
  - B. Automatic prompting of operator comment shall occur before the resolution of each alarm.
  - C. Operator comments shall be recorded by time, date, and operator number.
  - D. Comments shall be sorted and viewed through reports and history.
  - E. The operator may enter comments in two ways; either or both may be used:
    - 1. Manually entered through keyboard data entry (typed), up to 65,000 characters per each alarm.
    - 2. Predefined and stored in database for retrieval on request.
  - F. System shall have a minimum of 999 predefined operator comments with up to 30 characters per comment.
- 5.10 Group:
- A. Group names may be used to sort cardholders into groups that allow the operator to determine the tenant, vendor, contractor, department, division, or any other designation of a group to which the person belongs.
  - B. System software shall have the capacity to assign one of 32,000 group names to an access authorization.
  - C. Make provision in software to deactivate and reactivate all access authorizations assigned to a particular group.
  - D. Allow sorting of history reports and code list printouts by group name.
- 5.11 Time Zones:
- A. Each zone consists of a start and stop time for seven days of the week and three holiday schedules. A time zone is assigned to inputs, outputs, or access levels to determine when an input shall automatically arm or disarm, when an output automatically opens or secures, or when access authorization assigned to an access level will be denied or granted.
  - B. Up to four time zones may be assigned to inputs and outputs to allow up to four arm or disarm periods per day or four lock or unlock periods per day; up to three holiday override schedules may be assigned to a time zone.
  - C. Data-entry window shall display a dynamically linked bar graph showing active and inactive times for each day and holiday, as start and stop times are entered or edited.
  - D. System shall have the capacity for time zones for each Location.

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### 5.12 Holidays:

- A. Three different holiday schedules may be assigned to a time zone. Holiday schedule consists of date in format MM/DD/YYYY and a description. When the holiday date matches the current date of the time zone, the holiday schedule replaces the time-zone schedule for that 24-hour period.
- B. System shall have the capacity for 50,000 holidays.
- C. Three separate holiday schedules may be applied to a time zone.
- D. Holidays have an option to be designated as occurring on the designated date each year. These holidays remain in the system and will not be purged.
- E. Holidays not designated to occur each year shall be automatically purged from the database after the date expires.

### 5.13 Access Levels:

- A. System shall allow for the creation of up to 50,000 access levels.
- B. One level shall be predefined as the Master Access Level. The Master Access Level shall work at all doors at all times and override any anti-passback.
- C. System shall allow for access to be restricted to any area by reader and by time. Access levels shall determine when and where an Identifier is authorized.
- D. System shall be able to create multiple door and time-zone combinations under the same access level so that an Identifier may be valid during different time periods at different readers even if the readers are on the same controller.

### 5.14 User-Defined Fields:

- A. System shall provide a minimum of 99 user-defined fields, each with up to 50 characters, for specific information about each credential holder.
- B. System shall accommodate a title for each field; field length shall be 20 characters.
- C. A "Required" option may be applied to each user-defined field that, when selected, forces the operator to enter data in the user-defined field before the credential can be saved.
- D. A "Unique" option may be applied to each user-defined field that, when selected, will not allow duplicate data from different credential holders to be entered.
- E. Data format option may be assigned to each user-defined field that will require the data to be entered with certain character types in specific spots in the field entry window.
- F. A user-defined field, if selected, will define the field as a deactivate date. The selection shall automatically cause the data to be formatted with the windows MM/DD/YYYY date format. The credential of the holder will be deactivated on that date.

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- G. A search function shall allow any one user-defined field or combination of user-defined fields to be searched to find the appropriate cardholder. The search function shall include a search for a character string.
- H. System shall have the ability to print cardholders based on and organized by the user-defined fields.

### 5.15 Code Tracing:

- A. System shall perform code tracing selectable by cardholder and by reader.
- B. Any code may be designated as a "traced code" with no limit to how many codes can be traced.
- C. Any reader may be designated as a "trace reader" with no limit to which or how many readers can be used for code tracing.
- D. When a traced code is used at a trace reader, the access-granted message that usually appears on the monitor window of the central station shall be highlighted with a different color than regular messages. A short singular beep shall occur at the same time the highlighted message is displayed on the window.
- E. The traced cardholder image (if image exists) shall appear on workstations when used at a trace reader.

### 5.16 SURGE AND TAMPER PROTECTION

- A. Surge Protection: Protect components from voltage surges originating external to equipment housing and entering through power, communication, signal, control, or sensing leads. Include surge protection for external wiring of each conductor-entry connection to components.
- B. Minimum Protection for Power Connections 120 V and More: Auxiliary panel suppressors complying with requirements in Section 264313 "Surge Protection for Low-Voltage Electrical Power Circuits."
- C. Minimum Protection for Communication, Signal, Control, and Low-Voltage Power Connections: Comply with requirements in Section 264313 "Surge Protection for Low-Voltage Electrical Power Circuits" as recommended by manufacturer for type of line being protected.
- D. Tamper Protection: Tamper switches on enclosures, control units, pull boxes, junction boxes, cabinets, and other system components shall initiate a tamper-alarm signal when unit is opened or partially disassembled. Control-station control-unit alarm display shall identify tamper alarms and indicate locations.

## PART 6 - EQUIPMENT

### 6.1 CENTRAL STATION SERVER:

- 1. Standard unmodified Server of modular design. Intel® Xeon® E3-1270v6 3.80 Ghz.
- 2. Power Supply: Minimum capacity of **250W**.
- 3. Real-Time Clock:



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4. Accuracy: Plus or minus one minute per month.
5. Time-Keeping Format: 24-hour time format including seconds, minutes, hours, date, day, and month; resettable by software.
6. Clock shall function for one year without power.
7. Provide automatic time correction once every 24 hours by synchronizing clock with the Time Service Department of the U.S. Naval Observatory.
8. Serial Ports: Provide two TIA 232-F serial ports for general use, with additional ports as required. Data transmission rates shall be selectable under program control.
9. Parallel Port: An enhanced parallel port.
10. LAN Adapter Card: [10/100] Mbps PCI bus, internal network interface card.
11. MANUFACTURER PART # GENETEC STREAM VAULT 1000

### 6.2 NON-PROPRIETARY HARDWARE INTERFACE:

1. A fixed map display may be used as another status indicator, supplementing the monitor display of the central station.
2. Processor: Onboard Intel Atom E3825 1.33GHz dual-core CPU.
3. System memory: 2GB of DDR3 DRAM 16GB on-board SATA Flash (SSD) for OS, firmware and database
4. Communications: Two (2) 10/100/1000 Mbps Gigabit Ethernet ports Four RS-485 ports (embedded).
5. Electrical: 9-16VDC or PoE+ (IEEE 802.3at) on one (1) Ethernet port.
6. Mechanical: Appliance dimensions (L × W): 6.89 × 4.22 inches (17.5 × 10.7 cm)
7. Environment: Temperature: 32°F to 122°F (0°C to 50°C) operational Relative humidity: Operating 5% to 95%, non-condensing For indoor use only, or within a NEMA Type 4 enclosure CONTROLLERS
8. Warranty: 24 months.
9. Certifications: UL 294 and ULC S319, CE approval, RoHS compliant, FCC Class A, EN60839-11-1
10. Downstream device support: 32 HID VertX downstream modules over RS-485 (across four ports) 32 Mercury Security EP panels (up to 256 readers) 32 Axis A1001 network door controllers 128 ASSA ABLOY IP locks (PoE or WiFi) 64 ASSA ABLOY Aperio-enabled wireless locks 64 SALTO SALLIS wireless locks 256 Allegion Schlage AD-Series hardwired and wireless locks 256 SimonsVoss SmartIntego locks.
11. MANUFACTURER PART # GENETEC SYNERGIS CLOUD LINK

### 6.3 DOOR CONTROLLER

1. Dimensions: 5.8" W x 4.825" H x 1.275" D (147.32 mm x 122.55 mm x 32.38 mm).
2. Weight: 12.4 oz (.35 kg).
3. Enclosure Material: UL94 Polycarbonate.
4. Power Supply Requirements: 60 mA @ 9–18 VDC (with no readers connected). Recommended: Supervised linear power supply with battery backup, input surge protection, and AC fail and battery low contact outputs. When VertX™ is supplying power to readers, the requirements are 600 mA @ 9–18 VDC. The V100 can supply 500 mA to two readers. Separate supervised DC supplies with battery back-up recommended for door locking or relay-activated devices, or for HID MaxiProx® readers.
5. Operating Environment: Indoors, or customer-supplied NEMA-4 rated enclosure.
6. Operating Temperature: 32° to 122° F (0° to 50° C).
7. Operating Humidity: 5% to 95% relative, non-condensing.
8. Storage Temperature -67° to 185° F (-55° to 85° C).

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9. Communications Ports RS-485 — two-wire. Two SIA standard Wiegand/Clock-and-Data ports
10. Certifications UL® 294 and UL® 1076 Recognized Component for the US, CSA 205 for Canada, FCC Class A Verification, EMC for Canada, EU (CE Mark), Australia (C-Tick Mark), New Zealand, Japan, EN 50130-4 Access Control Systems Immunity for the EU (CE Mark)
11. Cable Distance RS-485 — 4000 feet (1220 m) to host using Belden 3105A, 22 AWG twisted pair, shielded 100Ω cable; Wiegand — 500 feet (150 m) to reader using ALPHA 1299C 22 AWG, 9-conductor, stranded, overall shield (fewer conductors needed if all control lines are not used); Input Circuits — 500 feet (150 m), 2-conductor, shielded, using ALPHA 1292C (22 AWG) or Alpha 2421C (18 AWG); Output Circuits — 500 feet (150 m), 2-conductor, using ALPHA 1172C (22 AWG) or Alpha 1897C (18 AWG); minimum wire gauge depends on cable length and current requirements.
12. MANUFACTURER PART # HID VERTX V100

### 6.4 CARD READER WITH KEYPAD

1. Read Range: iCLASS Card: 3.5 – 4.25” (9.0 - 11.0 cm) iCLASS Key/Tag: 1.0 – 1.5” (2.5 - 4.0 cm) HID Prox ISO Card: 2.5 – 3.5” (6.5 - 9.0 cm) HID Prox Clamshell Card: 3.5 – 4.0” (9.0 - 10.0 cm) HID Prox Keyfob/Tag: 1.25 – 1.75” (3.2 - 4.5 cm) Indala Proximity ISO Card: 1.5 – 2.0” (4.0 - 5.0 cm) Indala Proximity Clamshell Card: 1.75 – 2.25” (4.5 - 5.5 cm) Indala Proximity Keyfob/Tag: 1.0 – 1.25” (2.5 - 3.2 cm)
2. Mounting: Mounting plate attaches to U.S./EU/Asian back box, 52-60 mm screw hole spacing (vertical or horizontal). Keypad reader housing latches onto mounting plate, secured with a screw. An optional spacer can be used for surface mount installations. Mounting on metal can affect optimal read range and we recommend the use of our spacer to maximize read range.
3. Dimensions: 3.3” x 4.8” x .95” (8.4 cm x 12.2 cm x 2.4 cm) 3.3” x 4.8” x 1.05” (8.4 cm x 12.2 cm x 2.7 cm) 6.1” x 1.9” x 0.9” (15.6 cm x 4.8 cm x 2.3 cm).
4. Weight: 8.8 oz (249.5 g) 9.1 oz (258 g) 5.9 oz (166 g)
5. Power Supply: 5 to 16 VDC. Linear supply recommended.
6. Current: Requirements 55 mA AVG, 141 mA PEAK @ 12 VDC 85 mA AVG, 169 mA PEAK @ 12 VDC 55 mA AVG, 114 mA PEAK @ 12 VDC
7. Operating Temperature: -31° to 150° F (-35° to 65° C).
8. Operating Humidity: 5% to 95% relative humidity non-condensing.
9. Transmit Frequency: 125 kHz and 13.56 MHz.
10. Cable Distance: Wiegand/Clock-and-Data Interface 500 ft (150 m) 22 AWG.
11. Card Compatibility: 125 kHz Proximity • HID or Indala proximity cards, keyfobs, and tags • AWID Credentials • EM4102 Credentials 13.56 MHz contactless smart cards • ISO 15693 - read only; 2k bit (256 Byte), 16k bit (2k Byte) and 32k bit (4k Byte) iCLASS Credentials, serial number • ISO 14443A - read only; MIFARE and DESFire® (serial number) • ISO 14443B - read only; 2k bit (256 Byte), 2k bit (256 Byte), 16k bit (2k Byte) and 32k bit (4k Byte) iCLASS Credentials, serial number • FeliCa IDm, CEPAS CAN/CSN • US Government (PIV) \*\*\*\* Certifications UL294/cUL (US), FCC.
12. Certification: (US), IC (Canada), CE (EU), C-tick (Australia, New Zealand), SRRC (China), MIC (Korea), NCC (Taiwan), MIC (Japan), iDA (Singapore), RoHS.
13. Housing Material UL94 Polycarbonate.
14. Environmental IP55
15. MANUFACTURER PART # HID RPK40

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### 6.5 VIDEO INTERCOM

1. Signaling protocol: SIP 2.0 (RFC - 3261)
2. Buttons: Buttons Transparent buttons with white backlight and easily removable label  
Number of buttons 1.
3. Audio: Microphone 1 built-in microphone Speaker 2W Sound pressure at 1 kHz at 1 m distance 78 Db.
4. Audio: stream Codecs G.711, G.722, G.729, L16/16kHz
5. Camera: Resolution – JPEG 1280 x 960 px Resolution – video call 640 x 480 px Viewing angle 120° (H), 90° (V), 145° (D) Night vision.
6. Video stream: Codecs H.263+, H.263, H.264, MJPEG.
7. Interfaces: Power supply 12V ± 15%/ 2A DC, or PoE PoE PoE 802.3af (Class 0 - 12.95W) LAN Screw-in connector, 10/100BASE-TX with Auto-MDIX Passive output NC/NO contacts, max 30 V/1 A AC/DC Active switch output 10 to 14 V DC depending on Power supply (PoE: 14 V; adapter: source voltage), max 700 mA Supported protocols SIP2.0, DHCP opt. 66, ONVIF, SMTP, 802.1x, RTSP, RTP, TFTP, HTTP, HTTPS, Syslog
8. Mechanical properties: Operating temperature -40°C – 60°C Storage temperature -40°C – 70°C Operating relative humidity 10%-95% (non-condensing) Outdoor coverage level IP54, IK08.
9. Dimensions: Frame for surface installation 1 module 107x130x28mm Frame for flush installation 1 module 130x153x5mm Controllers: Intelligent peripheral control unit, complying with UL 294, that stores time, date, valid codes, access levels, and similar data downloaded from the central station or workstation for controlling its operation.
10. MANUFACTURER PART # 2N IP Force

### 6.6 ANSWERING DOOR STATION

1. Power supply: Type External power adapter 12 V DC 2A / PoE 802.3af Power consumption 10 W
2. User interface: Capacitive touch panel 16:9 Display size 7" Resolution 1024x600px 24bpp (16.7 million colors) Backlighting LED with standby mode Status indicator 1x RGB LED (missed calls, standby, etc.) Configuration local or remote via the web.
3. Operating system: Android 4.4.4
4. Audio: Microphone built-in Speaker 1x2W integrated Protocol SIP Codecs G.711, G.722.
5. Video: Codec H.264, MJPEG Supervision and control of the intercom, IP camera surveillance
6. Interfaces: LAN Ethernet 10/100BaseT, RJ-45 WiFi 802.11b/g/n, integrated antenna (optional) 2x Relay 2x GPIO Memory card microSD card (up to 16 GB)
7. Mechanical parameters: Wall mounted Dimensions (W x H x D) 235 x 165 x 40 mm Weight 850 g Operating temperature 0°C – 60°C Operating relative humidity 10% – 90% (non-condensing) Storage temperature from -20°C - 70°C.
8. MANUFACTURER PART # 2N INDOOR TOUCH

### 6.7 INTRUSION DETECTION

#### A. Panel: Bosh B9512G-C

1. Communications: Ethernet 10/100 full-duplex (N/A for “E” control panels).
2. Environmental considerations: Relative humidity 5% to 93% at +90°F (+32°C), non-condensing Temperature (operating) +32°F to +122°F (0°C to +49°C).

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3. Power requirements: Current draw (maximum) Idle 125 mA; alarm 155 mA Output (alarm) 1.3 A at 12 VDC Output (auxiliary, continuous power, and switched auxiliary combined) 800 mA at 12 VDC nominal Voltage (operating): 12 VDC nominal Voltage (AC) 16.5 - 18 VAC
4. Number of... Areas 4 Custom functions 4 Events 1024 Passcode users 50, plus 1 installer passcode.
5. Points: 48 (8 on-board, up to 40 off-board and virtual) Programmable outputs 43 (3 on-board, up to 40 off-board and virtual) RF points 40.
6. Manufacturer Part # B942W Keypad – White

### 6.8 ACOUSTIC-TYPE, GLASS-BREAK SENSORS:

- A. Detect unique, airborne acoustic energy spectrum caused by breaking glass.
  1. Sensor Element: Microprocessor-based, digital device to detect breakage of plate, laminate, tempered, and wired glass while rejecting common causes of false alarms. Detection pattern shall be at least a 20-foot range.
  2. Hookup Cable: Factory installed, not less than 72 inches.
  3. Activation Indicator: LED on sensor housing that lights when responding to vibrations, remaining on until manually reset at sensor controller or at central-station control unit.
  4. Controller: Integral with sensor housing or in a separate assembly, locally adjustable by control under housing cover
  5. Bosh # DS11011

### 6.9 DOOR AND WINDOW SWITCHES

- A. Description: Balanced-magnetic switch, complying with UL 634, installed on frame with integral overcurrent device to limit current to 80 percent of switch capacity. Bias magnet and minimum of two encapsulated reed switches shall resist compromise from introduction of foreign magnetic fields.
- B. Flush-Mounted Switches: Unobtrusive and flush with surface of door and window frame.
- C. Overhead Door Switch: Balanced-magnetic type, listed for outdoor locations, and having door-mounting magnet and floor-mounting switch unit.
- D. Bosh #: ISN-CSD70-B/W and ISN-CSM35 where needed.
- E. Bosh #: ISN-CMET-4418 (overhead doors contacts)

### 6.10 MICROWAVE-PIR DUAL-TECHNOLOGY MOTION SENSORS

- A. Description: Single unit combining a sensor that detects changes in microwave signals and a PIR sensor that detects changes in ambient level of infrared emissions caused by standard-intruder movement within detection pattern.
- B. Device Performance: An alarm is transmitted when either sensor detects a standard intruder within a period of three to eight seconds from when the other sensor detects a standard intruder.

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1. Minimum Detection Pattern: A room 20 by 30 feet.
2. PIR Sensor Sensitivity: Adjustable pattern coverage to detect a change in temperature of 2 deg F or less, and standard-intruder movement within sensor's detection patterns at any speed between 0.3 to 7.5 fps across 2 adjacent segments of detector's field of view.
3. Microwave Sensor Sensitivity: Adjustable, able to detect standard-intruder movement within sensor's detection pattern at any speed between 0.3 to 7.5 fps. Sensor sensitivity adjustments shall be accessible only when sensor housing is removed, and sensors shall comply with 47 CFR 15.
4. Activation Indicator: LED indicator shall not be visible during normal operation. Indicator shall light when sensor detects a standard intruder. Locate test enabling switch under sensor housing cover.

### C. Model #'s

1. Bosh # ISC-TDL1-WA148G.
2. Bosh #: Hallway motion detectors (long and narrow throw) Bosh ISC-PDL1-WA18G
2. Bosh #: Ceiling Mounted Part # DS9370 (white)

### D. REQUEST TO EXIT

1. Alarm Control # for Request to exit button. TS-60
2. Bosh #: for motion sensor to release exit doors DS150i/DS151i.

## 6.11 RISE ROOM

- A. Local Unit and recording. - Should connect up-to four AXIS F Sensor Units, with enable streaming of 1080p or HDTV 720p videos. It should also support quad view streaming and provide Wide Dynamic Range (WDR) – Forensic Capture, Support for Zipstream technology lowers bandwidth and storage use. Other supported features include audio, input/output ports, power over Ethernet, 8–28 V DC and two SD card slots.

1. Manufacturer part # Axis F44

- B. Sensor units and mics. – Should be a recessed dome sensor unit for discreet indoor video. For use with an AXIS F Main Unit and provide a 1080p resolution and a wide 113°, horizontal field of view, WDR – Forensic Capture, Corridor view and audio locations as specify on the floor plans.

1. Manufacturer part # Axis F4005 and Axis T8351

## 6.12 CABLES

- A. General Cable Requirements: Comply with requirements in Section 280513 "Conductors and Cables for Electronic Safety and Security" and as recommended by system manufacturer for integration requirement.

- B. PVC-Jacketed, TIA 232-F Cables:

1. Two pairs, No. 22 AWG, stranded (7x30) tinned copper conductors, polypropylene insulation, and individual aluminum-foil/polyester-tape shielded pairs with 100 percent shield coverage; PVC jacket.

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2. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire.
  3. NFPA 70, Type CM.
  4. Flame Resistance: UL 1581 vertical tray.
- C. Plenum-Type, TIA 232-F Cables:
1. Two pairs, No. 22 AWG, stranded (7x30) tinned copper conductors, plastic insulation, and individual aluminum-foil/polyester-tape shielded pairs with 100 percent shield coverage; plastic jacket.
  2. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire.
  3. NFPA 70, Type CMP.
  4. Flame Resistance: NFPA 262 flame test.
  5. TIA 485-A communications require two twisted pairs with a distance limitation of 4000 ft. (1220 m).
  6. PVC-Jacketed, TIA 485-A Cables: Two pairs, twisted, No. 22 AWG, stranded (7x30) tinned copper conductors, PVC insulation, unshielded, PVC jacket, and NFPA 70, Type CMG.
- D. Plenum-Type, TIA 485-A Cables:
1. Two pairs, No. 22 AWG, stranded (7x30) tinned copper conductors, fluorinated-ethylene-propylene insulation, unshielded, and fluorinated-ethylene-propylene jacket.
  2. NFPA 70, Type CMP.
  3. Flame Resistance: NFPA 262 flame test.
  4. Retain one of first two paragraphs below or allow Contractor to choose. First paragraph allows use of multiconductor cables instead of a separate cable for each reader or keypad; if retaining, retain the remaining paragraphs that refer to readers and keypads to allow use of multiconductor cables. Retain uniform shielding characteristics or differentiate on Drawings where 100 percent shielding is required or where less shielding is allowed. Retain insulating materials based on engineer's preference, considering manufacturer's written instructions. When revising cable paragraphs pertaining to readers and keypads, verify that the new combination of conductor size, insulation material, shielding, and jacket is commercially available.
  5. The connection of card readers and Wiegand keypads to the controller requires a three-pair, No. 22 or 20 AWG cable with an overall braided shield. Maximum distance from controller to reader is 250 ft. (76 m) with No. 22 AWG wire, 500 ft. (152 m) with No. 20 AWG wire, or 750 ft. (228 m) with No. 18 AWG wire. The three pairs provide one pair for power, one pair for data, and one pair for two separate digital control lines. Readers with a buzzer or other options require additional conductors.
- E. Multiconductor, PVC, Reader and Wiegand Keypad Cables:
1. No. 22 AWG, paired and twisted multiple conductors, stranded (7x30) tinned copper conductors, semirigid PVC insulation, overall aluminum-foil/polyester-tape shield with 100 percent shield coverage, plus tinned copper braid shield with 65 percent shield coverage, and PVC jacket.
  2. NFPA 70, Type CMG.
  3. Flame Resistance: UL 1581 vertical tray.
  4. For TIA 232-F applications.
- F. Paired, PVC, Reader and Wiegand Keypad Cables:

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1. Three pairs, twisted, No. 22 AWG, stranded (7x30) tinned copper conductors, polypropylene insulation, individual aluminum-foil/polyester-tape shielded pairs each with No. 22 AWG, stranded tinned copper drain wire, 100 percent shield coverage, and PVC jacket.
  2. NFPA 70, Type CM.
  3. Flame Resistance: UL 1581 vertical tray.
- G. Paired, PVC, Reader and Wiegand Keypad Cables:
1. Three pairs, twisted, No. 20 AWG, stranded (7x28) tinned copper conductors, polyethylene (polyolefin) insulation, individual aluminum-foil/polyester-tape shielded pairs each with No. 22 AWG, stranded (19x34) tinned copper drain wire, 100 percent shield coverage, and PVC jacket.
  2. NFPA 70, Type CM.
  3. Flame Resistance: UL 1581 vertical tray.
- H. Paired, Plenum-Type, Reader and Wiegand Keypad Cables:
1. Three pairs, No. 22 AWG, stranded (7x30) tinned copper conductors, plastic insulation, individual aluminum-foil/polypropylene-tape shielded pairs each with No. 22 AWG, stranded tinned copper drain wire, 100 percent shield coverage, and fluorinated-ethylene-propylene jacket.
  2. NFPA 70, Type CMP.
  3. Flame Resistance: NFPA 262 flame test.
- I. Multiconductor, Plenum-Type, Reader and Wiegand Keypad Cables:
1. Six conductors, No. 20 AWG, stranded (7x28) tinned copper conductors, fluorinated-ethylene-propylene insulation, overall aluminum-foil/polyester-tape shield with 100 percent shield coverage plus tinned copper braid shield with 85 percent shield coverage, and fluorinated-ethylene-propylene jacket.
  2. NFPA 70, Type CMP.
  3. Flame Resistance: NFPA 262 flame test.
  4. Coordinate first four paragraphs below with power requirements of locks specified in Section 087100 "Door Hardware" and Section 087111 "Door Hardware (Descriptive Specification)." Lock wire size recommendations are for the power draw of 500 mA or less, with an inrush current of not more than 1 A. Twelve- to 24-V lock wire from controller to door requires a two-conductor cable. Maximum distance from controller to lock is 250 ft. (76 m) with No. 18 AWG wire, and 500 ft. (152 m) with No. 16 AWG wire.
- J. Paired, Lock Cables:
1. One pair, twisted, No. 16 AWG, stranded (19x29) tinned copper conductors, PVC insulation, unshielded, and PVC jacket.
  2. NFPA 70, Type CMG.
  3. Flame Resistance: UL 1581 vertical tray.
- K. Paired, Plenum-Type, Lock Cables:
1. One pair, twisted, No. 16 AWG, stranded (19x29) tinned copper conductors, PVC insulation, unshielded, and PVC jacket.
  2. NFPA 70, Type CMP.
  3. Flame Resistance: NFPA 262 flame test.
- L. Paired, Lock Cables:

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1. One pair, twisted, No. 18 AWG, stranded (19x30) tinned copper conductors, PVC insulation, unshielded, and PVC jacket.
  2. NFPA 70, Type CMG.
  3. Flame Resistance: UL 1581 vertical tray.
- M. Paired, Plenum-Type, Lock Cables:
1. One pair, twisted, No. 18 AWG, stranded (19x30) tinned copper conductors, fluorinated-ethylene-propylene insulation, unshielded, and plastic jacket.
  2. NFPA 70, Type CMP.
  3. Flame Resistance: NFPA 262 flame test.
  4. Input cables in first two paragraphs below connect monitored devices to controllers. Input requires a two-conductor, No. 22 AWG cable; distance limitation is 1000 ft. (305 m) maximum. Cable shielding is optional but required for UL-labeled systems.
- N. Paired, Input Cables:
1. One pair, twisted, No. 22 AWG, stranded (7x30) tinned copper conductors, polypropylene insulation, overall aluminum-foil/polyester-tape shield with No. 22 AWG, stranded (7x30) tinned copper drain wire, 100 percent shield coverage, and PVC jacket.
  2. NFPA 70, Type CMR.
  3. Flame Resistance: UL 1666 riser flame test.
- O. Paired, Plenum-Type, Input Cables:
1. One pair, twisted, No. 22 AWG, stranded (7x30) tinned copper conductors, fluorinated-ethylene-propylene insulation, aluminum-foil/polyester-tape shield (foil side out), with No. 22 AWG drain wire, 100 percent shield coverage, and plastic jacket.
  2. NFPA 70, Type CMP.
  3. Flame Resistance: NFPA 262 flame test.
  4. AC transformer cables in first two paragraphs below connect the power transformers to the controllers if the transformers are remotely mounted from the controllers. AC transformer cables require a single-pair cable with a maximum distance of 25 ft. (8 m) for 18 AWG cable.
- P. Paired, AC Transformer Cables:
1. One pair, twisted, No. 18 AWG, stranded (7x26) tinned copper conductors, PVC insulation, unshielded, and PVC jacket.
  2. NFPA 70, Type CMG.
- Q. Paired, Plenum-Type, AC Transformer Cables:
- R. One pair, twisted, No. 18 AWG, stranded (19x30) tinned copper conductors, fluorinated-ethylene-propylene insulation, unshielded, and plastic jacket.
1. NFPA 70, Type CMP.
  2. Flame Resistance: NFPA 262 flame test.
- S. Elevator Travel Cables:
1. Steel center core with shielded, twisted pairs, No. 20 AWG conductor size.
  2. Steel center core support shall be preformed, flexible, low-torsion, zinc-coated, steel wire rope; insulated with 60 deg C flame-resistant PVC and covered with a nylon or cotton braid.
  3. Shielded pairs shall be insulated copper conductors; color-coded, insulated with 60 deg C flame-resistant PVC; each pair shielded with bare copper braid for 85 percent coverage.



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4. Electrical grade, dry jute filler.
5. Helically wound synthetic fiber binder.
6. Rayon or cotton braid applied with 95 percent coverage.
7. 60 deg C PVC jacket specifically compounded for flexibility and abrasion resistance; and complying with UL VW-1 and CSA FT1 flame rated.

T. LAN cabling in paragraph below is used for PC-to-PC communications.

1. LAN Cabling:
  - a. Comply with requirements in Section 280513 "Conductors and Cables for Electronic Safety and Security."
  - b. NFPA 262.

U. Underground cabling: Please provide water resistant/water blocking type, equal to West Penn "Aquaseal".

### 6.13 TRANSFORMERS

A. NFPA 70, Class II control transformers, NRTL listed. Transformers for security access-control system shall not be shared with any other system.

## PART 7 - ENROLLMENT CENTER

7.1 Thru Active Directory Software

7.2 Equipment for enrolling personnel into, and removing personnel from, system database, using Active Directory or server.

7.3 Enrollment equipment shall support encoding of credential cards including cryptographic and other internal security checks as required for system.

- A. Allow only authorized entry-control enrollment personnel to access the enrollment equipment using passwords.
- B. Include enrollment-subsystem configuration controls and electronic diagnostic aids for subsystem setup and troubleshooting with the central station.
- C. Enrollment-station records printer shall meet requirements of the report printer.

7.4 Entry-Control Enrollment Software:

- A. Shall include database management functions for the system and shall allow an operator to change and modify the data entered in the system as needed.
- B. Software shall not have alarm response or acknowledgment functions as a programmable function.
- C. Multiple, password-protected access levels shall be provided at the enrollment station.
- D. Database management and modification functions shall require a higher operator-access level than personnel enrollment functions.

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- E. Software shall provide a means for disabling the enrollment station when it is unattended, to prevent unauthorized use.
  - F. Software shall provide a method to enter personnel identifying information into the entry-control database files through enrollment stations to include a credential unit in use at the installation.
  - G. In the case of personnel identity-verification subsystems, this data shall include biometric data.
  - H. Software shall allow entry of this data into the system database files through the use of simple menu selections and data fields. The data field names shall be customized to suit user and site needs.
  - I. Personnel identity-verification subsystems selected for use with the system shall fully support the enrollment function and shall be compatible with the entry-control database files.
- 7.5 System Capacity: Number of badges shall be limited only by hard disk space. Badge templates and images shall be in color, supporting the maximum color capability of Microsoft Windows.
- 7.6 DOOR AND GATE HARDWARE INTERFACE
- A. Exit Device with Alarm: Operation of the exit device shall generate an alarm and annunciate a local alarm. Exit device and alarm contacts are specified in Section 087100 "Door Hardware."
  - B. Exit Alarm: Operation of a monitored door shall generate an alarm. Exit devices and alarm contacts are specified in Section 087100 "Door Hardware."
  - C. Electric Door Strikes: Use end-of-line resistors to provide power-line supervision. Signal switches shall transmit data to controller to indicate when the bolt is not engaged and the strike mechanism is unlocked, and they shall report a forced entry. Power and signal shall be from the controller. Electric strikes are specified in Section 087100 "Door Hardware."
  - D. Electromagnetic Locks: End-of-line resistors shall provide power-line supervision. Lock status sensing signal shall positively indicate door is secure. Power and signal shall be from the controller. Electromagnetic locks are specified in Section 087100 "Door Hardware."
  - E. Vehicle Gate Operator: Interface electrical operation of gate with controls in this Section. Vehicle gate operators shall be connected, monitored, and controlled by the security access controllers. Vehicle gate and accessories are specified in Section 323113 "Chain Link Fences and Gates."
  - F. Intercom integration: Interface intercom audio and video via software with electrical operation of gate.

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### PART 8 - EXECUTION

#### 8.1 EXAMINATION

- A. Examine pathway elements intended for cables. Check raceways, cable trays, and other elements for compliance with space allocations, installation tolerances, hazards to cable installation, and other conditions affecting installation.
- B. Examine roughing-in for LAN and control cable conduit systems to PCs, controllers, card readers, and other cable-connected devices to verify actual locations of conduit and back boxes before device installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 8.2 PREPARATION

- A. Comply with recommendations in SIA CP-01.
- B. Comply with TIA/EIA 606-A, Administration Standard for Commercial Telecommunications Infrastructure, RCDD certification, Genetec Authorize dealer and certification
- C. Obtain detailed Project planning forms from manufacturer of access-control system; develop custom forms to suit Project. Fill in all data available from Project plans and specifications and publish as Project planning documents for review and approval.
- D. Record setup data for control station and workstations.
- E. For each Location, record setup of controller features and access requirements.
- F. Propose start and stop times for time zones and holidays and match up access levels for doors.
- G. Set up groups, facility codes, linking, and list inputs and outputs for each controller.
- H. Assign action message names and compose messages.
- I. Set up alarms. Establish interlocks between alarms, intruder detection, and video surveillance features.
- J. Prepare and install alarm graphic maps.
- K. Develop user-defined fields.
- L. Develop screen layout formats.
- M. Propose setups for guard tours and key control.
- N. Discuss badge layout options, design badges.
- O. Complete system diagnostics and operation verification.

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- P. Prepare a specific plan for system testing, startup, and demonstration.
- Q. Develop acceptance test concept and, on approval, develop specifics of the test.
- R. Develop cable and asset-management system details, input data from construction documents. Include system schematics and Visio Technical Drawings in electronic format.
- S. In meetings with Architect and Owner, present Project planning documents and review, adjust, and prepare final setup documents. Use final documents to set up system software.

### 8.3 CABLING

- A. Comply with NECA 1, "Good Workmanship in Electrical Construction."
- B. Install cables and wiring according to requirements in Section 280513 "Conductors and Cables for Electronic Safety and Security."
- C. Installation: UL 681.
- B. Wiring Method: Install wiring in raceways except in accessible indoor ceiling spaces. Secure from building structure steel (no from walls) by means of J-hooks. Conceal raceways and wiring except in unfinished spaces and as indicated. Minimum conduit size shall be ¾" inch. Control and data transmission. Wiring shall not share conduit with other building wiring systems. Wiring shall not be exposed below ceiling.
- D. Wiring Method: Install wiring in raceway and cable tray except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces and in gypsum board partitions where unenclosed wiring method may be used. Use NRTL-listed plenum cable in environmental airspaces, including plenum ceilings. Conceal raceway and cables except in unfinished spaces.
- E. Install LAN cables using techniques, practices, and methods that are consistent with Category 5E rating of components and fiber-optic rating of components, and that ensure Category 6 and fiber-optic performance of completed and linked signal paths, end to end.
- F. Boxes and enclosures containing security-system components or cabling, and which are easily accessible to employees or to the public, shall be provided with a lock. Boxes above ceiling level in occupied areas of the building shall not be considered accessible. Junction boxes and small device enclosures below ceiling level and easily accessible to employees or the public shall be covered with a suitable cover plate and secured with tamperproof screws.
- G. Install end-of-line resistors at the field device location and not at the controller or panel location.

### 8.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections.

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- B. Retain subparagraph below to require a factory-authorized service representative to assist Contractor with inspections, tests, and adjustments.
- C. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- D. Retain first paragraph below to describe tests and inspections to be performed.
- E. Tests and Inspections:
- F. Retain subparagraphs below unless testing will be performed by Owner-engaged testing and inspecting agency.
- G. LAN Cable Procedures: Inspect for physical damage and test each conductor signal path for continuity and shorts. Use Class 2, bidirectional, Category 5 tester. Test for faulty connectors, splices, and terminations. Test according to TIA/EIA 568-B.1, "Commercial Building Telecommunications Cabling Standards - Part 1: General Requirements." Link performance for UTP cables must comply with minimum criteria in TIA/EIA 568-B.1.
- H. Test each circuit and component of each system. Tests shall include, but are not limited to, measurements of power-supply output under maximum load, signal loop resistance, and leakage to ground where applicable. System components with battery backup shall be operated on battery power for a period of not less than 10 percent of the calculated battery operating time. Provide special equipment and software if testing requires special or dedicated equipment.
- I. Operational Test: After installation of cables and connectors, demonstrate product capability and compliance with requirements. Test each signal path for end-to-end performance from each end of all pairs installed. Remove temporary connections when tests have been satisfactorily completed.
- J. See Section 014000 "Quality Requirements" for retesting and reinspecting requirements and Section 017300 "Execution" for requirements for correcting the Work.
- K. Devices and circuits will be considered defective if they do not pass tests and inspections.
- L. Prepare test and inspection reports.

### 8.5 STARTUP SERVICE

- A. Engage a factory-authorized service representative to supervise and assist with startup service.
- B. Complete installation and startup check according to approved procedures that were developed in "Preparation" Article and with manufacturer's written instructions.
- C. Enroll and prepare badges and access cards for Owner's operators, management, and security personnel.

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### 8.6 PROTECTION

- A. Maintain strict security during the installation of equipment and software. Rooms housing the control station, and workstations that have been powered up shall be locked and secured with an activated burglar alarm and access-control system reporting to a central station complying with UL 1610, "Central-Station Burglar-Alarm Units," during periods when a qualified operator in the employ of Contractor is not present.

### 8.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain security access system. See Section 017900 "Demonstration and Training."
- B. Develop separate training modules for the following:
- C. Computer system administration personnel to manage and repair the LAN and databases and to update and maintain software.
- D. Operators who prepare and input credentials to man the control station and workstations and to enroll personnel.
- E. Security personnel.
- F. Hardware maintenance personnel.
- G. Corporate management.

END OF SECTION 267240

## SECTION 267260 – CAFETORIUM INTEGRATED AUDIO VIDEO SYSTEMS

### PART I - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. This Section includes a system for amplifying sound signals from sources such as microphones and distributing and reproducing them on loudspeakers at various locations. Provide cabling to interface with multimedia outlet.

#### 1.3 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product Data for each type of products specified.
- C. Shop Drawings detailing public address and music systems including, but not limited to, the following:
  - 1. System block diagrams.
  - 2. Rack Elevation
  - 3. Control panels.
- D. Wiring diagrams detailing wiring for power, signal, and control systems and differentiating clearly between manufacturer installed and field-installed wiring. Identify terminals to facilitate installation, operation, and maintenance.
- E. Report of field tests and observations, including record of final tap settings of speaker line matching transformers and signal ground-resistance measurement certified by Installer.
- F. Maintenance data for system to include in the operation and maintenance manual specified in Division 1.

#### 1.4 WARRANTY

- A. Provide for a period of two (2) years commencing from the date of final system acceptance, including annual inspections of the system.
- B. During the warranty period report to the site and repair or replace any defective materials or workmanship without cost to the Owner. Warranty service shall be rendered within 24 hours after request by Owner. Equivalent replacement equipment shall be temporarily provided when immediate on-site repairs cannot be made

### QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced installer with at least 2 years from the day of the

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certification and who is an authorized representative of the system manufacturer to perform Work of this Section.

1. Crestron Fusion Programmer
2. Crestron Avia DSP Integration Certification
3. CTS Certified
4. DMC-4K-E Certified
5. Dante Certification Level 2

- B. **Manufacturer Qualifications:** Engage a firm experienced in manufacturing professional Audio and Video systems complying with the requirements of these Specifications and experienced with at least 5 projects of similar size and scope that have been in operation for 3 years or more.
- C. **Listing Labeling:** Provide products specified in this Section that are listed and labeled.
1. This Terms "listed and Labeled": As defined in the National Electrical Code, Article 100.
  2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NTRL) as defined in OSHA Regulation 1910.7.
- D. Comply with NFPA 70.
- E. Comply with UL50.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. **Manufacturers:** Subject to compliance with requirements, provide products by one the following:
1. Williams Sound.
  2. Crestron.
  4. Bose Professional
  6. Shure.

#### 2.2 SYSTEM REQUIREMENTS

- A. Provide materials that will allow a turnkey solution for the end user, coordinate the features of materials and equipment's to and form an integrated system, Match components and interconnections for optimum performance of specified functions.
- B. **Functional Performance:** System functions include, but are not limited to the following:
1. Selectability of sources for amplifying sound and video between various Dante Audio outlets and other audio/video inputs.
  2. **High-Quality Sound Reproduction:** Sound is free from noises, such as pops, clicks hisses, and hums at loudspeakers at all times during system operation including standby mode with inputs off. System output is free from distortion and nonuniform coverage of amplified sound.



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3. High-Quality Video Reproduction with no latency, and image quality

### 2.3 EQUIPMENT

- A. General: Use all solid-state components, fully rated for continuous duty at the ratings indicated. Select equipment for normal operation on input power usually supplied at 105 to 130 V, 60 Hz.
- B. DSP: Shall be of equal to Crestron DSP-1283
  1. DSP shall include:
    - a. Acoustic Echo Cancellation on all 12 input channels
    - b. Separate POTS connector RJ11
    - c. Separate VoIP connector RJ45
    4. USB 2.0 audio 8x8 with type B connector I.
    - d. Dante audio connectivity
    - e. Separate Primary and Secondary Dante network ports, RJ45
    - f. Front panel 5 segment LED indicators referencing:
      1. Microphone and line in
      2. Line Out J.
    - g. User Interface Export
    - h. Touch Panels by same manufacturer shall integrate natively with the DSP for a rich graphic user interface.
    - i. Graphic control elements will be selectable and exportable directly from the DSP software tool.
- C. Amplifier: Shall Comply with EIA-SE0101 and be or equal to Crestron AMP-2800. Provide two (2) with following features:
  1. Dante communication between mixer outputs and equalizer inputs.
  2. 800W Vrms of amplification.
  3. Rack Mount chassis with security cover.
  4. Five Year Warranty
  5. UL Listed.
  6. Frequency response shall be +0/-25db from 20Hz to 20KHZ at rated power, 8 Ohm.
  7. Total harmonic distortion shall be less than 0.35% at full rated power, 20 Hz to 20 KHZ.
  8. Signal-to-noise shall be greater than 90dB from 20 Hz to 20KHZ at rated power.
  9. Damping factor >1000 at 20Hz to 100Hz
- D. Speakers. Shall be or equal to Bose DS 100SE. Provide with following features:
  1. Frequency Response: 75Hz to 18 kHz +/- 10 dB (on axis)
  2. Optimum Power: 100 watts (400W peak) RMS total
  3. Impedance; 8 ohms
  4. Dispersion: 180 deg. Horizontal, 75 deg. Vertical
  5. +/- 6 dB Level 55 Hz to 20 kHz
  6. Sensitivity: 85 dB (Ave. 80 Hz – 20 kHz)
  7. Maximum S.P.L.: Direct 8Ω: 103 dB
- E. Microphone System: Shall be or equal to Shure Microphone system Model No. BLX88

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1. Provide the following accessories:
  - a. Two Shure Model No. CVL Centraverve Lavalier Condenser Microphones.
  - c. Two Shure Model No. PG58 Wireless Handheld Microphone.
  - b. Two Microphone stand
  
- F. ASSISTIVE LISTENING SYSTEM: Shall be or equal to Williams. Model No. FM T55 D.  
Provide with following features:
  1. Furnish and install an FM/wi-fi wireless assistive listening (A Frequency) system for use by the hearing impaired.
    - a. Furnish and install the following.
    - b. FM R38 receiver with battery and surround earphone (Qty: 40 ea.)
  
- G. WIRING AND CABLE: Jacketed, twisted-pair, stranded copper conductors.
  1. Speaker cable shall be 2 cond. #16 ga.
  2. Any cable installed in the return Air Plenum shall be in conduit.
  3. Insulation for wire in conduit: Thermoplastic, not less than 1/32 inch (0.8 mm)
  4. Microphone Cables: Neoprene jacketed, not less than 2/64 inch (0.8 mm) thick over shield with filled interstices. Shield No. 34 AWG tinned, soft-copper strands formed into a braid or approved equivalent foil. Shielding coverage on the conductors not less than 60 percent.
  
- H. INTEGRATED AUDIO-VIDEO SYSTEMS AND CONTROL
  1. Shall be or equal to Crestron DMPS3-4K-150, DM-TX-200-C-2G (Multimedia Box), TSW-760-B-S (User Interface). Video Inputs/Outputs:
    - a. Video inputs include HDMI and HDBaseT type input.
    - b. HDBaseT type inputs shall be compatible with HDBaseT and manufacturers proprietary format supporting additional control functionality.
    - c. HDMI inputs are compatible with DVI and Dual-Mode DisplayPort sources
    - d. 4K Video Switcher
    - e. Built-in video matrix switching allows video sources to be routed simultaneously to output connectors.
    - f. Internal switcher shall support routing of HDMI and other AV sources to HDMI and HDBaseT outputs.
    - g. The HDMI outputs are compatible with DVI and the HDBaseT outputs are compatible with HDBaseT and manufacturer proprietary format supporting additional control functionality.
    - h. 4K/60 Video Scaling - Unit shall include an independent, 4K scaler on each HDMI output.
  
  2. Control Processor
    - a. Unit shall include a built-in control processor with onboard control ports for control of external devices.
    - b. The Central Switching and Control Unit shall include an integrated microprocessor-based control processor.
    - c. The built-in control processor shall support customizable control of integrated AV devices, room lighting hardware, window shades, and projection screens.
    - d. Controller shall include the following onboard control ports:

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- i. Ethernet
- ii. Four IR ports
- iii. Two RS-232 COM ports
- iv. Four relay ports
- v. Four digital input ports
- vi. RS-422 type network control bus

### 3. User Interface

- a. The Touch Screen UI shall be composed of the following functional elements:
  - i. Graphical touch video display
  - ii. Programmable capacitive buttons
  - iii. Ambient light sensor
  - iv. Feedback indication via text, button object changes in color, animated object or graphical element.
  - v. Custom Control UI - control of integrated system components through custom programming or preset configuration of the system control processor by same manufacturer.

### I. Wheeled Cart to be or equal to ProX T-12MRSS13ULT

#### 1. Provide with the following Equipment

- a. Power Sequencer.
- b. Assistive Listening System.
- c. Mics Transmitters.
- d. Professional DSP with Audio Dante Connection to Amplifiers.
- e. User Interface.

### J. PROJECTOR – Owner provided

### K. PROJECTOR SCREENS – specified by Architect

### L. RACK-MOUNTABLE POWER CONDITIONER AND CONTROLER

#### 1. Shal be or equal to Crestron PC-200

- a. Eight switched rear panel outlets, arranged in banks of two
- b. Adjustable turn-on delay and remote switching per each of three banks
- c. One unswitched front panel outlet
- d. Built-in current sensing and energy monitoring
- e. Line voltage monitoring
- f. Professional grade surge protection
- g. UL® 1449 Type 3 compliant
- h. Thermal breaker overload protection
- i. Adjustable over-voltage and under-voltage cutoff
- j. EMI and RFI noise filtering
- k. Wiring fault detection [3]
- l. Ambient temperature sensing and over-temperature cutoff
- m. Ping monitoring (device lockup detection and reboot)
- n. Built-in energy usage and event logging
- o. Front panel main power switch and status indicators
- p. Easy setup and operation via web browser

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- q. Crestron® control system integration via Ethernet or Cresnet®
- r. Remote management via MyCrestron.com,
- s. Crestron Fusion® Cloud, or SNMP [2]
- t. Single-space 19 inch rack-mountable
- u. Rated 15 Amps at 120 Volts AC
- v. Limited Lifetime Product Warranty
- w. Limited 5 Year Connected Equipment Protection Warranty

### M. NETWORK SWITCH

1. Shall be or equal to Crestron CEN-SWPOE-16, Minimum Functional Requirements:
  - a. Power over Ethernet
    - i. Switchable PoE on all ports
    - ii. Switches without individual control of port PoE power shall not be accepted.
  - b. Port speed configuration:
    - i. Individually configurable per port
    - ii. Detect and Auto-Negotiate
  - c. Duplex Mode:
    - i. Individually configurable per port
    - ii. Detect and Auto-Negotiate
  - d. Auto MDI and MDIX
  - e. Layer 2 managed switching
  - f. Port Mirroring
  - g. Multiple Configuration methods:
    - i. Web browser interface
    - ii. Software application via direct USB connection
  - h. Front panel port label
2. Switch shall meet or exceed the following:
  - a. Internal PoE power supply: 255 watts (total for all ports combined)
  - b. IEEE 802.3at Type 1, Class 0-3
    - i. Maximum power per port: 15.4 watts
    - ii. Supported by all ports simultaneously.
  - c. IEEE 802.3at Type 2, Class 4
    - i. Maximum power per port: 34.2 watts
    - ii. Supported by all ports up to the maximum power capability of the main PoE power supply.
3. Control Processor Accessible PoE Parameters
  - a. The following parameters shall be available to remote control processor.
    - iii. PoE power: Enable/Disable
      - i. PoE ports shall be capable of individual PoE power control via remote control processor.
      - ii. Switch shall provide status feedback.
      - iii. PoE state at switch boot up
4. Control Processor Accessible PoE Status Feedback
  - a. Link Status: Good/Down
  - b. Data Transmission: Full/Half Duplex
  - c. Link Speed
  - d. PoE device connected
  - e. Port PoE power usage in milliwatts

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- f. Port PoE power allocated in milliwatts
- g. Port Poe power class

N. STAGE LIGHTING CONTROL INTERFACE: Include all necessary hardware and wire to properly control any type of DMX 512 light thru the A/V processor.

1. Shal be or equal to Crestron DIN-DMX-1UNIVERSE (Pharos LPC)

O. GROUNDING COMPONENTS: As specified in Division 16 Section "Grounding."

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. General: Install equipment to comply with manufacturer's written instructions.
- B. Wiring Method: Install wiring in raceway except within consoles, desks, and counters. Conceal raceway and wiring except in unfinished spaces.
- C. Wiring Method: Install wiring in raceway except within consoles, desks, and counters and except in accessible ceiling spaces and in gypsum-board partitions where cable wiring method may be used. Use plenum cable in environmental air spaces, including plenum ceilings. Conceal cable and raceway wiring except in unfinished spaces.
- D. Install exposed cables parallel and perpendicular to surfaces or exposed structural members and follow surface contours. Secure and support cables by straps, staples, or similar fittings so designed and installed as not to damage the cables. Secure cable at intervals not exceeding 30 inches (762 mm) and not more than 6 inches (152 mm) from cabinets, boxes, or fittings.
- E. 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.
- F. Control Circuit Wiring: Provide number of conductors as recommended by system manufacturer for control functions indicated.
- G. Splices, Taps and Terminations: Make splices, taps and terminations on numbered terminal strips in junction, pull and outlet boxes, terminal cabinets, and equipment enclosures.
- H. Impedance and Level Matching: Carefully match input and output impedances and signal level at audio signal interfaces. Provide matching networks where required.
- I. Provide physical isolation from each other for microphone, line-level, speaker, and power wiring. Run in separate raceways or provide 12-inch (305-mm) minimum separation where exposed or in same enclosure. Provide additional physical separation as recommended by equipment manufacturer.

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- J. Conductor Sizing: Except as otherwise indicated size speaker circuit conductors from racks to loudspeaker outlets not smaller than No. 18 AWG and conductors from microphone receptacles to amplifiers not smaller than No. 22 AWG.
- K. 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.
- L. Line Matching Transformer Connections: Make initial connections using tap settings indicated on the Drawings.
- M. Interface room lighting controls to room Crestron controller (user interface).

### 3.2 GROUNDING

- A. Ground cable shields and equipment to eliminate shock hazard and to minimize ground loops, common mode returns, noise pickup, cross talk, and other impairments.
- B. Signal Ground Terminal: Locate at main equipment rack or cabinet. Isolate from power system and equipment grounding.
- C. Install grounding electrodes of type, size, location, and quantity as indicated. Comply with installation requirements of Division 16 Section "Grounding."

### 3.3 Field Quality Control

- A. Manufacturer's Field Service: Provide services of a factory-authorized service representative to supervise the field assembly and connection of components and the testing and adjustment of the system.
- B. Testing Procedure: Conform to the following:
  - 1. Schedule tests a minimum of 7 days in advance of performance.
  - 2. Report: Submit a written record of test results.
  - 3. Operational Test: Perform operational system test to verify conformance of system to these Specifications. Perform tests that include originating program and page material at microphone outlets, preamplifier program inputs, and other inputs. Verify proper volume levels and freedom from noise and distortion.
  - 4. Signal to Noise Ratio Test: Measure the ratio of signal to noise of the complete system at normal gain settings, using the following procedure:  
Disconnect a microphone at the connector or jack closest to it and replace it the circuit with a signal generator using a 1000-Hz signal. Replace all other microphones at the corresponding connectors with dummy loads, each in impedance to the microphone it replaces. Measure the ratio of signal to noise.
  - 5. Acoustic Coverage Test: Feed pink noise into the system using octaves centered at 500 and 4000 Hz. Use a sound-level meter with octave band filters to measure the level at 5 locations in each zone. For spaces with seated audiences, the maximum permissible variation in level is plus or minus 2 dB. In addition, the levels between locations in the same zone and between locations in adjacent zones must not vary

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more than plus or minus 3 dB.

- C. Inspection: Verify that units and controls are properly labeled, and interconnecting wires and terminals are identified.
- D. Retesting: Rectify deficiencies indicated by tests and observations. Include revising tap settings of speaker line matching transformers where necessary to optimize volume and uniformity of sound levels. Completely retest work affected by such deficiencies at the Contractor's expense. Verify by the system tests that the total system meets the specifications and complies with applicable standards. Provide a written record of all retest results.

### 3.4 CLEANING

- A. Prior to final acceptance, clean system components and protect from damage and deterioration.

### 3.5 DEMONSTRATION

- A. Demonstration and Training: Obtain and pay for the services of a factory-authorized service representative to demonstrate the system in all operating modes and functions and to train Owner's maintenance personnel.
- B. Schedule training with Owner with at least 7 days' advance notice.
- C. Train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, and preventive maintenance. Provide a minimum of 3 hours' training.
- D. Training Aid use the approved operation and maintenance manual as an instructional aid. Refer to Division 1 Section "Contract Closeout." Provide copies of pertinent excerpts from the manual for use in the instruction.

END OF SECTION 267260

## SECTION 267265 – LECTURE HALL INTEGRATED AUDIO-VIDEO SYSTEMS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

#### SUMMARY

- B. This Section includes a system for amplifying sound signals from sources such as microphones and distributing and reproducing them on loudspeakers at various locations. Provide cabling to interface with multimedia outlet.

#### 1.2 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product Data for each type of products specified.
- C. Shop Drawings detailing public address and music systems including, but not limited to, the following:
  - 1. System block diagrams.
  - 2. Control panels.
- D. Wiring diagrams detailing wiring for power, signal, and control systems and differentiating clearly between manufacturer installed and field-installed wiring. Identify terminals to facilitate installation, operation, and maintenance.
- E. Report of field tests and observations, including record of final tap settings of speaker line matching transformers and signal ground-resistance measurement certified by Installer.
- F. Maintenance data for system to include in the operation and maintenance manual specified in Division 1.

#### 1.3 WARRANTY

- A. Provide for a period of two (2) years commencing from the date of final system acceptance, including annual inspections of the system.
- B. During the warranty period report to the site and repair or replace any defective materials or workmanship without cost to the Owner. Warranty service shall be rendered within 24 hours after request by Owner. Equivalent replacement equipment shall be temporarily provided when immediate on-site repairs cannot be made



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### 1.3 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced installer with at least 2 years from the day of the certification and who is an authorized representative of the system manufacturer to perform Work of this Section.
  - 1. Crestron Fusion Programmer
  - 2. Creston Avia DSP Integration Certification
  - 3. CTS Certified
  - 4. DMC-4K-E Certified
  - 5. Dante Certification Level 2
- A. Manufacturer Qualifications: Engage a firm experienced in manufacturing professional sound reinforcement systems complying with the requirements of these Specifications and experienced with at least 5 projects of similar size and scope that have been in operation for 3 years or more.
- B. Listing Labeling: Provide products specified in this Section that are listed and labeled.
  - 1. This Terms "listed and Labeled": As defined in the National Electrical Code, Article 100.
  - 2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NTRL) as defined in OSHA Regulation 1910.7.
- C. Comply with NFPA 70.
- D. Comply with UL50.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one the following:
  - 1. Shure
  - 2. Draper
  - 3. Epson
  - 4. Crestron Electronics
  - 5. Bose Professional

### 2.2 INTEGRATED AUDIO-VIDEO SYSTEMS AND EQUIPMENT

- A. AV Multi-Function Presentation System - A single unit integrated digital media presentation system. The single central switching and control unit integrates audio-video switching, audio mixing and amplification, and system control.
- B. Video System
  - 1. Video Inputs
  - 2. Video inputs include HDMI and HDBaseT type input.

3. SPECIFIER: the DMPS3-4K-200 includes INPUTS: (6) HDMI, (1) DM; OUTPUTS: (1) HDMI, (1) DM
4. The DMPS3-4K-300/350 include INPUTS: (6) HDMI, (2) DM; OUTPUTS: (2) HDMI, (2) DM
5. HDBaseT type inputs shall be compatible with HDBaseT and manufacturers proprietary format supporting additional control functionality.
6. HDMI inputs are compatible with DVI and Dual-Mode DisplayPort sources
7. 4K Video Switcher
8. Built-in video matrix switching allows video sources to be routed simultaneously to output connectors.
9. Internal switcher shall support routing of HDMI and other AV sources to HDMI and HDBaseT outputs.

C. Audio System

1. Audio Inputs - Each HDMI and analog audio input includes adjustable input compensation to accommodate a range of signals and maintain consistent volume levels when switching between sources.
2. Audio Matrix Functions:
  - a. Any analog input, digital audio input, or HDBaseT audio input signal shall be routable to:
    - 1) Amplified Speaker Output
    - 2) Analog line level outputs
    - 3) HDBaseT type output
    - 4) HDMI output
    - 5) Microphone Preamplifier
3. Microphone Inputs - Each internal microphone preamplifier input shall be connected to two mutually exclusive input connections:
  - a. Detachable terminal block - Balanced microphone level analog audio with switchable 48-volt DC phantom power.
  - b. Detachable terminal block - Balanced or unbalanced line level analog audio.
4. Audio Mixer
  - a. All stereo audio outputs shall be capable of outputting independent microphone and program audio mixes.
  - b. All stereo sources and microphone sources shall be available simultaneously.
  - c. All stereo sources and microphone sources shall have controllable levels in mixed output signal.
5. Audio DSP
  - a. Each analog audio output shall include DSP processing, allowing each output to be configured separately. DSP parameters include:
    - 1) real-time adjustable volume, bass, treble, and mute controls
    - 2) 10-band graphic equalization
    - 3) 4-band parametric equalization
    - 4) Adjustable limiting
    - 5) Up to 85 ms of speaker delay adjustment
    - 6) Single Cable Transmission System
6. HDBaseT type inputs and outputs allow for connecting to remote sources and display devices and integrating with larger systems via a single CAT5 type cable.

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- a. The one-wire interface supports transmission of ultra-high-definition video, audio, control, power, and networking signals over CAT type cable at distances up to 330 feet (100 meters).
- b. Unit shall be HDBaseT Certified
- c. The processor shall be designed using HDBaseT Alliance specifications and shall support interoperability with other HDBaseT certified products.

### D. Control Processor

1. Unit shall include a built-in control processor with onboard control ports for control of external devices.
2. The Central Switching and Control Unit shall include an integrated microprocessor-based control processor.
3. The built-in control processor shall support customizable control of integrated AV devices, room lighting hardware, window shades, and projection screens.
4. Controller shall include the following onboard control ports:
  - a. Ethernet
  - b. Four IR ports
  - c. Two RS-232 COM ports
  - d. Four relay ports
  - e. Four digital input ports
  - f. RS-422 type network control bus
  - g. Control Subnet Networking
5. The controller shall support a network management system by the same manufacturer, supporting overall remote system controlling, monitoring, and managing through network computers and mobile devices.
6. The controller shall support touch screens, keypads, and wireless remotes and mobile device Apps from the same manufacturer.
7. Multimedia Presentation Gateway
8. Specifier Note: AirMedia Gateway functionality is included in the DMPS3-4K-250-C and DMPS3-4K-350-C only.
9. General Functionality
10. Gateway shall support presentation of content from network connected devices.
11. Architecture
  - a. Gateway functionality shall be a built-in function.
  - b. Communication: Dedicated LAN Connection 10/100 Mbps, auto-switching, auto-negotiating, full/half duplex, DHCP, SSL, TLS, SSH, SNMP, IPv4, HTTPS web server
12. User Device Support:
  - a. Gateway shall support multiple user device types and Operating Systems:
    - 1) Laptop and desktop computers:
      - a) Windows XP, Windows Vista, Windows 7, Windows 8, Window 10, Mac OS X (versions 10.5 thru 10.11)
    - 2) Mobile Devices:
      - a) Apple iOS, Android
13. Specified Product: Crestron DMPS3-4K-250-C-AIRMEDIA,

## 2.3 AMPLIFIER

- A. Shall be or equal to Crown DCI 4|300DA. Provide with following features:

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1. Dante communication between mixer outputs and equalizer inputs.
2. 300W Vrms of amplification.
3. Rack Mount chassis with security cover.
4. Five Year Warranty
5. UL Listed.
6. Frequency response shall be +0/-25db from 20Hz to 20KHZ at rated power, 8 Ohm.
7. Total harmonic distortion shall be less than 0.35% at full rated power, 20 Hz to 20 KHz.
8. Signal-to-noise shall be greater than 90dB from 20 Hz to 20KHZ at rated power.
9. Damping factor >1000 at 20Hz to 100Hz

### 2.4 SPEAKERS

- A. Woofer: 6.5 inch (165 mm) polypropylene w/ring mode decoupled cloth surround & steel basket Tweeter: 0.98 inch (25 mm) titanium dome, horn loaded Crossover Frequency: 2.5 kHz Impedance: 8 Ohms nominal with transformer set to “8Ω” Transformer Taps: 12.5W/25W/50W/100W at 70V; 25W/50W/100W at 100V Frequency Response: 50 Hz to 20 kHz (±3 dB) Frequency Range: 40 Hz to 20 kHz (-10 dB) Power Handling: 100 Watts program (8 Ohms) Sensitivity: 88.5 dB @ 1W/1m Coverage: 160° conical (nominal)
- B. Specified Product: BOSE FreeSpace DS 100F

### 2.5 MICROPHONE

- A. Microphone System: Shall be or equal to Shure Microphone system Model No. BLX88
  1. Provide the following accessories:
    - a. Two Shure Model No. CVL Centravese Lavalier Condenser Microphones.
    - c. Two Shure Model No. PG58 Wireless Handheld Microphone.
    - b. Two Microphone stand

### 2.6 ASSISTIVE LISTENING SYSTEM

- A. Shall be or equal to Williams. Model No. FM T55 D. Provide with following features:
  1. Furnish and install an FM/wi-fi wireless assistive listening (A Frequency) system for use by the hearing impaired.
  2. Furnish and install the following.
    - a. FM R38 receiver with battery and surround earphone (Qty: 40 ea.)

### 2.7 PROJECTOR – Owner provided

### 2.8 PROJECTOR SCREENS – specified by Architect

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### 2.9 USER INTERFACE

- A. The Touch Screen UI shall be composed of the following functional elements:
1. Graphical touch video display
  2. Programmable capacitive buttons
  3. Ambient light sensor
  4. Feedback indication via text, button object changes in color, animated object or graphical element.
  5. Custom Control UI - control of integrated system components through custom programming or preset configuration of the system control processor by same manufacturer.
  6. 7-inch TFT active-matrix color LCD touch screen 1024 by 600 WSVGA resolution display.
  7. Wired Connection - Device shall utilize a single wired connection for power and data communication.
  8. Shall be or equal to Crestron TSW-760-B-S

### 2.10 RACK-MOUNTABLE POWER CONDITIONER AND CONTROLER

- A. Shall be or equal to Crestron PC-200, with the following features:
1. Eight switched rear panel outlets, arranged in banks of two
  2. Adjustable turn-on delay and remote switching per each of three banks
  3. One unswitched front panel outlet
  4. Built-in current sensing and energy monitoring
  5. Line voltage monitoring
  6. Professional grade surge protection
  7. UL® 1449 Type 3 compliant
  8. Thermal breaker overload protection
  9. Adjustable over-voltage and under-voltage cutoff
  10. EMI and RFI noise filtering
  11. Wiring fault detection [3]
  12. Ambient temperature sensing and over-temperature cutoff
  13. Ping monitoring (device lockup detection and reboot)
  14. Built-in energy usage and event logging
  15. Front panel main power switch and status indicators
  16. Easy setup and operation via web browser
  17. Crestron® control system integration via Ethernet or Cresnet®
  18. Remote management via MyCrestron.com,
  19. Crestron Fusion® Cloud, or SNMP [2]
  20. Single-space 19-inch rack-mountable
  21. Rated 15 Amps at 120 Volts AC
  22. Limited Lifetime Product Warranty
  23. Limited 5 Year Connected Equipment Protection Warranty

### 2.11 WIRING AND CABLE

- A. Jacketed, twisted-pair, plenum #16 AWG, stranded copper conductors.

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1. Insulation for wire in conduit: Thermoplastic, not less than 1/32 inch (0.8 mm) thick.
1. Microphone Cables: Neoprene jacketed, plenum not less than 2/64 inch (0.8 mm) thick over shield with filled interstices. Shield No. 34 AWG tinned, soft-copper strands formed into a braid or approved equivalent foil. Shielding coverage on the conductors not less than 60 percent.

2.12 GROUNDING COMPONENTS: As specified in Division 16 Section "Grounding."

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. General: Install equipment to comply with manufacturer's written instructions.
- B. Wiring Method: Install wiring in raceway except within consoles, desks, and counters. Conceal raceway and wiring except in unfinished spaces.
- C. Wiring Method: Install wiring in raceway except within consoles, desks, and counters and except in accessible ceiling spaces and in gypsum-board partitions where cable wiring method may be used. Use plenum cable in environmental air spaces, including plenum ceilings. Conceal cable and raceway wiring except in unfinished spaces.
- D. Install exposed cables parallel and perpendicular to surfaces or exposed structural members and follow surface contours. Secure and support cables by straps, staples, or similar fittings so designed and installed as not to damage the cables. Secure cable at intervals not exceeding 30 inches (762 mm) and not more than 6 inches (152 mm) from cabinets, boxes, or fittings.
- E. 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.
- F. Control Circuit Wiring: Provide number of conductors as recommended by system manufacturer for control functions indicated.
- G. Splices, Taps and Terminations: Make splices, taps and terminations on numbered terminal strips in junction, pull and outlet boxes, terminal cabinets, and equipment enclosures.
- H. Impedance and Level Matching: Carefully match input and output impedances and signal level at audio signal interfaces. Provide matching networks where required.
- I. Provide physical isolation from each other for microphone, line-level, speaker, and power wiring. Run in separate raceways or provide 12-inch (305-mm) minimum separation where exposed or in same enclosure. Provide additional physical separation as recommended by equipment manufacturer.
- J. Microphone Outlets: Install as follows, except as otherwise indicated.
  1. Wall Outlets: Flush mounted

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2. Floor outlets: Provide 10" X 12" X 6" steel box. Floor outlet shall be provided with a lift of section and hinged trap door to accommodate cable exit. Cover shall be 1/8" thick with 1/4" brass edging. Trim with carpet in carpeted areas.
- K. Conductor Sizing: Except as otherwise indicated size speaker circuit conductors from racks to loudspeaker outlets not smaller than No. 16 AWG and conductors from microphone receptacles to amplifiers not smaller than No. 22 AWG.
- L. 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.
- M. Line Matching Transformer Connections: Make initial connections using tap settings indicated on the Drawings.
- N. Multimedia equipment: interface projector and multimedia outlet with amplifier and central speaker.
- O. Interface room lighting controls to room Crestron controller (user interface).

### 3.2 GROUNDING

- A. Ground cable shields and equipment to eliminate shock hazard and to minimize ground loops, common mode returns, noise pickup, cross talk, and other impairments.
- B. Signal Ground Terminal: Locate at main equipment rack or cabinet. Isolate from power system and equipment grounding.
- C. Install grounding electrodes of type, size, location, and quantity as indicated. Comply with installation requirements of Division 16 Section "Grounding."

### 3.3 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Provide services of a factory-authorized service representative to supervise the field assembly and connection of components and the testing and adjustment of the system.
- B. Testing Procedure: Conform to the following:
  1. Schedule tests a minimum of 7 days in advance of performance.
  2. Report: Submit a written record of test results.
  3. Operational Test: Perform operational system test to verify conformance of system to these Specifications. Perform tests that include originating program and page material at microphone outlets, preamplifier program inputs, and other inputs. Verify proper volume levels and freedom from noise and distortion.
  4. Signal to Noise Ratio Test: Measure the ratio of signal to noise of the complete system at normal gain settings, using the following procedure:
    - a. Disconnect a microphone at the connector or jack closest to it and replace it the circuit with a signal generator using a 1000-Hz signal. Replace all other

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microphones at the corresponding connectors with dummy loads, each in impedance to the microphone it replaces. Measure the ratio of signal to noise.

5. Acoustic Coverage Test: Feed pink noise into the system using octaves centered at 500 and 4000 Hz. Use a sound-level meter with octave band filters to measure the level at 5 locations in each zone. For spaces with seated audiences, the maximum permissible variation in level is plus or minus 2 dB. In addition, the levels between locations in the same zone and between locations in adjacent zones must not vary more than plus or minus 3 dB.

C. Inspection: Verify that units and controls are properly labeled and interconnecting wires and terminals are identified.

D. Retesting: Rectify deficiencies indicated by tests and observations. Include revising tap settings of speaker line matching transformers where necessary to optimize volume and uniformity of sound levels. Completely retest work affected by such deficiencies at the Contractor's expense. Verify by the system tests that the total system meets the specifications and complies with applicable standards. Provide a written record of all retest results.

### 3.4 CLEANING

A. Prior to final acceptance, clean system components and protect from damage and deterioration.

### 3.5 DEMONSTRATION

A. Demonstration and Training: Obtain and pay for the services of a factory-authorized service representative to demonstrate the system in all operating modes and functions and to train Owner's maintenance personnel.

1. Schedule training with Owner with at least 7 days' advance notice.
2. Train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, and preventive maintenance. Provide a minimum of 3 hours' training.
3. Training Aid use the approved operation and maintenance manual as an instructional aid. Refer to Division 1 Section "Contract Closeout." Provide copies of pertinent excerpts from the manual for use in the instruction.

END OF SECTION 267265



## SECTION 268050 - HAND DRYERS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Furnishing and installation of electric hand dryers.

#### 1.2 RELATED SECTIONS

- B. Basic Electrical Requirements - Section 260100
- C. Wire and Cables - Section 260519
- D. Grounding and Bonding- Section 260526
- E. Raceways and Boxes - Section 260533

#### 1.3 SUBMITTALS

- A. Refer to Division 01 Section "Submittal Procedures" as "action submittals."

#### 1.4 WARRANTY

- A. Unit shall be protected by a limited 5-year warranty on all parts except motor brushes. Motor brushes shall be warranted for three years from date of purchase.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURER / MODEL

- A. Basis of Design: Bobrick / B-750 115V
- B. Substitution: World Dryer / XRA5-Q974
- C. Substitution: American Dryer / AD90-M ADA-RK

#### 2.2 FEATURES

- A. Cover: One-piece, minimum 1/8" (3mm) thick, white iron-casting is finished in high-gloss, acid-resistant, multicoat vitreous enamel. Equipped with a two-position, self-returning, chrome-plated air-outlet nozzle. Air-outlet opening is equipped with vandal-resistant grille. Cover is secured to base unit with two concealed, vandal-resistant, recessed hex-screws.
- B. Recessed Mounting Box: 16-gauge (1.5mm) steel with baked enamel finish. Rust-resistant.
- C. Base Unit: One-piece aluminum casting. Incorporates concealed, vandal-resistant air-inlet vanes on both sides and bottom.

## SECTION 16805 - HAND DRYERS

- D. Motor: Universal, 1/10 hp, 6200 rpm, on resilient mounting. Sealed ball bearing at drive-shaft end and self-lubricating sleeve bearing at non-drive end. Equipped with automatic thermal-overload switch.
- E. Fan: Dynamically balanced, single-inlet centrifugal fan is mounted on motor shaft; directs airflow through heating element at 150 cfm.
- F. Heating Element: Coiled nickel-chrome heating element is mounted in mica frame and protected by an automatic thermal overload switch. Heating element, which is located on inlet side of fan, heats air without hot spots — inaccessible to vandals.
- G. Electronic Control: Infrared sensor automatically turns dryer on when hands or self-returning nozzle are held under air outlet opening and across path of sensor. Remove hands or release self-returning nozzle from path of sensor and dryer stops. Electronic sensor has automatic shutoff approximately 1-1/2 minutes after dryer turns on if an inanimate object is placed across air-outlet opening. After inanimate object is removed, electronic sensor automatically resets itself and dryer operates normally.

### 2.3 ELECTRICAL

- A. 115V, 20A, 2300W, 60Hz, Single Phase.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install in accordance with manufacturer's recommendations and instructions.

END OF SECTION 268050

## SECTION 31 05 13

### SOILS FOR EARTHWORK

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Subsoil materials.
  - 2. Topsoil materials.
  
- B. Related Sections:
  - 1. Section 310513 - Aggregates for Earthwork.
  - 2. Section 320516 - Aggregates for Exterior Improvements.
  - 3. Section 312213 - Rough Grading.
  - 4. Section 312323 - Backfill.
  - 5. Section 312317 - Trenching.

##### 1.2 REFERENCES

- A. American Association of State Highway and Transportation Officials:
  - 1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.
  
- B. ASTM International:
  - 1. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft<sup>3</sup> (600 kN-m/m<sup>3  - 2. ASTM D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (6,000 ft-lbf/ft<sup>3</sup> (2,700 kN-m/m<sup>3  - 3. ASTM D2487 - Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System).</sup></sup>

#### PART 2 PRODUCTS

##### 2.1 SOURCE QUALITY CONTROL

- A. Section 014000 - Quality Requirements: Testing and Inspection Services Testing and analysis of soil material.
  
- B. Testing and Analysis of Subsoil Material: Perform in accordance with ASTM D698.
  
- C. Testing and Analysis of Topsoil Material: Perform in accordance with ASTM D698.
  
- D. When tests indicate materials do not meet specified requirements, change material and retest.

- E. Furnish materials of each type from same source throughout the Work.

### PART 3 EXECUTION

#### 3.1 EXCAVATION

- A. Excavate subsoil and topsoil from areas designated. Strip topsoil to full depth of topsoil in designated areas.
- B. Stockpile excavated material meeting requirements for subsoil materials and topsoil materials.
- C. Remove excess excavated materials subsoil and topsoil not intended for reuse, from site.
- D. Remove excavated materials not meeting requirements for subsoil materials and topsoil materials from site.

#### 3.2 STOCKPILING

- A. Stockpile materials on site at locations designated by Architect/Engineer.
- B. Stockpile in sufficient quantities to meet Project schedule and requirements.
- C. Separate differing materials with dividers or stockpile apart to prevent mixing.
- D. Prevent intermixing of soil types or contamination.
- E. Direct surface water away from stockpile site to prevent erosion or deterioration of materials.

#### 3.3 STOCKPILE CLEANUP

- A. Remove stockpile, leave area in clean and neat condition. Grade site surface to prevent free standing surface water.

END OF SECTION

## SECTION 31 10 00

### SITE CLEARING

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Removing surface debris.
  - 2. Removing designated trees, shrubs, and other plant life.
  - 3. Removing abandoned utilities.
  - 4. Excavating topsoil.
- B. Related Sections:
  - 1. Section 312213 - Rough Grading.
  - 2. Section 312318 - Rock Removal.

#### PART 2 EXECUTION

##### 2.1 EXAMINATION

- A. Section 013000 - Administrative Requirements: Verification of existing conditions before starting work.
- B. Verify existing plant life designated to remain is tagged or identified.
- C. Identify waste area for placing removed materials.

##### 2.2 PREPARATION

- A. Call Local Utility Line Information not less than three working days before performing Work.
  - 1. Request underground utilities to be located and marked within and surrounding construction areas.

##### 2.3 PROTECTION

- A. Locate, identify, and protect utilities indicated to remain, from damage.
- B. Protect trees, plant growth, and features designated to remain, as final landscaping
- C. Protect bench marks, survey control points, and existing structures from damage or displacement.

## 2.4 CLEARING

- A. Clear areas required for access to site and execution of Work.
- B. Remove trees and shrubs within marked areas. Remove stumps.
- C. Clear undergrowth and deadwood, without disturbing subsoil.
- D. Apply herbicide to remaining stumps to inhibit growth.

## 2.5 REMOVAL

- A. Remove debris, rock, and extracted plant life from site.
- B. Remove abandoned utilities. Indicated removal termination point for underground utilities on Record Documents.
- C. Continuously clean-up and remove waste materials from site. Do not allow materials to accumulate on site.
- D. Do not burn or bury materials on site. Leave site in clean condition.

## 2.6 TOPSOIL EXCAVATION

- A. Excavate topsoil from areas to be further excavated, relandscaped, or regraded, without mixing with foreign materials for use in finish grading.
- B. Do not excavate wet topsoil.
- C. Stockpile in area designated on site to depth not exceeding 8 feet and protect from erosion.
- D. Remove excess topsoil not intended for reuse, from site.

END OF SECTION

**SECTION #31 14 00 – EARTHWORK****PART 1 GENERAL****1.1 SECTION INCLUDES**

- A. Protection, modification and/or installation of utilities as sitework progresses paying particular attention to grade changes and any necessary staging of work.
- B. Cutting, filling and grading to required lines, dimensions, contours and proposed elevations for proposed improvements.
- C. Scarifying, compaction, drying and removal of unsuitable material to ensure proper preparation of areas for fills or proposed improvements.

**1.2 RELATED SECTIONS**

- A. Section 02 41 00 - Demolition
- B. Section 31 10 00 - Site Preparation
- C. Section 31 23 00 - Excavation, Backfill and Compaction for Utilities
- D. Section 31 22 00 - Excavation, Backfill and Compaction for Pavement
- E. Section 31 20 00 - Aggregate Materials
- F. Section 31 32 00 - Soil Stabilization
- G. Geotechnical Report (if available) for boring locations and findings of subsurface materials and conditions.
- H. Construction Drawings
- I. Architectural Plans and Specifications as they relate specifically to the earthwork beneath the buildings, where the architectural requirements are more stringent than the civil requirements

**1.3 REFERENCE STANDARDS**

- A. American Society for Testing and Materials (ASTM) latest edition.
  - D 422 Method for Particle Size Analysis of Soils
  - D 698 Test for Moisture-Density Relations of Soils Using 5.5 lb. (2.5 kg) Rammer and 12-inch (304.8 mm) Drop (Standard Proctor)
  - D 1556 Test for Density of soil in Place by the Sand Cone method
  - D 1557 Test for Moisture-Density Relations of Soils Using 10-lb (4.5 Kg) Rammer and 18-inch (457 mm) Drop (Modified Proctor)
  - D 1559 Test Method for Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus
  - D 2167 Test for Density of Soil in Place by the Rubber Balloon Method
  - D 2216 Laboratory Determination of Moisture content of Soil
  - D 2487 Classification of Soils for Engineering Purposes
  - D 2922 Tests for Density of Soil and Soil- Aggregate in Place by Nuclear Methods (Shallow Depth)
  - D 3017 Test for Moisture Content of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
  - D 4318 Test for Plastic Limit, Liquid Limit, and Plasticity Index of Soils
  - C 25 Chemical Analysis of Limestone, Quicklime and Hydrate Lime
  - C110 Physical Testing for Quicklime and Hydrated Lime, Wet Sieve Method
  - C618 Specification for Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete
  - C977 Quicklime and Hydrated Lime for Soil Stabilization
- B. American Association of State Highway and Transportation Officials (AASHTO) latest edition
  - T88 Mechanical Analysis of Soils

**1.4 QUALITY ASSURANCE**

- A. Independent Testing Laboratory selected and paid by owner, shall be retained to perform construction testing on site based on the following:

1. Building Subgrade Areas, including 10' –0" Outside Exterior Building Lines: In cut areas, not less than one compaction test for every 2,500 square feet. In fill areas, same rate of testing for each 8" lift (measured loose).
  2. Areas of Construction exclusive of building subgrade: In cut areas, not less than one compaction test for every 10,000 square feet. In fill areas, same rate of testing for each 8" lift (measured loose).
- B. If compaction requirements are not complied with at any time during construction process, remove and recompact deficient areas until proper compaction is obtained at no additional expense to owner.
- C. In all areas to receive pavement, a CBR (or LBR) test shall be performed for each type of material imported from off-site.
- D. The following tests shall be performed on each type of on-site or imported soil material used as compacted fill as part of construction testing requirements.
1. Moisture and Density Relationship: ASTM D 698 or ASTM D1557.
  2. Mechanical Analysis: AASHTO T-88
  3. Plasticity Index: ASTM D 4318
- E. Field density tests for in-place materials shall be performed according to one of the following standards as part of construction testing requirements.
1. Sand-Cone Method: ASTM D 1556
  2. Balloon Method: ASTM D 2167
  3. Nuclear method: ASTM D 2922 (Method B-Direct Transmission)
- F. Independent Testing Laboratory shall prepare test reports that indicate test location, elevation data, and test results. Owner, architect, and contractor shall be provided with copies of reports within 96 hours of time test was performed. In event that any test performed fails to meet these Specifications, owner and contractor shall be notified immediately by independent testing laboratory.
- G. All costs related to retesting due to failures shall be paid for by the contractor at no additional expense to owner. Owner reserves the right to employ an Independent Testing Laboratory and to direct any testing that is deemed necessary. Contractor shall provide free access to site for testing activities.

## 1.5 SUBMITTALS

- A. Submit a sample of each type of off-site fill materials that is to be used at the site in an air tight, 10 lb container for the testing laboratory.
- B. Submit the name of each material supplier and specific type and source of each material. Any change in source throughout the job requires approval of the owner or engineer.
- C. For use of fabrics or geogrids, a design shall be submitted for approval by the Owner

## PART 2 PRODUCTS

### 2.1 MATERIALS

- A. Excavated and re-used material for subsoil fill as specified herein.
- B. Aggregate fill as specified in Section 31 20 00.
- C. Imported subsoil material approved by the owner and specified herein.
- D. Topsoil fill as specified in Section 31 10 00.
- E. Acceptable stabilization fabrics and Geogrids:
  1. Mirafi 500X or 600X
  2. Phillips 66 Supac 6WS
  3. Dupont Typar 3401 and 3601
  4. Trevira S1114 and S1120
  5. Tensar SS-1 and SS-2
  6. Exxon GTF-200 or 350
- F. Filter/Drainage Fabrics
  1. Mirafi 14ONS
  2. Phillips 66 Supac 4NP
  3. Dupont Typar 3341



**PART 3 EXECUTION****3.1 PREPARATION**

- A. Identify required lines, levels, contours and datum.
- B. Locate and identify existing utilities that are to remain and protect them from damage.
- C. Notify utility companies to remove and/or relocate any utilities that are in conflict with the proposed improvements.
- D. Protect plant life, lawns, fences, existing structures, sidewalks, paving and curbs from excavating equipment and vehicular traffic.
- E. Protect benchmarks, property corners and all other survey monuments from damage or displacement. If a marker needs to be removed it shall be referenced by a licensed land surveyor and replaced, as necessary, by the same.
- F. Remove from site material encountered in grading operations that, in opinion of owner or owners representative, is unsuitable or undesirable for backfilling, subgrade or foundation purposes. Dispose of in a manner satisfactory to owner. Backfill areas with layers of suitable material and compact as specified.
- G. Prior to placing fill in low areas, such as previously existing creeks, ponds, or lakes, perform following procedures:
  1. Drain water out by gravity with ditch having flow line lower than lowest elevation in low area. If drainage cannot be performed by gravity ditch, use adequate pump to obtain same results.
  2. After drainage of low area is complete, remove mulch, mud, debris, and other unsuitable material by using acceptable equipment and methods that will keep natural soils underlying low areas dry and undisturbed.
  3. If proposed for fill, all muck, mud, and other materials removed from above low areas shall be dried on-site by spreading in thin layers for observation by owner or owner's representative. Material shall be inspected and, if found to be suitable for use as fill material, shall be incorporated into lowest elevation of site filling operation, but not under the building area or within all of perimeter of building pad or paving subgrade. If, after observation by owner or owners representative, material is found to be unsuitable, all unsuitable material shall be removed from site.

**3.2 EXCAVATION FOR FILLING AND GRADING**

- A. Classification of Excavation: Contractor by submitting bid acknowledges that he has investigated the site to determine type, quantity, quality, and character of excavation work to be performed. Excavation shall be considered unclassified excavation, except as indicated by "Article 4 - Administration of the Contract" in the "Supplementary Conditions" portion of the specification.
- B. Perform excavation using capable, well maintained equipment and methods acceptable to owner and governing agencies.
- C. When performing grading operations during periods of wet weather, provide adequate drainage and ground water management to control moisture of soils.
- D. Shore, brace, and drain excavations as necessary to maintain safe, secure, and free of water at all times.
- E. Excavated material containing rock or stone greater than 6" in largest dimension is unacceptable as fill to within the proposed building and paving area.
- F. Rock or stone less than 6" in largest dimension is acceptable as fill to within 24" of surface of proposed subgrade when mixed with suitable material.
- G. Rock or stone less than 2" in largest dimension and mixed with suitable material is acceptable as fill within the upper 24" of proposed subgrade.

**3.3 FILLING AND SUBGRADE PREPARATION**

- A. Fill areas to contours and elevations shown with unfrozen materials.
- B. Place fill in continuous lifts specified herein.
- C. Refer to Section 31 22 00 for filling requirements for pavements.
- D. Areas exposed by excavation or stripping and on which subgrade preparations are to be performed shall be scarified to minimum depth of 8" and compacted to minimum of 95% of optimum density, in accordance with ASTM D 698 (or 92% of optimum density, in accordance with ASTM D 1557), at a moisture content of not less than 1% below and not more than 3% above the optimum moisture

content. These areas shall then be proofrolled to detect any areas of insufficient compaction. Proofrolling shall be accomplished by making a minimum of two (2) complete passes with a fully-loaded tandem-axle dump truck, or approved equivalent, in each of the two perpendicular directions under the supervision and direction of a field geotechnical engineer. Areas of failure shall be excavated and recompacted as stated above.

- E. Fill materials used in preparation of subgrade shall be placed in lifts or layers not to exceed 8" loose measure and compacted to a minimum density of 95% of optimum density, in accordance with ASTM D 698, (or 92% of the optimum density, in accordance with ASTM D 1557) at a moisture content of not less than it below and not more than 3% above the optimum moisture content.
- F. Material imported from off -site shall have a CBR (California Bearing Ratio) or LBR (Limerock Bearing Ratio) value equal to or above the pavement design subgrade CBR or LBR value indicated on the Drawings.

### **3.4 MAINTENANCE OF SUBGRADE**

- A. Finished subgrades shall be verified to ensure proper elevation and conditions for construction above subgrade.
- B. Protect subgrade from excessive wheel loading during construction, including concrete trucks and dump trucks.
- B. Remove areas of finished subgrade found to have insufficient compaction density to depth necessary and replace in a manner that will comply with compaction requirements by use of material equal to or better than best subgrade material on site. Surface of subgrade after compaction shall be hard, uniform, smooth, stable, and true to grade and cross-section.

### **3.5 RIP RAP**

- A. Place rip-rap in all areas where indicated on the Drawings. The stone for rip-rap shall consist of field stone or rough unhewn quarry stone as nearly uniform, in section as is practical. The stones shall be dense, resistant to the action of air and water, and suitable in all aspects for the purpose intended. Unless otherwise specified, all stones used as rip-rap shall weigh between 50 and 150 pounds each, and at least 60 percent of the stones shall weigh more than 100 pounds each.
- B. Slopes and other areas to be protected shall be dressed to the line and grade shown on the plans prior to the placing of rip-rap. Contractor shall undercut the areas to receive rip-rap to an elevation equal to the final elevation less the average diameter of the stones before placing the rip-rap.
- C. Filter fabric and bedding stone shall be installed prior to the placement of the stones if so indicated on the drawings. The bedding stone shall be quarried and crushed angular limestone in accordance with Section 31 20 00 and shall be 6" in depth. Filter fabric shall be as specified herein and as detailed on the plans.
- D. Stones shall be placed so that the greater portion of their weight is carried by the earth and not by the adjacent stones. The stones shall be placed in a single layer with close joints. The upright areas of the stone shall make an angle of approximately 90 degree with the embankment slope. The courses shall be placed from the bottom of the embankment upward, the larger stones being placed in the lower courses. Open joints shall be filled with spalls. Stones shall be embedded in the embankment as necessary to present a uniform top surface such that the variation between tops of adjacent stones shall not exceed three inches.

### **3.6 FINISH GRADING**

- A. Grade all areas where finish grade elevations or contours are indicated on Drawings, other than paved areas and buildings, including excavated areas, filled and transition areas, and landscaped areas. Graded areas shall be uniform and smooth, free from rock, debris, or irregular surface changes. Finished subgrade surface shall not be more than 0.10 feet above or below established finished subgrade elevation, and all ground surfaces shall vary uniformly between indicated elevations. Finish ditches shall be graded to allow for proper drainage without ponding and in a manner that will minimize erosion potential.
- B. Correct all settlement and eroded areas within one year after date of completion at no additional expense to owner. Bring grades to proper elevation. Replant or replace any grass, shrubs, bushes, or other vegetation that appears dead, dying or disturbed by construction activities. Refer to Section 31 35 00 for slope protection and erosion control.

- C. Refer to Section 31 32 00 for soil stabilization using lime, cement, fly ash and geotextile fabric methods for subbase materials.

**END OF SECTION #31 14 00**

**SECTION #31 20 00 - AGGREGATE MATERIALS****PART 1 GENERAL****1.1 SECTION INCLUDES**

Aggregate Materials

**1.2 RELATED SECTIONS**

- A.. Section 31 10 00 - Site Preparation
- B. Section 31 14 00 - Earthwork
- C. Section 31 06 00 - Excavation, Backfill and Compaction for Structures
- D. Section 31 23 00 - Excavation, Backfill and Compaction for Utilities
- E. Section 31 22 00 - Excavation, Backfill and Compaction for Pavement
- F. Section 31 32 00 - Soil Stabilization
- G. Section 31 35 00 - Slope Protection and Erosion Control
- H. Construction Drawings

**1.3 REFERENCE STANDARDS**

- A. American Society for Testing and Materials (ASTM) latest edition.
  - ANSI/ASTM C136 - Method for Sieve Analysis of Fine and Coarse Aggregates.
  - ANSI/ASTM D698 - Test Methods for Moisture-Density Relations of Soils and Soil-aggregate Mixtures, Using 5.5 lb (2.49 Kg) Rammer and 12 inch (304.8 mm) Drop.
  - ANSI/ASTM D155 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10 lb (4.54 Kg) Rammer and 18 inch (457 mm) Drop.
  - ASTM D2167 - Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
  - ASTM D2487 - Classification of Soils for Engineering Purposes.
  - AS7'M D2922 - Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
  - ASTM D3017 - Test Methods for Moisture Content of Soil and Soil-Aggregate Mixtures.
  - ASTM D4318 - Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
- B. American Association of State Highway and Transportation Officials (AASHTO) latest edition.
  - AASHTO T180 - Moisture-Density Relations of Soils Using a 10-lb (4.54 Kg) Rammer and an 18 inch (457 mm) Drop.
  - AASHTO M147 - Materials for Aggregate and Soil-Aggregate.

**1.4 QUALITY ASSURANCE**

Tests and analysis of aggregate material will be performed in accordance with standard ASTM and AASHTO procedures listed herein.

**1.5 SUBMITTALS**

- A. Submit in air tight containers a 10 pound sample of each aggregate or mixture that is to be incorporated into the project to the testing laboratory designated by the owner.
- B. Submit the name of each material supplier and specific type and source of each material. Any change in source throughout the job requires approval of the owner and engineer.
- C. Submit materials certificate to on-site independent testing laboratory which is signed by material producer and Contractor, certifying that materials comply with, or exceed, the requirements herein.

**PART 2 PRODUCTS**

**2.1 MATERIALS**

- A. All construction and materials shall meet or exceed the requirements of this section and any state highway department specification section referred to or noted on the drawings which pertain to paving base course design, materials, preparation, and/or execution. All materials shall be as indicated on Drawings and shall comply with applicable state highway specification regarding source, quality, gradation, liquid limit, plasticity index, and mix proportioning.

**PART 3 EXECUTION**

**3.1 STOCKPILING**

Stockpile on-site at locations indicated by the owner in such a manner that there will be no standing water or mixing with other materials.

**3.2 BORROW SITES**

Upon completion of borrow operations, clean up borrow areas as indicated on the plans in a neat and reasonable manner to the satisfaction of the property owner, the owner and the engineer.

**3.3 TRANSPORTATION**

Off-site materials shall be transported to the project using well maintained and operating vehicles. Once on the job site, all transporting vehicles shall stay on designated haul roads and shall at no time endanger any of the improvements by rutting, overloading or pumping the haul road.

**END OF SECTION #31 20 00**

**SECTION #31 21 00 - ROCK REMOVAL****PART 1 GENERAL****1.1 SECTION INCLUDES**

- A. Removal of identified and discovered rock during excavation.
- B. Use of explosives to assist rock removal.
- C. Incorporating removed rock into fills and embankments.

**1.2 RELATED SECTIONS**

- A. Section 31 14 00 – Earthwork
- B. Section 31 06 00 – Excavation, Backfill and Compacting for Structures
- C. Section 31 23 00 – Excavation, Backfill and Compacting for Utilities
- D. Section 31 22 00 – Excavation, Backfill and Compacting for Pavement
- E. Geotechnical report (if available) for boring locations and findings of subsurface materials and conditions.
- F. Construction drawings.

**1.3 REFERENCE STANDARDS**

NFPA 495 – Code for Explosive Materials

**1.4 ENVIRONMENTAL REQUIREMENTS**

Determine all environmental effects associated with proposed work and safeguard those concerns as regulated by law and all others by reasonable and practiced methods.

**1.5 JOB CONDITIONS**

Any discrepancy with plans and specifications regarding amount and type of rock to be removed shall immediately be brought to the attention of the Owner and the Engineer. A revised removal plan and schedule shall subsequently be provided and followed by the Contractor.

**1.6 QUALIFICATIONS**

Contractor shall submit records of documented experience to the Owner and the Engineer prior to removal of rock by blasting.

**PART 2 PRODUCTS****2.1 MATERIALS**

Explosives, detonator/delay device and blast mat materials shall be the type recommended by the explosive supplier and shall comply with the requirements of this section.

**PART 3 EXECUTION****3.1 PREPARATION**

- A. Verify site conditions and note subsurface conditions affecting work of this section.
- B. Identify required lines, levels and elevations that will determine the extent of the proposed removals.

**3.2 ROCK EXCAVATION**

- A. Rock excavation is defined as igneous, metamorphic or sedimentary rock that cannot be removed by rippers or other mechanical methods and; therefore, requires drilling and blasting. Cut rock to form level bearing at bottom of footing and trench excavations. In utility trenches, excavate rock to 6" below invert

- elevation of pipe. Remove shaled layers to provide sound and unshattered base for footings or foundations. Reuse excavated materials on-site in accordance with section 31 14 00, if applicable.
- B. Comply with all laws, rules, and regulations of Federal, State and local authorities and insurer which govern storage, use, manufacture, sale, handling, transportation, licensing, or other disposition of explosives. Take special precautions for proper use of explosives to prevent harm to human life and damage to surface structures, all utility lines, or other subsurface structures. Do not conduct blasting operations until persons in vicinity have had ample notice and have reached positions of safety.
  - C. Contractor shall save harmless the Owner, Architect, Engineer and Owner's representative from any claim growing out of use of such explosives. Removal of materials of any nature by blasting shall be done in such a manner and such time as to avoid damage affecting the integrity of design and to avoid damage to any new or existing structure included in or adjacent to work. It shall be contractor's responsibility to determine method of operation to ensure desired results and integrity of completed work.
  - D. Perform rock excavation in a manner that will produce material of such size as to permit it being placed in embankments in accordance with Section 31 14 00. Remove rock to limits as indicated. Remove loose or shattered rock, overhanging ledges and boulders which might dislodge.
  - E. Use lean concrete or suitable materials to replace rock overblast or over excavation in building area and in expansion area to facilitate placement of utilities and future footings.

**END OF SECTION #31 21 00**

**SECTION #31 22 00 - EXCAVATION, BACKFILLING AND COMPACTING FOR PAVEMENT****PART 1 GENERAL****1.1 SECTION INCLUDES**

- A. Excavate to line, grade and configuration as shown in the plans and specifications for proposed and future pavement areas.
- B. Fill to line, grade and configuration as shown in the plans and specifications for proposed and future pavement areas.
- C. Compacting fill materials in an acceptable manner as stated herein.

**1.2 RELATED SECTIONS**

- A. Section 31 14 00 - Earthwork
- B. Section 31 20 00- Aggregate Materials
- C. Section 31 32 00 - Soil Stabilization
- D. Section 32 11 00- Paving Base Course
- E. Section 32 12 00 - Asphaltic Concrete Paving
- F. Section 32 13 00 - Portland Cement Concrete
- G. Section 32 16 00 - Curbs and Sidewalks
- H. Geotechnical Report (if available) for Boring Locations and Findings of Subsurface Materials and Conditions.
- I. Construction Drawings

**1.3 REFERENCE STANDARDS**

- A. American Society for Testing and Materials (ASTM) latest edition.
  - D 422 Method for Particle Size Analysis of Soils
  - D 698 Test for Moisture-Density Relations of Soils Using 5.5 lb. (2.5 kg) Rammer and 12-inch (304.8 mm) Drop (Standard Proctor)
  - D 1556 Test for Density of soil in Place by the Sand Cone Method
  - D 1557 Test for Moisture-Density Relations of Soils Using 10-lb (4.5 Kg) Rammer and 18-inch (457 mm) Drop (Modified Proctor)
  - D 1559 Test Method for Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus
  - D 2167 Test for Density of Soil in Place by the Rubber Balloon Method
  - D 2216 Laboratory Determination of Moisture content of Soil
  - D 2487 Classification of Soils for Engineering Purposes
  - D 2922 Tests for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
  - D 3017 Test for Moisture Content of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
  - D 4318 Test for Plastic Limit, Liquid Limit, and Plasticity Index of Soils
  - C 25 Chemical Analysis of Limestone, Quicklime and Hydrated Lime
  - C110 Physical Testing for Quicklime and Hydrated Lime, Wet Sieve Method
  - C618 Specification for Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete
    - C977 Quicklime and Hydrated Lime for Soil Stabilization
- B. American Association of State Highway and Transportation Officials (AASHTO) latest edition
  - T88 Mechanical Analysis of Soils

**1.4 QUALITY ASSURANCE**

Independent testing laboratory selected and paid by owner shall be retained to perform construction testing on filling operations and subgrade analysis as specified in Section 31 14 00 and as stated herein.

**1.5 SUBMITTALS**

EXCAVATION, BACKFILLING AND COMPACTING FOR PAVEMENT  
SECTION #31 22 00 - 1



- A. Shop drawings or details pertaining to excavating and filling for pavement are not required unless otherwise shown on the drawings or specifications or if contrary procedures to the project documents are proposed.
- B. Submit a sample of each type of off-site fill material that is to be used in backfilling in an air-tight, 10 lb. container for the testing laboratory or submit a gradation and certification of the aggregate material that is to be used to the testing laboratory for review.

## **PART 2 PRODUCTS**

### **2.1 MATERIALS**

- A. Fill material from on-site as specified in Section 31 14 00 and approved by the owner or owner's representative.
- B. Fill material from off-site as specified in Section 31 14 00 and approved by the owner or owner's representative.
- C. Aggregate material as specified in Section 31 20 00.
- D. Acceptable stabilization fabrics and geogrids:
  - 1. Mirafi 500X or 600X
  - 2. Phillips 66 Supac 6WS
  - 3. Dupont Tytar 3401 and 3601
  - 4. Trevira S1114 and S1120
  - 5. Tensar SS-1 and SS-2
  - 6. Exxon GTF-200 or 350

## **PART 3 EXECUTION**

### **3.1 PREPARATION**

- A. Identify all lines, elevations and grades necessary to construct pavements, curb and gutter, bases, walkways and roadways as shown in the plans and specifications.
- B. Carefully protect benchmarks, property corners, monuments or other reference points.
- C. Locate and identify all site utilities that have previously been installed and may be in danger of damage by grading operations.
- D. Locate and identify all existing utilities that are to remain and protect them from damage.
- E. Over excavate and properly prepare areas of subgrade that are not capable of supporting the proposed systems. These areas shall be stabilized by using acceptable filter fabrics and/or aggregate material placed and compacted as specified.

### **3.2 EXCAVATION**

- A. Excavate roadway and pavement areas to line and grade as shown in the plans and specifications.
- B. Engage all suitable material into the project fill areas as specified in Section 31 14 00
- C. Unsuitable excavated material is to be disposed of in a manner and location that is acceptable to the owner and local governing agencies.
- D. Perform excavation using capable, well maintained equipment and methods acceptable to the owner and the project document requirements.

### **3.3 FILLING AND SUBGRADE PREPARATION**

- A. Areas exposed by excavation or stripping and on which subgrade preparations for paving are to be performed, including future pavement areas, shall be scarified to minimum depth of 8", and compacted to minimum of 98% of optimum density, in accordance with ASTM D 698, at a moisture content of not less than 2% below and not more than 2% above the optimum moisture content. These areas shall then be proofrolled to detect any areas of insufficient compaction. Proofrolling shall be accomplished by making a minimum of two (2) complete passes with a fully-loaded tandem-axle dump truck, or approved equivalent, in each of the two perpendicular directions under the supervision and direction of a field geotechnical engineer. Areas of failure shall be excavated and recompactd as stated above.
- B. Fill materials used in preparation of subgrade shall be placed in lifts or layers not to exceed 8" loose measure and compacted to a minimum density of 98% of optimum density, in accordance with ASTM D

698, at a moisture content of not less than 2% below and not more than 2% above the optimum moisture content.

- C. The following table stipulates maximum allowable values for plasticity index (PI) and liquid limit (LL) of suitable fill materials to be used in the specified areas, unless specifically stated otherwise on the Drawings:

	<u>PI</u>	<u>LL</u>
*Paving Area, below upper two feet	20	50
*Paving Area, upper two feet	18	40

(\*References to Depth are to Proposed Subgrade Elevations)

- D. Material imported from off-site shall have a CBR (California Bearing Ratio) or LBR (Limerock Bearing Ratio) value equal to or above the pavement design subgrade CBR or LBR value indicated on the Drawings.

### 3.4 COMPACTION

- A. Maintain optimum moisture content of fill materials to attain required compaction density.  
 B. All materials shall be tested in accordance with Section 31 14 00  
 C. An independent testing laboratory selected and paid by the owner, shall be retained to perform testing on-site.  
 D. Compaction test will be as specified in Section 31 14 00 together with the following for paving areas:
1. In cut areas not less than one compaction test for every 10,000 square feet.
  2. In fill areas, same rate of testing for each 8", lift (measured loose).
- E. If compaction requirements are not complied with at any time during construction process, remove and recompact deficient areas until proper compaction is obtained at no additional expense to owner.

### 3.5 MAINTENANCE OF SUBGRADE

- A. Finished subgrades shall be verified to ensure proper elevation and conditions for construction above subgrade.  
 B. Protect subgrade from excessive wheel loading during construction including concrete trucks and dump trucks.  
 C. Remove areas of finished subgrade found to have insufficient compaction density to depth necessary and replace in a manner that will comply with compaction requirements by use of material equal to or better than best subgrade material on-site. Surface of subgrade after compaction shall be hard, uniform, smooth, stable, and true to grade and cross-section.

### 3.6 FINISH GRADING

- A. Finish grading shall be in accordance with Section 31 14 00 and as more specifically stated herein.  
 B. Grading of paving areas shall be checked by string line from grade stakes (blue tops) set at not more than 50' centers. Tolerances of .10 feet, more or less, will be permitted. Contractor to provide engineering and field staking necessary for verification of lines, grades, and elevations.

**END OF SECTION #31 22 00**

## SECTION 31 22 13

### ROUGH GRADING

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Excavating topsoil.
  - 2. Excavating subsoil.
  - 3. Cutting, grading, filling, compacting site for site structures, building pads.
  
- B. Related Sections:
  - 1. Section 310513 - Soils for Earthwork: Soils for fill.
  - 2. Section 310516 - Aggregates for Earthwork: Aggregates for fill.
  - 3. Section 311000 - Site Clearing: Excavating topsoil.
  - 4. Section 312316 - Excavation and Fill: Building excavation.
  - 5. Section 312318 - Rock Removal.
  - 6. Section 312323 - Backfill: General building area backfilling.
  - 7. Section 312317 - Trenching: Trenching and backfilling for utilities.

##### 1.2 REFERENCES

- A. American Association of State Highway and Transportation Officials:
  - 1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.
  
- B. ASTM International:
  - 1. ASTM C136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
  - 2. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft<sup>3</sup> (600 kN-m/m<sup>3  - 3. ASTM D1556 - Standard Test Method for Density of Soil in Place by the Sand-Cone Method.
  - 4. ASTM D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (6,000 ft-lbf/ft<sup>3</sup> (2,700 kN-m/m<sup>3  - 5. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
  - 6. ASTM D2419 - Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate.
  - 7. ASTM D2434 - Standard Test Method for Permeability of Granular Soils (Constant Head).
  - 8. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
  - 9. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).</sup></sup>

## PART 2 EXECUTION

### 2.1 PREPARATION

- A. Call Local Utility Line Information service not less than three working days before performing Work.
  - 1. Request underground utilities to be located and marked within and surrounding construction areas.
- B. Identify required lines, levels, contours, and datum.
- C. Protect utilities indicated to remain from damage.
- D. Protect bench marks, survey control point, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.

### 2.2 FILLING

- A. Fill areas to contours and elevations with unfrozen materials.
- B. Place fill material in continuous layers and compact as required.
- C. Maintain optimum moisture content of fill materials to attain required compaction density.
- D. Slope grade away from building minimum 2 percent slope for minimum distance of 10 ft, unless noted otherwise.
- E. Make grade changes gradual. Blend slope into level areas.

### 2.3 FIELD QUALITY CONTROL

- A. Perform in place compaction tests in accordance with the following:
  - 1. As required by geotechnical engineer.

END OF SECTION

SECTION 31 23 00  
EXCAVATION AND FILL

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
  - 1. Soil densification.
  - 2. Excavating for building foundations.
  - 3. Excavating for slabs-on-grade.
  - 4. Excavating for site structures.
  
- B. Related Sections:
  - 1. Section 310513 - Soils for Earthwork: Stockpiling excavated materials.
  - 2. Section 310516 - Aggregates for Earthwork: Stockpiling excavated materials.
  - 3. Section 312213 - Rough Grading: Topsoil and subsoil removal from site surface.
  - 4. Section 312318- Rock Removal: Removal of rock during excavating.
  - 5. Section 312323- Backfill.
  - 6. Section 312317 - Trenching: Excavating for utility trenches.

1.2 REFERENCES

- A. ASTM International:
  - 1. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft<sup>3</sup> (600 kN-m/m<sup>3</sup>)).
  - 2. ASTM D1556 - Standard Test Method for Density of Soil in Place by the Sand-Cone Method.
  - 3. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
  - 4. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
  
- B. Local utility standards when working within 24 inches of utility lines.

PART 2 EXECUTION

2.1 EXCAVATION

- A. Underpin adjacent structures which may be damaged by excavation work.
  
- B. Excavate subsoil to accommodate building foundations, slabs-on-grade.
  
- C. Excavate to working elevation for piling work.

- D. Compact disturbed load bearing soil in direct contact with foundations to original bearing capacity; perform compaction in accordance with Section 02320 and Section 02324.
- E. Grade top perimeter of excavation to prevent surface water from draining into excavation.
- F. Trim excavation. Remove loose matter.
- G. Notify Architect/Engineer of unexpected subsurface conditions.
- H. Correct areas over excavated with structural fill.
- I. Remove excess and unsuitable material from site.
- J. Repair or replace items indicated to remain damaged by excavation.

## 2.2 PROTECTION

- A. Prevent displacement or loose soil from falling into excavation; maintain soil stability.
- B. Protect bottom of excavations and soil adjacent to and beneath foundation from freezing.
- C. Protect structures, utilities and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth operations.

END OF SECTION

**SECTION #31 23 00 - EXCAVATION, BACKFILLING AND COMPACTING FOR UTILITIES****PART 1 GENERAL****1.1 SECTION INCLUDES**

- A. Excavating trenches for the installation of utilities
- B. Backfilling trench with bedding material as specified and indicated and finishing filling trench with suitable material to proposed subgrade.
- C. Compacting backfill materials in an acceptable manner
- D. Borings and casings under roads

**1.2 RELATED SECTIONS**

- A. Section 31 14 00 - Earthwork
- B. Section 31 20 00 - Aggregate Materials
- C. Section 33 39 00 - Sewer Structures
- D. Section 33 11 00 - Water Distribution Systems
- E. Section 33 41 00 - Storm Sewer Systems
- F. Section 33 31 00 - Sanitary Sewer Systems
- G. Geotechnical report (if available) for boring locations and findings of subsurface materials and conditions
- H. Construction Drawings

**1.3 REFERENCE STANDARDS**

- A. American society for testing and materials (ASTM) Latest Edition
  - D 422 Method for Particle Size Analysis
  - D 698 Test for Moisture-Density Relations of Soils Using 5.5-lb. (2.5 Kg) Rammer and 12-inch (304.8mm) Drop (Standard Proctor)
  - D 1556 Test for Density of Soil in Place by the Sand Cone Method
  - D 1557 Test for Moisture-Density Relations of Soils Using 10-lb. (4.5 Kg) Rammer and 18-inch (457 mm) Drop (Modified Proctor)
  - D 1559 Test Method for Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus
  - D 2216 Laboratory Determination of Moisture Content of Soil
  - D 2487 Classification of Soils for Engineering Purposes
  - D 2922 Tests for Density of Soil and Soil-Aggregate in Place by Nuclear methods (Shallow Depth)
    - D 3017 Test for Moisture Content of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
  - D 4318 Test for Plastic Limit, Liquid Limit, & Plasticity Index of Soils
  - C 25 Chemical Analysis of Limestone, Quicklime and Hydrated Lime.
  - C 110 Physical Testing for Quicklime and Hydrated Lime, Wet Sieve Method
  - C 618 Specification for Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete
  - C 977 Quicklime and Hydrated Lime for Soil Stabilization
- B. American Association of State Highway and Transportation Officials (AASHTO) latest edition
  - T88 Mechanical Analysis of Soils

**1.4 QUALITY ASSURANCE**

Independent testing laboratory selected and paid by owner, shall be retained to perform construction testing on backfilling operations as specified in Section 31 14 00 and as stated herein.

**1.5 SUBMITTALS**

- A. Shop Drawings or details pertaining to Site Utilities are not required unless required by regulatory authorities or unless use of materials, methods, equipment, or procedures are contrary to Drawings or these specifications are proposed. Do not perform work until required shop drawings have been accepted by Owner.
- B. The Contractor shall contact all utility companies and determine if additional easements will be required to complete the project. Contractor shall provide written confirmation of the status of all easements to the Owner's Construction Manager at the time of the preconstruction conference or no later than 90 days prior to the project possession date.
- C. Submit a sample of each type of offsite fill material that is to be used in backfilling in an air-tight, 10 lb container for the testing laboratory or submit a gradation and certification of the aggregate material that is to be used to the testing laboratory for review.

**1.6 PROJECT RECORD DOCUMENTS**

Accurately record actual locations of all subsurface utilities, structures and obstructions encountered.

**PART 2 PRODUCTS****2.1 MATERIALS**

- A. Bedding Material: Processed sand and gravel free from clay lumps, organic, or other deleterious material, and complying with following gradation requirements:
 

<u>U. S. Sieve Size</u>	<u>Percent Passing (by weight)</u>
1 Inch	100
3/4 Inch	90-100
3/8 Inch	20- 55
No. 4	0- 10
No. 8	0- 5
- B. Backfill material from site as specified in Section 31 14 00 and approved by the owner or owner's representative.
- C. Backfill material from offsite as specified in Section 31 14 00 and approved by the owner or owner's representative.
- D. Steel Casing Pipe: Comply with AWWA C-201 or C-202, minimum grade B, size and wall thickness as indicated on Drawings.
- E. Acceptable Stabilization Fabrics and Geogrids
  - 1. Mirafi 500X or 600X
  - 2. Phillips 66 Supac 6WS
  - 3. Dupont Typar 3401 and 3601
  - 4. Trevira S1114 and S1120
  - 5. Tensar SS-1 and SS-2
  - 6. Exxon GTF-200 or 350
- F. Filter/Drainage Fabrics
  - 1. Mirafi 140 NS
  - 2. Phillips 66 Supac 4NP
  - 3. Dupont Typar 3341

**PART 3 EXECUTION****3.1 PREPARATION**

- A. Set all lines, elevations, and grades for utility and drainage system work and control system for duration of work, including careful maintenance of bench marks, property corners, monuments, or other reference points.
- B. Maintain in operating condition all existing utilities, active utilities and drainage systems encountered in utility installation. Repair any surface or subsurface improvements shown on Drawings.

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SECTION #31 23 00-2



- C. Verify location, size, elevation, and other pertinent data required to make connections to existing utilities and drainage systems as indicated on Drawings. Contractor shall comply with local codes and regulations.
- D. Over excavate and properly prepare areas of subgrade that are not capable of supporting the proposed systems. These areas shall be stabilized by using acceptable filter fabrics and/or additional bedding material placed and compacted as specified.
- E. Install dewatering systems that will be required to construct the proposed utilities in a manner that is described herein.

### 3.2 EXCAVATION

- A. The local utility companies shall be contacted before excavation shall begin. Dig trench at proper width and depth for laying pipe, conduit, or cable. Cut trench banks vertical if possible and remove stones from bottom of trench as necessary to avoid point-bearing. Over excavate wet or unstable soil, if encountered, from trench bottom as necessary to provide suitable base for continuous and uniform bedding.
- B. All trench excavation side walls greater than 5 feet in depth shall be sloped, shored, sheeted, braced or otherwise supported by means of sufficient strength to protect the workmen within them in accordance with the applicable rules and regulations established for construction by the Department of Labor, Occupational Safety and Health Administration (OSHA), and by local ordinances. Lateral travel distance to an exit ladder or steps shall not be greater than 25 feet in trenches 4 feet or deeper.
- C. Perform excavation as indicated for specified depths. During excavation, stockpile materials suitable for backfilling in orderly manner far enough from bank of trench to avoid overloading, slides, or cave-ins.
- D. Remove excavated materials not required or not suitable for backfill or embankments and waste as specified. Any structures discovered during excavation(s) shall be disposed of as specified.
- E. Prevent surface water from flowing into trenches or other excavations by temporary grading or other methods, as required. Remove accumulated water in trenches or other excavations by pumping or other acceptable methods.
- F. Open cut excavation with trenching machine or backhoe. Where machines other than ladder or wheel-type trenching machines are used, do not use clods for backfill. Dispose of unsuitable material and provide other suitable material at no additional cost to Owner.
- G. Accurately grade trench bottom to provide uniform bearing and support for each section of pipe on bedding material at every point along entire length, except where necessary to excavate for bell holes, proper sealing of pipe joints, or other required connections. Dig bell holes and depressions for joints after trench bottom has been graded. Dig no deeper, longer, or wider than needed to make joint connection properly.
- H. Trench width requirements below the top of the pipe shall not be less than 12" nor more than 18", wider than outside surface of any pipe or conduit that is to be installed to designated elevations and grades. All other trench width requirements for pipe, conduit, or cable shall be the least practical width that will allow for proper compaction of trench backfill.
- I. Trench depth requirements measured from finished grade or paved surface shall meet the following requirements or applicable codes and ordinances:
  1. Water Mains: 30" to top of pipe barrel or 6", below the frost line (established by the local building official), whichever is deeper.
  2. Sanitary Sewer: Elevations, and grades as indicated on Drawings.
  3. Storm Sewer: Depths, elevations, and grades as shown on Drawings.
  4. Electrical Conduits: 24" minimum to top of conduit or as required by NEC 300-5, NEC 710-36 codes, or the local utility company requirements, whichever is deeper.
  5. TV Conduits: 18" minimum to top of conduit or as required by the local utility company, whichever is deeper.
  6. Telephone Conduits: 18" minimum to top of conduit, or as required by the local utility company, whichever is deeper.
  7. Gas Mains and Service: 30" minimum to top of pipe, or as required by the local utility company, whichever is deeper.

- J. Provide sheeting and bracing, when necessary, in trenches and other excavations where protection of workmen required. Sheeting may be removed after sufficient backfilling to protect against damaging or injurious caving.

### **3.3 PIPE BEDDING**

- A. Accurately cut trenches for pipe or conduit that is installed to designated elevations 4" below bottom of pipe and to width as specified. Place 40 of bedding material, compact in bottom of trench, and accurately shape to conform to lower portion of pipe barrel. After pipe installation, place backfill as specified and compact in maximum 8" layers measured loose to the top of the trench.
- B. Place geotextile fabric as specified on the plans and specifications.

### **3.4 BACKFILLING**

- A. Criteria: Trenches shall not be backfilled until required tests are performed and the utility systems comply with and are accepted by applicable governing authorities. Backfill trenches as specified. If improperly backfilled, reopen to depth required to obtain proper compaction. Backfill and compact, as specified, to properly correct condition in an acceptable manner.
- B. Backfilling: After pipe or conduit has been installed, bedded, and tested as specified, backfill trench or structure excavation with specified material placed in 8" maximum loose lifts.
- C. Backfill trenches to the contours and elevations shown on the plans with unfrozen materials.
- D. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen or spongy subgrade surfaces.

### **3.5 COMPACTION**

- A. Exercise proper caution when compacting immediately over top of pipes or conduits. water jetting or flooding is not permitted as a method of compaction.
- B. Maintain optimum moisture content of fill materials to attain required compaction density.
- C. An independent testing laboratory shall perform testing at intervals not exceeding 200' of trench for the first and every other eight-inch (8") lift of compacted trench backfill and furnish copies of test results as specified. Compact to minimum density of 95% of optimum density in accordance with ASTM D 699 or 92% of optimum density in accordance with ASTM D1557.
- D. All materials used for backfill shall comply with the requirements of Section 31 14 00.

### **3.6 BORINGS AND CASINGS UNDER ROADS, HIGHWAYS AND RAILROAD CROSSINGS**

- A. When indicated by Drawings and specifications, all street, road, highway, or railroad crossings for utility mains installed by the jacking and boring method shall be in accordance with area specifications and governing authorities.
- B. Excavation of approach pits and trenches within right- of-way of street, road, highway, or railroad shall be of sufficient distance from paving or railroad tracks to permit traffic to pass without interference. Tamp backfill for approach pits and trenches within right - of -way in layers not greater than 6", thick for entire length and depth of trench or pit. Compact backfill to 95% of maximum density obtained at optimum moisture as determined by AASHTO T 180-57, Method A. Mechanical tampers may be used after cover of 6" has been obtained over top of barrel of pipe.
- C. Accomplish boring operation using commercial type boring rig and hole shall be bored to proper alignment and grade and within 2" of same diameter as largest outside joint diameter of pipe installed. Install pipe in hole immediately after bore has been made, and in no instance shall hole be left open while unattended.
- D. In event subsurface operations result in failure or damage to pavement within one year of construction, Contractor shall make necessary repairs to pavement at no additional cost to Owner. In event paving cracks on either side of pipe line or is otherwise disturbed or broken due to construction operations, Contractor shall repair or replace disturbed or broken area at no additional expense to the Owner.

- E. Clean and prime interior and exterior of casing pipe; and line with two coats of asphalt in accordance with area specifications and governing authorities.
- F. Butt weld steel casing welds shall be full penetration single butt-welds in accordance with AWWA C-205 and AWS D7-0-62.
- G. Install casing and utility pipe with end seals, vent pipe, and other special equipment in accordance with area specifications and governing authorities.

**END OF SECTION #31 23 00**

EXCAVATION, BACKFILLING AND COMPACTING FOR UTILITIES  
SECTION #31 23 00-6

SECTION 31 31 16  
TERMITE CONTROL

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
  - 1. Soil treatment for termite control.
- B. Related Sections:
  - 1. Section 310513 - Soils for Earthwork: Backfill materials.
  - 2. Section 312316 - Excavation and Fill: Subgrade preparation.
  - 3. Section 033000 - Cast-In-Place Concrete: Slabs on grade and foundations placed over treated soil.

1.2 REFERENCES

- A. Environmental Protection Agency:
  - 1. EPA FIFRA - Federal Insecticide, Fungicide and Rodenticide Act.
- B. National Pest Management Association:
  - 1. NPMA WDO - Wood Destroying Organism Library.

1.3 SUBMITTALS

- A. Product Data: Submit toxicants to be used, composition by percentage, dilution schedule, intended application rate. Include product label information.
- B. Test Reports: Indicate regulatory agency approval reports.
- C. Manufacturer's Application Instructions: Indicate caution requirements and in accordance with current product label of chosen pesticide.
- D. Certify applications followed NPMA WDO for termite control or other regional location guidance.

1.4 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record moisture content of soil before application, date and rate of application, areas of application, diary of toxicity meter readings and corresponding soil coverage.
- B. Operation and Maintenance Data: Indicate re-treatment schedule.

## 1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.
- B. Applicator: Company specializing in performing the Work of this section and licensed in State of Texas.

## 1.6 SEQUENCING

- A. Section 011000 - Summary: Work sequence.
- B. Apply toxicant immediately prior to installation of vapor barrier under slabs-on-grade in accordance with product label supplemented by the NPCA's ARP for termiticiding or local requirements.

## 1.7 WARRANTY

- A. Warranty: Include coverage for damage and repairs to building and building contents caused by termites. Repair damage. Re-treat where required.

## PART 2 PRODUCTS

### 2.1 MATERIALS

- A. Toxicant Chemical: EPA FIFRA approved; synthetically color dyed to permit visual identification of treated soil.
- B. Diluent: Recommended by toxicant manufacturer.

### 2.2 MIXES

- A. Mix toxicant to manufacturer's instructions.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Section 013000 - Administrative Requirements: Verification of existing conditions before starting work.
- B. Verify soil surfaces are unfrozen, sufficiently dry to absorb toxicant, and ready to receive treatment.
- C. Verify final grading and excavation are complete.

### 3.2 APPLICATION

- A. Apply toxicant at locations indicated in Schedule at end of section.
- B. Apply extra treatment to structure penetration surfaces including pipe or ducts, and soil penetrations including grounding rods or posts.
- C. Re-treat disturbed treated soil with same toxicant as original treatment.
- D. When inspection or testing identifies presence of termites, re-treat soil and re-test.

### 3.3 PROTECTION OF FINISHED WORK

- A. Section 017000 - Execution Requirements: Protecting finished Work.
- B. Do not permit soil grading over treated work.

### 3.4 SCHEDULES

- A. Locations:
  - 1. Under Slabs-on-Grade.
  - 2. Both Sides of Foundation Surface.

END OF SECTION

## **SECTION #31 32 00 - SOIL STABILIZATION**

### **PART 1 GENERAL**

#### **1.1 SECTION INCLUDES**

- A. Lime Stabilized Subgrade
- B. Cement Stabilized Subgrade
- C. Fly Ash Stabilized Subgrade
- D. Geotextile Fabric Stabilized Subgrade

#### **1.2 RELATED SECTIONS**

- A. Section 31 14 00 - Earthwork
- B. Section 31 22 00 - Excavation, Backfill and Compacting for Pavement
- C. Section 31 20 00 - Aggregate Materials
- D. Construction Drawings
- E. Geotechnical Report (if available) for boring locations and findings of subsurface materials and conditions.

#### **1.3 REFERENCE STANDARDS**

- A. American Society for Testing Materials (ASTM) latest edition.
  - C 150- Portland Cement
  - C 618- Fly Ash for Soil Stabilization
  - C 977- Quicklime and Hydrated Lime for Soil Stabilization
  - D 1633- Test method for compressive strength of molded soil cement cylinders
- B. American Association of State Highway and Transportation Officials (AASHTO) latest edition.
  - M 216 - Lime for Soil Stabilization
- C. National Lime Association (NLA)
  - Bulletin 326 - Lime Stabilization Construction Manual

#### **1.4 ENVIRONMENTAL REQUIREMENTS**

Do not install mixed materials in wind in excess of 10 mph or when temperature is below 40° F.

#### **1.5 QUALITY ASSURANCE**

Perform work in accordance with state and local standards in conjunction with requirements specified herein.

#### **1.6 SUBMITTALS**

- A. Submit a sample of each material to be used in a 10 pound air tight container to the testing laboratory.
- B. Submit the name of each materials supplier and specific type and source of each material. Any change in source throughout the job requires approval of the owner or engineer.
- C. Submit mix design and materials mix ratio that will achieve specified requirements for soil stabilization of state and local agencies.

### **PART 2 PRODUCTS**

#### **2.1 MATERIALS**

- A. Quicklime or Hydrated Lime
- B. Portland Cement
- C. Fly Ash



- D. Coarse Aggregate
- E. Fine Aggregate
- F. Subsoil: Existing Reused
- G. Geotextile Fabric for Stabilization
  - 1. Mirafi 500X or 600X
  - 2. Phillips 66 Supac 6WS
  - 3. Dupont Typar 3401 and 3601
  - 4. Trevira S1114 and S1120
  - 5. Tensar SS-1 and SS-2
  - 6. Exxon GTF-200 or 350

## **2.2 EQUIPMENT**

Perform operations using suitable, well maintained equipment capable of excavating subsoil, mixing and placing materials, wetting, consolidation and compaction of material.

## **PART 3 EXECUTION**

### **3.1 PREPARATION**

- A. Obtain Engineers approval of the mix design before proceeding with the placement.
- B. Do not start stabilization without weather and soil conditions being favorable for the successful application of the proposed material.
- C. Proof roll subgrade to identify areas in need of stabilization.

### **3.2 EXCAVATION**

- A. Excavate subsoil to a depth sufficient to accommodate soil stabilization.
- B. Remove lumped subsoil, boulders and rock that interferes with achieving uniform subsoil conditions.

### **3.3 SOIL TREATMENT AND BACKFILLING**

- A. Lime Stabilized Subgrade: Where indicated on Drawings, treat prepared subgrade with hydrated lime in accordance with applicable state highway specification. Compact to not less than 98% of optimum density as determined by ASTM D 698.
- B. Cement Stabilized Subgrade: where indicated on Drawings, treat prepared subgrade with portland cement in accordance with applicable state highway specification. Compact to not less than 98% of optimum density as determined by ASTM D 698.
- C. Fly Ash Stabilized Subgrade: where indicated on Drawings, treat prepared subgrade with fly ash in accordance with applicable state highway specification. Compact to not less than 98% of optimum density as determined by ASTM D 698.
- D. Maintain optimum moisture of mix materials to attain required stabilization and compaction.
- E. Finish subgrade surface in accordance with Section 31 14 00.

### **3.4 GEOTEXTILE FABRIC**

- A. Place fabric in those areas that are shown on the plans or in those areas that need additional stabilization prior to the placement of the base course.
- B. Place fabric specified in the plans and specifications in accordance with the manufacturers recommendations.

**END OF SECTION #31 32 00**

SOIL STABILIZATION  
SECTION #31 32 00-2

**SECTION #31 35 00 - SLOPE PROTECTION AND EROSION CONTROL**

**PART 1 GENERAL**

**1.1 SECTION INCLUDES**

- A. Temporary and permanent erosion control systems.
- B. Slope Protection Systems.

**1.2 RELATED SECTIONS**

- A. Section 31 10 00 - Site Preparation
- B. Section 31 14 00 - Earthwork
- C. Erosion Control Plan
- D. Construction Drawings

**1.3 ENVIRONMENTAL REQUIREMENTS**

- A. The contractor shall protect adjacent properties and water resources from erosion and sediment damage throughout the life of the contract.

**PART 2 PRODUCTS**

**2.1 MATERIALS**

- A. Quick growing grasses such as wheat, rye or oats.
- B. Hay or straw bales.
- C. Fencing for siltation control as specified on the plans.
- D. Curlex blankets by American Excelsior Company or approved equal.
- E. Bale stakes for each bale shall be a minimum of 4 feet in length and shall be either 2 #4 rebars, 2 steel pickets or 2-2"x2" hardwood stakes driven 1'-6" to 2'-0" into ground.
- F. Temporary mulches such as loose hay, straw, netting, wood cellulose or agricultural silage.
- G. Fence stakes shall be metal stakes a minimum of 8 feet in length.
- H. RipRap (See Section 31 14 00)

**PART 3 EXECUTION**

**3.1 PREPARATION**

- A. Review site erosion control plan.
- B. Deficiencies or changes in the erosion control plan as it is applied to current conditions will be brought to the attention of the Owner and the Engineer for remedial action.

**3.2 EROSION CONTROL AND SLOPE PROTECTION IMPLEMENTATION**

- A. Place erosion control systems in accordance with the erosion control plan.
- B. The Owner has the authority to limit the surface area of erodible earth material exposed by clearing and grubbing, excavation, borrow and embankment operations and to direct the contractor to provide immediate permanent or temporary pollution control measures. The contractor will be required to incorporate all permanent erosion control features into the project at the earliest practical time to minimize the need for temporary controls. Cut slopes shall be permanently seeded and mulched as the excavation proceeds to the extent considered desirable and practical.

- C. The temporary erosion control systems installed by the contractor shall be maintained as directed by the Owner to control siltation at all times during the life of the -contract. The contractor must respond to any maintenance or additional work ordered by the Owner within a 48 hour period.
- D. Any additional material and work required and authorized by the Owner which is beyond the extent of the erosion control plan shall be paid for by the owner.
- E. Slopes that erode easily shall be temporary seeded as the work progresses with a wheat, rye or oats application.

**3.3 STORM WATER POLLUTION PREVENTION PLAN (SWP3)**

- A. Prepare and submit Notice of Intent (NOI) to Texas Commission of Environmental Quality (TCEQ).
- B. The general contractor shall prepare a SWP3 in accordance with all requirements of TXR 150000 and submit to the Architect for review and approval prior to commencing anywork.
- C. The general contractor shall implement the SWP3 through completion of the work.

**END OF SECTION #31 35 00**

**SECTION #31 36 00 - RETAINAGE SYSTEMS****PART 1 GENERAL****1.1 SECTION INCLUDES**

- A. Furnishing and installing modular retaining wall units to the lines and grades designated on the construction drawings and as specified herein.
- B. Preparing foundation soil, furnishing and installing leveling pad or footing, unit fill and backfill to the lines and grades designated on the construction drawings.
- C. Furnishing and installing all appurtenant materials required for construction of the retaining wall (s) as shown on the construction drawings.
- D. Submission of the proprietary design information, engineering calculations, materials lists and design certifications as required herein, on the construction drawings or in the Special Conditions to the contract.

**1.2 RELATED SECTIONS**

- A. Section 31 10 00 Site Preparation
- B. Section 31 14 00 Earthwork
- C. Section Cast In Place Concrete (See Architectural/Building Specifications)
- D. Construction Drawings

**1.3 REFERENCE STANDARDS**

American Society for Testing and Materials (ASTM)  
C 90-85 Hollow Load Bearing Masonry Units  
C140-75 Sampling and Testing Concrete Masonry Units  
C145-85 Solid Load Bearing Concrete Masonry Units

**1.4 SUBMITTALS**

- A. Samples of all products used in the work of this section. If units are of such size to make submission impractical, adequate examples of finish and material shall be provided.
- B. Latest edition of manufacturer's specifications for proposed materials, and method of installation and list of materials proposed for use.
- C. Four copies of shop drawings for all walls showing overall dimensions, reinforcing, foundations, soil reinforcement, drainage systems, backfill, appurtenances to be provided and coordination with items not provided as part of the wall system.
- D. Submit required materials and drawings directly to the Owners Consulting Civil Engineer, within fifteen (15) days of the Contract Date, with a copy of the transmittal to the owner's Construction department. Prior to submittal, the design shall be certified by a professional engineer registered in the state where the project is located.

The design shall incorporate factors of safety for Sliding, Bearing, Overturning, Slope Stability and Design Uncertainties as recommended in the geotechnical investigation unless specifically waived or modified in writing by Owner's Construction Department and the Owner's Consulting Civil Engineer.

**1.5 QUALITY ASSURANCE**

- A. Soil testing and associated testing for quality control during earthwork operations will be supplied by the Owner (see Section 31 14 00). Any specific testing or inspection services required by the retaining wall design shall be clearly delineated in the submission.
- B. Construction of a mockup of adequate size to illustrate the finish and construction techniques may be required, at a location acceptable to the Owner, for any wall system with which the Owner is not familiar or for which unique design modifications are proposed.

**PART 2 PRODUCTS****2.1 MANUFACTURED UNITS**

RETAINAGE SYSTEMS  
SECTION #31 36 00-1

- A. Retaining wall units, reinforcing and accessories shall be supplied as specified in the manufacturer's submissions. Units produced under a license from an approved proprietary system shall be manufactured in a facility meeting all requirements of the licensing system with adequate capacity to supply the product to the site in a timely manner. Materials shall be stored as required to prevent damage and staining.
- B. Acceptable retainage systems which will be allowed based on shop drawings and calculations:  
"Reinforced Earth" retaining wall units - as manufactured by a licensed distribute for The Reinforced Earth Company, Bedford, Texas.  
Keystone Retaining Wall Units as manufactured by a licensed distribute for Keystone Retaining Wall Systems, Inc., Minneapolis, Minnesota.
- C. Geogrids as listed in Section 31 14 00 and specified in the approved shop drawings. Material shall be stored as required to protect from damage until used.

## 2.2 LEVELING PAD

Leveling pad material shall consist of compacted sand, gravel, crushed rock or leveling concrete as shown on the construction drawings and/or shop drawings.

## 2.3 FILL AND BACKFILL

Unit fill (if required) and backfill materials, shall be as specified and shown on the construction drawings and/or shop drawings.

## PART 3 EXECUTION

### 3.1 EXCAVATION

The contractor shall excavate to the lines and grades required. overexcavation and/or recompaction shall be performed as required to produce the specified bearing conditions.

### 3.2 LEVELING PADS

Leveling pads and foundations, unit installation, cap installation, installation of geogrid and/or other anchor materials and installation of accessories and appurtenances shall be carried out according to the manufacturer's recommendations and the approved drawings.

### 3.3 FIELD QUALITY CONTROL

- A. Testing for compaction of subgrade and fill materials shall be performed by an Independent Testing Laboratory selected and paid by Owner.
- B. If compaction requirements, embedment of reinforcing or other conditions are not met at any time during the construction process, Contractor shall remove and reconstruct deficient areas to obtain proper conditions at no additional cost to owner.
- C. Independent Testing Laboratory shall promptly prepare test reports and distribute to Owner, Owner's Consulting Civil Engineer and Contractor for all testing required by the certified and approved design documents. In the event any test performed fails to meet these requirements, Owner and Contractor shall be notified immediately by Independent Testing Laboratory.  
All costs related to retesting due to failures shall be paid for by the Contractor at no additional expense to Owner. Owner reserves the right to employ an Independent Testing Laboratory and to direct any testing that is deemed necessary. Contractor shall provide free access to site for testing activities.

**END OF SECTION #31 36 00**

## SECTION 31 63 29

### DRILLED CONCRETE PIERS AND SHAFTS

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Machine drilled shaft.
  - 2. Placing shaft liner.
  - 3. Shear rings.
  - 4. Concrete fill.
  - 5. Reinforcement.
  
- B. Related Sections:
  - 1. Section 032000 - Concrete Reinforcement: Requirements for concrete reinforcement.
  - 2. Section 033000 - Cast-In-Place Concrete.

##### 1.2 REFERENCES

- A. American Concrete Institute:
  - 1. ACI 336.1 - Reference Specification for the Construction of Drilled Piers.
  
- B. ADSC - The International Association of Foundation Drilling:
  - 1. ADSC TL-4 - Drilled Shafts: Construction Procedures and Design Methods.
  
- C. ASTM International:
  - 1. ASTM A252 - Standard Specification for Welded and Seamless Steel Pipe Piles.
  - 2. ASTM D1143 - Standard Test Method for Piles Under Static Axial Compressive Load.
  - 3. ASTM D4380 - Standard Test Method for Density of Bentonitic Slurries.
  - 4. ASTM D4381 - Standard Test Method for Sand Content by Volume of Bentonitic Slurries.

##### 1.3 DELIVERY, STORAGE, AND HANDLING

- A. Section 016000 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
  
- B. Store and handle controlled slurry materials in accordance with manufacturers instructions.
  
- C. Mix, store, and transport controlled slurry materials using equipment made for this purpose.

PART 2 PRODUCTS

2.1 DRILLED CONCRETE PIERS AND SHAFTS

- A. Concrete Materials and Mix: Specified in Section 033000.
- B. Reinforcement: Specified in Section 032000.
- C. Equipment: Appropriate to dewater excavated shaft.
- D. Controlled Slurry:
  - 1. Use controlled bentonite or polymer slurry only at locations specified or indicated on Drawings.
  - 2. Bentonite and Polymer Materials: Suitable for intended purpose according to manufacturer.
  - 3. Controlled Slurry Properties:

Properties	Results at 68EF	Test Methods
Density, before concreting, for slurry 1 ft from pier bottom	64 pcf max. for polymer slurry	API 13B, Section 1 (Mud Balance)
	85 pcf max for bentonite slurry	ASTM D4380
Marsh funnel viscosity, for entry slurry and pier slurry	26-50 sec/qt	API 13B, Section 2 (Marsh Funnel and Cup)
Sand content by volume, before concreting for slurry 1 ft from pier bottom	1% max for polymer slurry	API 13B, Section 4 (Sand Screen Set)
	25% max for bentonite slurry	ASTM D4381
pH, during excavation	8-12	API 13B, Section 6 (Paper test strips or glass-electrode pH meter)

- 4. Provide physical or chemical treatment of water or slurry necessary to meet specified requirements.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 013000 - Administrative Requirements: Coordination and project conditions.
- B. Verify site conditions are ready for Work of this section.

### 3.2 PREPARATION

- A. Use placement method that will not cause damage to nearby structures.
- B. Document existing conditions for existing structures susceptible to damage:
  - 1. Before move, inspect existing structure thoroughly and notify Architect/Engineer in writing of visible defects and factors capable of affecting safe movement of structure to final location.
  - 2. Compile list of existing visible defects to building structure, finishes, and accessories. This list will form basis for determining required repair Work after move.
- C. Notify adjacent and affected land owners and building occupants within 14 days before proceeding with the Work.
- D. Notify utility companies to mark location of existing underground services. Do not begin work of this section until existing underground services are marked.
- E. Provide survey benchmarks and control points before beginning construction of piers.
- F. Protect underground utilities and structures near the Work, from damage.

### 3.3 INSTALLATION

- A. Drill vertical pier shafts to diameters and depths indicated.
- B. Place steel liners immediately after drilling. Set firmly in place. Use shaft liner when free water is encountered.
- C. Clean shaft and bottom of loose material. Maintain shafts free of water.
- D. Allow inspection of shaft and liner prior to placement of reinforcement and concrete.
- E. Provide dowels for connection of caps and grade beams.
- F. Concreting: In accordance with Section 03300 and the following requirements:
  - 1. General:
    - a. Do not place concrete before Architect/Engineer has inspected pier.
    - b. Inspect piers before concreting, to verify loose material within pier has been removed.
    - c. Place concrete immediately after completion of cleaning operation and inspection. When concreting is postponed, repeat cleaning and inspection.
    - d. Place concrete in one continuous operation without cessation from bottom of pier to cut-off elevation to ensure complete homogeneity of concrete throughout pier with no possibilities of cavities, air pockets, honeycombing or cold joints forming in concrete.
    - e. Concrete Slump Dry Method: 5 to 6 inches.



### 3.4 DRILLING TOLERANCES

- A. Section 014000 - Quality Requirements Tolerances.
- B. Tolerances for deviations from design position, orientation and elevation:
  - 1. Maximum Deviation from Position at Top of Shaft: 3 inches.
  - 2. Maximum Deviation of Pier Shaft Radius at Bottom of Shaft: Minus 0 inches.
  - 3. Maximum Deviation of Pier Cut-Off Elevations: Plus 1 inch and minus 3 inches.
- C. Furnish corrective design and construction required to accommodate deviations exceeding specified tolerances, including replacement of piers, when necessary.

### 3.5 FIELD QUALITY CONTROL

- A. Section 014000 - Quality Requirements: Testing and Section inspection services.
- B. Engage licensed surveyor to perform survey work specified in this section, including survey of design and actual pier locations, and plumbness.
- C. Monitor benchmarks and survey control points for displacement during construction. Correct or replace displaced survey controls. Verify previous measurements relying on displaced controls.
- D. Submit survey information as the Work progresses, to expedite construction operations.
- E. Contractor Supervision: Provide supervision of each phase of drilled pier construction. Check each drilled pier or shaft for required depth, clean-up, workmanship, and for tolerance requirements before concrete is placed.
- F. Unacceptable Piers: Piers that fail, are placed out of position, exceed allowable tolerances, have defect inclusions, or are damaged.
- G. Provide additional piers or replace piers failing to conform to specified requirements.

END OF SECTION

**SECTION #32 11 00 - PAVING BASE COURSE****PART 1 GENERAL****1.1 SECTION INCLUDES**

- A. Granular Base
- B. Caliche Base
- C. Full Depth Asphalt Base
- D. Hot-Mix Sand Asphalt Base
- E. Soil Cement Stabilized Base

**1.2 RELATED SECTIONS**

- A. Section 31 10 00 - Site Preparation
- B. Section 31 14 00 - Earthwork
- C. Section 31 20 00 - Aggregate Materials
- D. Section 31 32 00 - Soil Stabilization
- E. Section 32 12 00 - Asphaltic Concrete Paving
- F. Section 32 13 00 - Portland Cement Concrete Paving
- G. Section 32 16 00 - Curbs and Sidewalk
- H. Construction Drawings
- I. Geotechnical Report for each campus

**1.3 REFERENCES**

- A. ANSI/ASTM D698 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, Using 5.5 lb (2.49 Kg) Rammer and 12 inch (304.8 mm) Drop.
- B. ANSI/ASTM D1557 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures using 10 lb (4.54 Kg) Rammer and 18 inch (457 mm) Drop.
- C. ASTM D2167 - Test Method for Density and Unit Weight of Soil in-place by the Rubber Balloon Method.
- D. ASTM D1556 - Test Method for Density of Soil in-place by the Sand-Cone Method.
- E. ASTM D2922 - Test Methods for Density of Soil and Soil-Aggregate in-place by Nuclear Methods (Shallow Depth), Method 8 (Direct Transmission).
- F. ASTM D3017 - Test Methods for Moisture Content of Soil and Soil-Aggregate Mixtures.

**PART 2 PRODUCTS****2.1 FILL MATERIALS**

- A. Submit materials certificate to on-site independent testing laboratory which is signed by material producer and Contractor, certifying that materials comply with, or exceed, the requirements herein.

**PART 3 EXECUTION****3.1 EXAMINATION**

Contractor shall verify that the subgrade has been inspected, tested and the gradients and elevations are correct, dry and properly prepared.

**3.2 CONSTRUCTION**

- A. Perform base course construction in a manner that will drain surface properly at all times and at the same time prevent runoff from adjacent areas from draining onto base course construction.
- B. Compact base material to not less than 98% of optimum density as determined by ASTM D 698 or 95% of optimum density, as determined by ASTM D 1557, unless otherwise indicated on the Drawings.
- C. Granular Base: Construct to thickness indicated on Drawings. Apply in lifts or layers not exceeding 8", measured loose.
- D. Caliche Base; Construct to thickness indicated on Drawings. Use 'Type A through E, Grades 1, 2,3 or 5" Base per TXDOT Spec. Item 247. Approximately three (3) percent lime by weight may be incorporated into the Flexible Base in the field at the Owner/Engineer's direction and will be paid for at the amount bid.  
The percent of density as determined by Compaction Ratio (Tex-113-E) for the new Flexible Base shall be a minimum of 98%.  
For water added under Item 247, the sulfate content will not exceed 3000-ppm and the chloride content will not exceed 3000-ppm.
- E. Asphalt Institute Type IV Mix for Full Depth Asphalt Base: Construct to thickness indicated on Drawings in lifts or layers not exceeding 3", measured loose.
- F. Asphalt Institute Type VI, VII, or VIII Mixes for Hot-mix Sand Asphalt Bases: Construct to thickness indicated on Drawings. Apply in lifts or layers not exceeding 3", measured loose.
- G. Soil Cement Stabilized Base: Construct to thickness and strength as indicated on Drawings and in accordance with applicable state highway specifications. If not indicated on the Drawings, the minimum compressive strength shall be 500 p.s.i., tested at 28 days.

### 3.3 FIELD QUALITY CONTROL

- A. An Independent Testing Laboratory, selected and paid by owner, shall be retained to perform construction testing of in-place base courses for compliance with requirements for thickness, compaction, density and tolerance. Paving base course tolerances shall be verified (by rod and level readings on not more than fifty-foot centers) to be not more than 0.05 feet above design elevation which will allow for paving thicknesses as shown in the Drawings. Contractor shall provide instruments and a suitable benchmark.
- B. The following tests shall be performed on each type of material used as base course material:
  - 1. Moisture and Density Relationship: ASTM D 698 or ASTM D 1557.
  - 2. Mechanical Analysis: AASHTO T-88.
  - 3. Plasticity Index: ASTM D-4318.
  - 4. Base material thickness: Perform one test for each 20,000 square feet of in-place base material area.
  - 5. Base material compaction: Perform one test in each lift for each 20,000 square feet of in-place base material area.
  - 6. Test each source of base material for compliance with applicable state highway specifications.
- C. Field density tests for in-place materials shall be performed according to one of the following standards as part of construction testing requirements:
  - 1. Sand-Cone Method: AS7M D 1556.
  - 2. Balloon Method: ASTM D 2167.
  - 3. Nuclear Method: ASTM D 2922, Method B (Direct Transmission).
- D. Independent Testing Laboratory shall prepare test reports that indicate test location, elevation data, and test results. The Owner, Engineer, and Contractor shall be provided with copies of reports within 96 hours of time test was performed. In event that any test performed fails to meet these Specifications, the Owner, Engineer and Contractor shall be notified immediately by Independent Testing Laboratory. The Owner reserves right to employ Independent Testing Laboratory and to direct any testing that is deemed by them to be necessary. Contractor shall provide free access to site for testing activities.

**END OF SECTION #32 11 00**

PAVING BASE COURSE  
SECTION #32 11 00-2

**SECTION #32 12 00 - ASPHALTIC CONCRETE PAVING****PART 1 GENERAL****1.1 SECTION INCLUDES**

- A. Asphaltic concrete paving; surface course, binder course and base course.

**1.2 RELATED SECTIONS**

- A. Section 31 22 00 - Excavation, Backfill and Compacting for Pavement
- B. Section 32 13 00 - Paving and Surfacing
- C. Section 32 11 00 - Paving Base Course
- D. Section 32 13 00- Portland Cement Concrete Paving
- E. Section 32 16 00 - Curbs
- F. Section 32 17 23 - Parking Lot and Roadway Marking
- G. Construction Drawings
- H. State Highway Department Standard Specifications
- I. Geotechnical Report for each campus

**1.3 SUBMITTALS**

- A. Design Mix: Before any asphaltic concrete paving is constructed, submit actual design mix to the Owner's Construction Department for review and/or approval. Design mix submittal shall follow the format as indicated in the Asphalt Institute Manual MS-2, Marshall Stability Method; and shall include the type/name of the mix, gradation analysis, grade of asphalt cement used, Marshall Stability (lbs.), flow, effective asphalt content (percent), and direct references to the applicable highway department specifications sections for each material. The design shall be for a mixture listed in the current edition of the applicable state roadway specifications. Mix designs over three (3) years old will not be accepted by the owner.
- B. Material Certificates: Submit materials certificate to on-site independent testing laboratory which is signed by material producer and Contractor, certifying that materials comply with, or exceed, the requirements herein.

**1.4 JOB CONDITIONS**

- A. Weather Limitations:
  - 1. Apply prime and tack coats when ambient temperature is above 40° F, and when temperature has been above 35° F for 12 hours immediately prior to application. Do not apply when base is wet, contains excess moisture, or during rain.
  - 2. Construct asphaltic concrete paving when atmospheric temperature is above 40° F.

**1.5 REFERENCES**

- A. MS-2-Mix design methods for asphaltic concrete and other hot mix types per The Asphalt Institute (AI)
- B. MS-3-Asphalt Plant Manual per The Asphalt Institute (AI)
- C. Hot Mix Asphalt Paving Handbook per US Army Corp of Engineers, UN-13 (CE MP-ET)
- D. MS-19-Basic Asphalt Emulsion Manual per The Asphalt Institute (AI)
- E. ASTM D946 - Penetration - Graded Asphalt Cement for use in Pavement Construction
- F. AASHTO M-226/ASTM D3381 Asphalt Cement
- G. AASHTO M-140/ASTM D997 or AASHTO M-208/ASTM D-2397 Tack Coat

- H. AASHTO M-117/ASTM D242 Mineral Filler
- I. AASHTO T-245/ASTM D1559 Marshall Mix Design

**PART 2 PRODUCTS**

**2.1 MATERIALS**

- A. Provide asphalt-aggregate mixture meeting TxDOT 2004 Standard Specification Item 340 for hot laid Type D (Fine Graded Surface Course). Use locally available materials and gradations which meet state highway specifications and exhibit satisfactory records of previous installations.
- B. Asphalt Cement: Comply with AASHTO M-226/ASTM D 3381; Table 2 AC-10, AC-20, or AC-30, viscosity grade, depending on local mean annual air temperature. (See chart below):

<u>Temperature Condition</u>	<u>Asphalt Grades</u>
Cold, mean annual air temperature at 7 degrees C (45 degrees F) or lower	AC-10 85/100 pen.
Warm, mean annual air temperature between 7 degrees C (45 degrees F) and 24 degrees C (75 degrees F)	AC-20 60/70 pen.
Hot, mean annual air temperature at 24 degrees C (75 degrees F) or higher	AC-30

- C. Prime Coat: A medium curing cut-back asphalt or an asphalt penetrating prime coat consisting of either MC- 30 or SS-1h.
- D. Tack Coat: Emulsified asphalt; AASHTO M-140/ASTM D 997 or AASHTO M 208/ASTM D 2397, SS-1h, CSS-1, or CSS-1h, diluted with one part water to one part emulsified asphalt.
- E. Mineral Filler: Rock or slag dust, hydraulic cement, or other inert material complying with AASHTO M-17/ASTM D 242, if recommended by applicable state highway standards.
- F. Asphalt-Aggregate Mixture: Unless otherwise noted on the Drawings, the Design Mix shall have a minimum stability based on 50-blow Marshall complying with ASTM D 1559 of 1000 lb with a flow between 8 and 16.

The Design Mix shall be within sieve analysis and bitumen ranges below:

**SIEVE ANALYSIS OF MIX**

<u>Square Sieve</u>	<u>Total Percent Passing</u>	<u>Percent Tolerance</u>
3/4"	100	7%
1/2"	80 – 100%	5%
3/8"	65 - 93%	4%
#8	40 - 55%	4%
#50	12 - 27%	2%
#200	0 - 10%	0%

Percent bitumen by weight of total mix: 5.0 - 8.5.

Air voids: 5-9%.

Percent aggregate voids filled with asphalt cement: 70 – 82%.

Allowable variance of percent bitumen by weight of total mix = 0.4

**2.2 EQUIPMENT**

Maintain equipment in satisfactory operating condition and correct breakdowns in a manner that will not delay or be detrimental to progress of paving operations.

**PART 3 EXECUTION****3.1 PREPARATION**

- A. Remove loose material from compacted base material surface immediately before applying prime coat.
- B. Proof roll prepared base material surface to check for areas requiring additional compaction and areas requiring removal and recompaction.
- C. Do not begin paving work until deficient base material areas have been corrected and are ready to receive paving.

**3.2 APPLICATIONS**

- A. Prime Coat:
  - 1. Apply bituminous prime coat to all base material surfaces where asphaltic concrete paving will be constructed.
  - 2. Apply bituminous prime coat in accordance with APWA Section 2204 and applicable state highway specifications.
  - 3. Apply at minimum rate of 0.25 gallon per square yard over compacted base material. Apply to penetrate and seal, but not flood surface.
  - 4. Make necessary precautions to protect adjacent areas from overspray.
  - 5. Cure and dry as long as necessary to attain penetration of compacted base and evaporation of volatile substances.
- Tack Coat:
  - 1. Apply to contact surfaces of previously constructed asphaltic concrete base courses or portland cement concrete and surfaces abutting or projecting into asphaltic concrete or into asphaltic concrete pavement.
  - 2. Apply tack coat to asphaltic concrete base course or sand asphalt base course. Apply emulsified asphalt tack coat between each lift or layer of full depth asphaltic concrete and sand asphalt bases and on surface of all such bases where asphaltic concrete paving will be constructed.
  - 3. Apply emulsified asphalt tack coat in accordance with APWA Section 2204 and applicable state highway specifications.
  - 4. Apply at minimum rate of 0.05 gallon per square yard of surface.
  - 5. Allow to dry until at proper condition to receive paving.

**3.3 ASPHALTIC CONCRETE PLACEMENT**

- A. Place asphaltic concrete mixture on completed compacted subgrade surface, spread, and strike off. Spread mixture at following minimum temperatures:
  - 1. When ambient temperature is between 40° F and 50° F, mixture temp. = 285° F
  - 2. When ambient temperature is between 50° F and 60° F, mixture temp. = 280° F
  - 3. When ambient temperature is higher than 60° F, mixture temp. = 275° F
- B. Whenever possible, all pavement shall be spread by a finishing machine; however, inaccessible or irregular areas may be placed by hand methods. The hot mixture shall be spread uniformly to the required depth with hot shovels and rakes. After spreading, the hot mixture shall be carefully smoothed to remove all segregated course aggregate and rake marks. Rakes and lutes used for hand spreading shall be of the type designed for use on asphalt mixtures. Loads shall not be dumped faster that they can be properly spread. workers shall-not stand on the loose mixture while spreading.

- C. Paving Machine Placement: Apply successive lifts of asphaltic concrete in transverse directions with the surface course placed in the direction of surface-water flow. Place in typical strips not less than 10'- 0" wide.
- D. Joints: Make joints between old and new pavements, or between successive days and work in a manner that will provide a continuous bond between adjoining work. Construction joints shall have same texture, density, and smoothness as other sections of asphaltic concrete course. Clean contact surfaces of all joints and apply tack coat.

### 3.4 ROLLING AND COMPACTION

- A. The mixture, after being spread, shall be thoroughly compacted by rolling as soon as it will bear the weight of the rollers without undue displacement. The number, weight, and types of rollers and sequences of rolling operations shall be such that the required density and surface are consistently attained while the mixture is in a workable condition
- B. Compact mixture with hot hand tampers or vibrating plate compactors in areas inaccessible to rollers.
- C. Breakdown Rolling: Accomplish breakdown or initial rolling immediately following rolling of joints and outside edge. Check surface after breakdown rolling, and repair displaced areas by loosening and filling with hot material.
- D. Second Rolling: Follow breakdown rolling as soon as possible, while mixture is hot. Continue second rolling until mixture has been thoroughly compacted.
- E. Finish Rolling: Perform finish rolling while mixture is still warm enough for removal of roller marks. Continue rolling until roller marks are eliminated and course has attained maximum density.
- F. Patching: Remove and replace paving areas mixed with foreign materials and defective areas. Cut out such areas and fill with fresh, hot asphaltic concrete. Compact by rolling to maximum surface density and smoothness.
- G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

### 3.5 FIELD QUALITY CONTROL

- A. Independent Testing Laboratory, selected and paid by Owner, shall be retained to perform construction testing of in-place asphaltic concrete courses for compliance with requirements for thickness, compaction and surface smoothness. Asphaltic surface and base courses shall be randomly cored at a minimum rate of one core for every 20,000 square feet of paving. However, no less than three cores in light duty areas and three cores in heavy duty areas shall be obtained. Coring holes shall be immediately filled with full-depth asphalt or with concrete. Asphaltic Concrete pavement samples shall be tested for conformance with the mix design.
- B. Grade Control: Establish and maintain required lines and elevations.
- C. Thickness: In-place compacted thickness shall not be less than thickness specified on the drawings. Areas of deficient paving thickness shall receive a tack coat and a minimum ill overlay; or shall be removed and replaced to the proper thickness, at the discretion of the Owner; until specified thickness of the course is met or exceeded at no additional expense to the Owner.
- D. Surface Smoothness: Testing shall be performed on the finished surface of each asphalt concrete course for smoothness, using 10'-0" straightedge applied parallel with, and at right angles to centerline of paved area. The results of these tests shall be made available to the owner upon request. Surfaces will not be acceptable if the following 10' straightedge tolerances for smoothness are exceeded.

Base Course Surface: 1/4"  
Wearing Course Surface: 3/16"

- E. Check surface areas at intervals necessary to eliminate ponding areas. Remove and replace unacceptable paving as directed by Owner.

- F. Compaction: Field density test for in place materials shall be performed by examination of field cores in accordance with one of the following standards:
1. Bulk specific gravity of paraffin-coated specimens: ASTM D-1188.
  2. Bulk specific gravity using saturated surface-dry specimens: ASTM D-2726.
- Rate of testing shall be one core per 20,000 square feet of pavement, with a minimum of 3 cores from heavy-duty areas and 3 cores from standard-duty areas. Cores shall be cut from areas representative of the project.
- Areas of insufficient compaction shall be delineated, removed, and replaced in compliance with the specifications at no expense to the Owner.

**END OF SECTION #32 12 00**



**SECTION #32 13 00 - PORTLAND CEMENT CONCRETE****PART 1 GENERAL****1.1 SECTION INCLUDES**

- A. Concrete, integral curbs, median barriers, parking areas and roads.

**1.2 RELATED SECTIONS**

- A. Section 31 10 00 - Site Preparation.
- B. Section 31 20 00 - Aggregate Material.
- C. Section 32 11 00- Paving Base Course.
- E. Section 32 16 00 - Curbs and Sidewalk.
- F. State Highway Department Standard Specifications.
- G. Construction Drawings.
- H. Geotechnical Report for each campus

**1.3 REFERENCES**

- A. ACI 301 - Specifications for Structural Concrete for Buildings.
- B. ACI 304 - Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete.
- C. ANSI/ASTM A185 - Welded Steel Wire Fabric for Concrete Reinforcement.
- D. ANSI/ASTM A497 - Welded Deformed Steel Wire Fabric for Concrete Reinforcement.
- E. ANSI/ASTM D1751 - Preformed Expansion Joint Fillers for Concrete Paving and Structural construction.
- F. ANSI/ASTM D1752 - Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.
- G. ASTM A615 - Deformed and Plain Billet-Steel for Concrete Reinforcement.
- H. ASTM C33 - Concrete Aggregates.
- I. ASTM C94 - Ready Mix Concrete.
- J. ASTM C150 - Portland Cement
- K. ASTM C260 - Air-Entraining Admixtures for Concrete.
- L. ASTM C309 - Liquid Membrane-Forming Compounds for Curing Concrete.
- M. ASTM C494 - Chemical Admixtures for Concrete.
- N. FS TT-C-800 - Curing Compound, Concrete, for New and Existing Surfaces.

**1.4 PERFORMANCE REQUIREMENTS**

- A. Contractor shall maintain access for vehicular and pedestrian traffic as required for other construction activities. Utilize temporary striping, flagmen, barricades, warning signs, and warning lights as required.

**PART 2 PRODUCTS****2.1 MATERIALS**

- A. Forms: Steel, wood, or other suitable material of size and strength to resist movement during concrete placement and to retain horizontal and vertical alignment until removal. Use straight forms, free of distortion and defects. Use flexible spring steel forms or laminated boards to form radius bends as required. Coat forms with non-staining type coating that will not discolor or deface surface of concrete.
- B. Welded Wire Mesh: Welded plain cold-drawn steel wire fabric, ASTM A 185. Furnish in flat sheets, not rolls, unless otherwise acceptable to Owner.
- C. Reinforcing Bars: Deformed steel bars, ASTM A 615, Grade 40.
- D. Concrete Materials: Comply with requirements applicable for concrete materials, admixtures, bonding materials, curing materials, and others as required.
- E. Joint Fillers: Resilient premolded bituminous impregnated fiberboard units complying with ASTM D 1751 FS HH-F-341, Type II, Class A; or AASHTO M 153, Type I.

- F. Joint Sealants: Non-priming, pourable, self-leveling polyurethane. Acceptable sealants are Sonneborn "Sonolastic Paving Joint Sealant, Sonneborn "Sonomeric CT 1 Sealant", Sonneborn "Sonomeric CT 2 Sealant", Mameco "Vulken 4511, or Woodmont Products "Chem-Caulk".

## 2.2 MIX DESIGN AND TESTING

- A. Concrete mix design and testing shall comply with requirements.
- B. Design mix to produce normal weight concrete consisting of Portland cement, aggregate, water-reducing admixture, air-entraining admixture, and water to produce the following properties:
1. Compressive Strength: 3,500 psi, minimum at 28 days, unless otherwise indicated on the Drawings.

## PART 3 EXECUTION

### 3.1 PREPARATION

- A. Proof-roll prepared base material surface to check for unstable areas. The paving work shall begin after the unsuitable areas have been corrected and are ready to receive paving. Compaction testing for the base material shall be completed prior to the placement of the paving.
- B. Surface Preparation: Remove loose material from compacted base material surface to produce a firm, smooth surface immediately before placing concrete.

### 3.2 INSTALLATION

- A. Form Construction
1. Set forms to required grades and lines, rigidly braced and secured.
  2. Install sufficient quantity of forms to allow continuance of work and so that forms remain in place a minimum of 24 hours after concrete placement.
  3. Check completed formwork for grade and alignment to following tolerances:  
Top of forms not more than 1/8" in 10'-0".  
Vertical face on longitudinal axis, not more than 1/4" in 10'-0".
  4. Clean forms after each use, and coat with form release agent as often as required to ensure separation from concrete without damage.
- B. Reinforcement: Locate, place and support reinforcement.
- C. Concrete Placement
1. Comply with applicable requirements .
  2. Do not place concrete until base material and forms have been checked for line and grade. Moisten base material if required to provide uniform dampened condition at time concrete is placed. Concrete shall not be placed around manholes or other structures until they are at the required finish elevation and alignment.
  3. Place concrete using methods which prevent segregation of mix. Consolidate concrete along face of forms and adjacent to transverse joints with internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Consolidate with care to prevent dislocation of reinforcing, dowels, and joint devices.
  4. Deposit and spread concrete in continuous operation between transverse joints, as far as possible. If interrupted for more than 1/2 hour, place construction joint
- D. Joint Construction: Construct expansion, weakened-plane Control (contraction), and construction joints straight with face perpendicular to concrete surface. Construct transverse joints perpendicular to centerline, unless otherwise detailed.
1. Weakened-Plane Control (Contraction) Joints: Provide joints at a spacing of 15'-0" o.c. maximum each way. Construct control joints for depth equal to at least 1/4 concrete thickness, as follows:
    - a. Form tooled joints in fresh concrete by grooving top portion with recommended tool and finishing edges with jointer.
    - b. Form sawed joints using powered saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut joints into hardened concrete as soon as surface will not be torn, abraded, or otherwise damaged by cutting action.

2. Construction Joints: Place concrete joints at end of placements and at locations where placement operations are stopped for period of more than 1/2 hour, except where such placements terminate at expansion joints. Construct joints using standard metal keyway-section forms.
  3. Expansion Joints: Locate expansion joints at 180'-0" o.c. maximum each way. Provide premolded joint filler for expansion joints abutting concrete curbs, catch basins, manholes, inlets, structures, walks, and other fixed objects.
- E. Joint Fillers: Extend joint fillers full-width and depth of joint, and not less than 1/2" or more than 1/4" below finished surface where joint sealer is indicated. Furnish joint fillers in one-piece lengths for full width being placed, wherever possible. Where more than one length is required, lace or clip joint filler sections together.
- F. Joint Sealants: All joints shall be sealed with approved exterior pavement joint sealants and shall be installed per manufacturer's recommendations.

### 3.3 CONCRETE FINISHING

- A. After striking off and consolidating concrete, smooth surface by screeding and floating. Adjust floating to compact surface and produce uniform texture. After floating, test surface for trueness with 10'-0" straightedge. Distribute concrete as required to remove surface irregularities, and refloat repaired areas to provide continuous smooth finish.
- B. Work edges of slabs, gutters, back top edge of integral curb, and formed joints with an edging tool, and round to 1/2" radius. Eliminate tool marks on concrete surface. After completion of floating and troweling when excess moisture or surface sheen has disappeared, complete surface finishing, as follows:
1. Inclined Slab Surfaces: Provide coarse, nonslip finish by scoring surface with stiff-bristled broom perpendicular to line of traffic.
  2. Paving: Provide coarse, nonslip finish by scoring surface with stiff-bristled broom perpendicular to line of traffic.
- C. Do not remove forms for 24 hours after concrete has been placed. After form removal, clean ends of joints and point up any minor honeycombed areas. Remove and replace areas or sections with major defects, as directed.
- D. Protect and cure finished concrete paving using acceptable moist-curing methods, more particularly described in the "water-curing" section of ACI 308-81.

### 3.4 CLEANING AND ADJUSTING

- A. Sweep concrete pavement and wash free of stains, discolorations, dirt, and other foreign material just prior to final inspection.
- B. Protect concrete from damage until acceptance of work. Exclude traffic from pavement for at least 14 days after placement when construction traffic is permitted, maintain pavement as clean as possible by removing surface stains and spillage of materials.

### 3.5 FIELD QUALITY CONTROL

An independent testing laboratory shall randomly core the pavement at a minimum rate of one core per 20,000 square feet of pavement, with a minimum of 3 cores from heavy-duty areas and 3 cores from standard duty areas. Core shall be tested for thickness and quality of aggregate distribution. Core holes shall be patched immediately with portland cement concrete conforming to section 2.02 and shall be finished to provide a level surface conforming to section 3.03 A & 3.03 B.

**END OF SECTION #32 13 00**

**SECTION #32 16 00 - CURB AND SIDEWALKS****PART I GENERAL****1.1 SECTION INCLUDES**

- A. Combination concrete curb and gutter
- B. Concrete Curb
- C. Concrete Flume
- D. Concrete Sidewalk

**1.2 RELATED SECTIONS**

- A. Section 31 10 00 - Site Preparation.
- B. Section 31 20 00 - Aggregate Material.
- C. Section 32 11 00 – Paving Base Course
- D. State Highway Department Standard Specifications.
- E. Construction Drawings.

**1.3 REFERENCES**

- A. ACI 304 - Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete.
- B. ANSI/ASTM D1751 - Preformed Expansion Joint Fillers for Concrete Paving and Structural construction.
- C. ANSI/ASTM D1752 - Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.
- D. AS774 C33 - Concrete Aggregates.
- E. ASTM C94 - Ready Mix Concrete.
- F. AS7M C150 - Portland Cement
- G. AS7M C260 - Air-Entraining Admixtures for Concrete.
- H. ASTM C309 - Liquid Membrane-Forming Compounds for Curing Concrete.
- I. AS7M C494 - Chemical Admixtures for Concrete.
- J. FS TT-C-800 - Curing Compound, Concrete, for New and Existing Surfaces.

**1.4 PERFORMANCE REQUIREMENTS**

- A. Contractor shall maintain access for vehicular and pedestrian traffic as required for other construction activities. Utilize temporary striping, flagmen, barricades, warning signs, and warning lights as required.

**PART 2 PRODUCTS****2.1 MATERIALS**

- A. Forms: Steel, wood, or other suitable material of size and strength to resist movement during concrete placement and to retain horizontal and vertical alignment until removal. Use straight forms, free of distortion and defects. Use flexible spring steel forms or laminated boards to form radius bends as required. The forms shall be of a depth equal to the depth of curbing or sidewalk, and so designed as to permit secure fastening together at the tops. Coat forms with non-staining type coating that will not discolor or deface surface of concrete.
- B. Concrete Materials: Comply with requirements for concrete materials, admixtures, bonding materials, curing materials, and others as required.
- C. Joint Fillers: Resilient premolded bituminous impregnated fiberboard units complying with ASTM D 1751 FS HH-F-341, Type II, Class A; or AASHTO M 153, Type I.

- D. Joint Sealers: Non-priming, pourable, self-leveling polyurethane. Acceptable sealants are Sonneborn "Sonolastic Paving Joint Sealant" Sonneborn "Sonomeric CT 1 Sealant", Sonneborn "Sonomeric CT 2 Sealant", Mameco "Vulken 4511, or Woodmont Products "Chem-Caulk".

## 2.2 MIX DESIGN AND TESTING

- A. Concrete mix design and testing shall comply with requirements.
- B. Design mix to produce normal weight concrete consisting of Portland cement, aggregate, water-reducing admixture, air-entraining admixture, and water to produce the following properties:
1. Compressive Strength: 3,500 psi, minimum at 28 days, unless otherwise indicated on the Drawings.
  2. Slump Range: 2"-5" at time of placement.
  3. Air Entrainment: 5% to 8%.

## PART 3 EXECUTION

### 3.1 PREPARATION

- A. Proof-roll prepared base material surface to check for unstable areas. The paving work shall begin after any unsuitable areas have been corrected and are ready to receive paving. Compaction testing for the base material shall be completed prior to the placement of the paving.
- B. Surface Preparation: Remove loose material from compacted base material surface to produce a firm, smooth surface immediately before placing concrete.

### 3.2 INSTALLATION

- A. Form Construction
1. Set forms to required grades and lines, rigidly braced and secured.
  2. Install sufficient quantity of forms to allow continuance of work and so that forms remain in place a minimum of 24 hours after concrete placement.
  3. Check completed formwork for grade and alignment to following tolerances:  
Top of forms not more than 1/8" in 10' – 0".  
Vertical face on longitudinal axis, not more than 1/4" in 10'-0".
  4. Clean forms after each use, and coat with form release agent as often as required to ensure separation from concrete without damage.
- B. Concrete Placement
1. Comply with applicable requirements .
  2. Do not place concrete until base material and forms have been checked for line and grade. Moisten base material if required to provide uniform dampened condition at time concrete is placed. Concrete shall not be placed around manholes or other structures until they are at the required finish elevation and alignment.
  3. Place concrete using methods which prevent segregation of mix. Consolidate concrete along face of forms and adjacent to transverse joints with internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Consolidate with care to prevent dislocation of dowels, and joint devices.
  4. Deposit and spread concrete in continuous operation between transverse joints, as far as possible. If interrupted for more than 1/2 hours, place construction joint. Automatic machine may be used for curb and gutter placement at Contractor's option. machine placement must produce curbs and gutters to required cross section, lines, grades, finish, and jointing as specified for formed concrete. If results are not acceptable, remove and replace with formed concrete as specified.
- C. Joint Construction
1. Contraction Joints: Concrete curb, concrete gutter or concrete curb and gutter, where specified on the plans, shall be constructed in uniform sections of the length specified on the plans. The joints between sections shall be formed either by steel templates 1/8 inch in thickness, of a length equal to the width of the gutter and/or curb, and with a depth

which will penetrate at least 2 inches below the surface of the curb and/or gutter; or with 3/4-inch thick preformed expansion joint filler cut to the exact cross section of the curb and/or gutter; or by sawing to a depth of at least 2 inches while the concrete is between 4 to 24 hours old. If steel templates are used, they shall be left in place until the concrete has set sufficiently to hold its shape, but shall be removed while the forms are still in place.

2. Longitudinal Construction Joints: Concrete curb, concrete gutter or combination concrete curb and gutter, where specified on the plans, shall be tied to concrete pavement with 1/2 inch round deformed reinforcement bars of the length and spacing shown on the plans.
  3. Transverse Expansion Joints: Transverse expansion joint in curb, curb and gutter, gutter or sidewalk shall have the filler cut to the exact cross section of the curb, curb and gutter, gutter or sidewalk. The joints shall be similar to the type of expansion joint used in the adjacent pavement.
- D. Joint Fillers: Extend joint fillers full-width and depth of joint, and not less than 1/2" or more than 1" below finished surface where joint sealer is indicated. Furnish joint fillers in one-piece lengths for full width being placed, wherever possible where more than one length is required, lace or clip joint filler sections together.
- E. Joint Sealants: All joints shall be sealed with approved exterior pavement joint sealants and shall be installed per manufacturer's recommendations.

### 3.3 CONCRETE FINISHING

- A. After striking off and consolidating concrete, smooth surface by screeding and floating. Adjust floating to compact surface and produce uniform texture. After floating, test surface for trueness with 10'-0" straightedge. Distribute concrete as required to remove surface irregularities, and refloat repaired areas to provide continuous smooth finish.
- B. Work edges of sidewalks, gutters, back top edge of integral curb, and formed joints with an edging tool, and round to 1/21, radius. Eliminate tool marks on concrete surface. After completion of floating and troweling when excess moisture or surface sheen has disappeared, complete surface finishing, as follows:
1. Inclined Slab Surfaces: Provide coarse, non-slip finish by scoring surface with stiff-bristled broom perpendicular to line of traffic.
  2. Curbs, gutters, and walks: Broom finish by drawing fine-hair broom across surface perpendicular to line of traffic. Repeat operation as necessary to produce a fine line texture.
- C. Do not remove forms for 24 hours after concrete has been placed. After form removal, clean ends of joints and point up any minor honeycombed areas. Remove and replace areas or sections with major defects, as directed.
- D. Protect and cure finished concrete paving using acceptable moist-curing methods, more particularly described in the "water-curing" section of ACI 308-81.

### 3.4 BACKFILL

After the concrete has set sufficiently, the spaces in front and back of the curb and gutter or sidewalk shall be refilled to the required elevation with suitable material which shall be compacted until firm and solid and neatly graded.

### 3.5 CLEANING AND ADJUSTING

- A. Sweep concrete pavement and wash free of stains, discolorations, dirt, and other foreign material just prior to final inspection.
- B. Protect concrete from damage until acceptance of work. Exclude traffic from pavement for at least 14 days after placement. When construction traffic is permitted, maintain pavement as clean as possible by removing surface stains and spillage of materials.

**END OF SECTION #32 16 00**

CURB AND SIDEWALKS  
SECTION #32 16 00- 3

**SECTION #32 17 23 - PAVEMENT MARKINGS****PART 1 GENERAL****1.1 SECTION INCLUDES**

- A. Painted pavement marking.
- B. Painted curbs, guard posts and light pole bases.

**1.2 RELATED SECTIONS**

- A. Section 31 14 00 - Earthwork
- B. Section 32 11 00 - Paving Base Course
- C. Section 32 12 00- Asphaltic Concrete Paving
- D. Section 32 13 00 - Portland Cement Concrete Paving
- E. Construction Drawings

**1.3 PROJECT CONDITIONS**

- A. Maintain access for vehicular and pedestrian traffic as required for other construction activities. Utilize flagmen, barricades, warning signs and warning lights as required.

**PART 2 PRODUCTS****2.1 MATERIALS**

- A. The paint shall be a non-bleeding, quick-drying, alkyd petroleum base paint suitable for traffic-bearing surface and shall meet FS 7TP-85E and mixed in accordance with manufacture's instructions before application.

**PART 3 EXECUTION****3.1 PREPARATION**

- A. Sweep and clean surface to eliminate loose material and dust.
- B. Where existing pavement markings are indicated on the drawings to be removed or would interfere with the adhesion of new paint, a motorized abrasive device shall be used to remove the markings. The equipment employed shall not damage the existing paving or create a surface hazardous to vehicle or pedestrian traffic. In all areas within public rights-of-way, the method of marking removal shall be approved by governing authority.

**3.2 APPLICATION**

- A. Apply two (2) coats of paint at manufacturer recommended rate without the addition of thinner, with a maximum of 100 square feet per gallon. Apply with mechanical equipment to produce uniform straight edges. At sidewalk curbs and crosswalks, use a straightedge to ensure a uniform, clean, and straight stripe.
- B. The following items shall be painted with the colors noted below:
  - 1. Pedestrian Crosswalks: Yellow
  - 2. Exterior Sidewalk Curbs, Light Pole Bases and Guardposts: Yellow
  - 3. Fire Lanes: Red or per local code
  - 4. Lane Striping where separating traffic in opposite directions: Yellow
  - 5. Lane Striping where separating traffic in the same direction: White
  - 6. Handicap Symbols: per local code
  - 7. Parking Stall Striping: plans Yellow, unless otherwise noted

**END OF SECTION #32 17 23**

**SECTION #33 11 00 - WATER DISTRIBUTION SYSTEMS****PART 1 GENERAL****1.1 SECTION INCLUDES**

Providing labor, materials, services, equipment, and other necessary items required for the construction of water systems. This shall include, but not be limited to the following: pipe and fittings for site water line including domestic water line and fire sprinkler system water line, valves and fire hydrants, setting line locations, elevations, and grades for water distribution systems work and control system for duration of work including careful maintenance of benchmarks, property corners, monuments, or other reference points.

**1.2 RELATED SECTIONS**

- A. Section 31 23 00 - Excavating, Backfill and Compacting for Utilities.
- B. Section 31 20 00 - Aggregate Materials.
- C. Section 33 39 00- Sewer Structures.
- D. Section - Fire Protection. (See Architectural/Building Specifications)
- E. Local Governing Authority and Code Requirements.
- F. All Necessary Construction Permits.
- G. Construction Drawings

**1.3 REFERENCES**

- A. AASHTO T180 - Moisture-Density Relations of Soils Using a 10-lb (4.54 kg) Rammer and an 18-in. (457 mm) Drop.
- B. ANSI/ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
- C. ANSI/ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
- D. ANSI/ASTM D1557 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10 lb (4.54 Kg) Rammer and 18 inch (457 mm) Drop.
- E. ANSI/ASTM D2466 - Polyvinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 40.
- F. ANSI/AWS A5.8 - Brazing Filler Metal.
- G. ANSI/AWWA C104 - Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
- H. ANSI/AWWA C105 - Polyethylene Encasement for Ductile Iron Piping for Water and other liquids.
- I. ANSI/AWWA C111- Rubber-Gasket Joints for Ductile Iron and Grey-Iron Pressure Pipe and Fittings.
- J. ANSI/AWWA C151 - Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids.
- K. ANSI/AWWA C500 - Gate Valves, 3 inch through 48 inch NPS, for Water and Sewage Systems.
- L. ANSI/AWWA C502 - Dry Barrel Fire Hydrants.
- M. ANSI/AWWA C504 - Rubber Seated Butterfly Valves.
- N. ANSI/AWWA C508 - Swing-Check Valves for Waterworks Service, 2 inch through 24 inch NPS.
- O. ANSI/AWWA C509 - Resilient Seated Gate Valves 3 inch through 12 inch NPS, for Water and Sewage Systems.
- P. ANSI/AWWA C600 - Installation of Ductile-Iron Water Mains and Appurtenances.
- Q. ANSI/AWWA C606 - Grooved and Shouldered Type Joints.
- R. ANSI/AWWA C651 - Disinfecting Water Mains
- S. ANSI/AWWA C900 - Standard for Polyvinyl Chloride (PVC) Pressure Pipe, 4 inch through 12 inch, for Water.
- T. ASTM B88 – Seamless Copper water Tube.
- U. ASTM D1785 - Polyvinyl Chloride (PVC) Plastic Pipe, Schedules 40, 80, and 120.
- V. ASTM D2241 - Polyvinyl Chloride (PVC) Plastic Pipe (SDR-PR).
- W. D2855 - Making Solvent-Cemented Joints with Polyvinyl Chloride (PVC) Pipe and Fittings.
- X. ASTM D2922 - Test Methods for Density of Soil and Soil- Aggregate in Place by Nuclear Methods (Shallow Depth).
- Y. ASTM D3017 - Test Methods for Moisture Content of Soil and Soil-Aggregate Mixtures.
- Z. ASTM D3139 - Joints for Plastic Pressure Pipes using Flexible Elastomeric Seals.
- AA. ASTM D3035 - Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Controlled Outside Diameter.



- BB. AWWA C901 - Polyethylene (PE) Pressure Pipe, Tubing, and Fittings, 1/2 inch through 3 inch, for water.
- CC. AWWA C600-82 - Hydrostatic Testing
- DD. UL 246 - Hydrants for Fire Protection Service.

#### **1.4 SUBMITTALS**

- A. Product Data: Provide Engineer with data on pipe materials, pipe fittings, hydrants, valves and accessories.
- B. Manufacturer's Certificate: Certify that products meet or exceed state or local requirements.

#### **1.5 PROJECT RECORD DOCUMENTS**

- A. Accurately record actual locations of piping mains, valves, connections, and top of pipe elevations
- B. Identify and describe unexpected variations to subsoil conditions and location of uncharted utilities.

#### **1.6 QUALITY ASSURANCE**

- A. Perform work in accordance with utility company and/or municipality requirements.
- B. Valves: Manufacturer's name and pressure rating marked on valve body.

### **PART 2 PRODUCTS**

#### **2.1 PIPE**

- A. Pipe sizes less than 3 inch that are installed below grade and outside building shall comply with one or combination of the following:
  - 1. Seamless Copper Tubing: Type "K" soft copper to comply with ASTM B 88-62 and installed with wrought copper (95-5 Tin Antimony solder joint) fittings in accordance with ASTM B16.22.
  - 2. Polyvinyl Chloride (PVC) Water Pipe: Pipe shall conform to ASTM D-2241 with an SDR 21 rating and shall be continually marked with manufacturer's name, pipe size, cell classification, SDR rating, and ASTM D 1784 classification. Pipe joints shall be integrally molded bell ends in accordance with ASTM D 3139 with factory supplied elastomeric gaskets and lubricant.
- B. Pipe sizes 3 inch and larger that are installed below grade and outside building shall comply with one of the following:
  - 1. Gray Cast Iron Water Pipe: In accordance with ANSI A21.6, thickness class 22, and pressure class 150. Fittings shall be either mechanical joint or push-on joint and shall comply with ANSI A21.10 or ANSI A21.11.
  - 2. Ductile Iron Water Pipe: In accordance with ANSI A21.51, Fittings shall be either mechanical joint or push-on joint complying with ANSI A21.10 or ANSI 21.11 (AWWA C-151) (CLASS 50).
  - 3. Polyvinyl Chloride (PVC) Water Pipe: Pipe shall meet the requirements of AWWA C-900 and comply with ASTM D 2241, rated SDR 21 (Class 150). Pipe shall be continually marked as for smaller pipes. Pipe joints shall be integrally molded bell ends in accordance with ASTM D 3034, Table 2, with factory supplied elastomeric gaskets and lubricant.

#### **2.2 GATE VALVES - 2 Inches and Larger**

- A. Manufacturers:
  - Mueller Resilient Seat Gate Valves or approved equal.
- B. ANSI/AWWA C509, Iron body, bronze mounted double disc, parallel seat type, non-rising stem with square nut, single wedge, resilient seat, flanged or mechanical joint ends, control rod, post indicator where indicated on plans, extension box and valve key.

#### **2.3 BALL VALVES - 2 Inches and Smaller**

- A. Manufacturers:
  - Mueller Oriseal or approved equal.

- B. Brass body, teflon coated brass ball, rubber seats and stem seals, Tee stem pre-drilled for control rod, AWWA compression inlet end, compression outlet with electrical ground connector, with control rod, extension box and valve key.

**2.4 BUTTERFLY VALVES - From 2 inches to 24 inches**

ANSI/AWWA C504, iron body, bronze disc, resilient replaceable seat, water or lug ends, infinite position lever handle.

**2.5 Check valves, post indicator valves and backflow preventors - Refer to Section 15300 (Fire Protection) in the Architectural/Building Specifications**

**2.6 HYDRANT**

- A. Hydrant: Type as required by utility company and as shown on plans.
- B. Hydrant Extensions: Fabricate in multiples of 6 inches with rod and coupling to increase barrel length.
- C. Hose and Steamer Connection: Match sizes with utility company, two hose nozzles, one pumper nozzle.
- D. Finish: Primer and two coats of enamel or special coating to as color as required by utility company.

**2.7 ACCESSORIES**

- A. Concrete for Thrust Blocks: Place thrust blocking consisting of 2,500 psi concrete to provide sufficient bearing area to transmit unbalanced thrust from bends, tees, caps, or plugs to undisturbed soil without loading undisturbed soil in excess of 2,500 lbs/sq ft when water main pressure is 100 psi.

MINIMUM THRUST BLOCKING BEARING AREAS

Pipe Diameter	Tees Sq. Ft.	90° Bend Sq. Ft.	45 ° Bend Sq. Ft.	22 1/2 ° Bend Sq. Ft.	11 1/4° Bend Sq. Ft.
3"	1.0	1.0	1.0	1.0	1.0
4"	1.0	1.0	1.0	1.0	1.0
6"	1.5	2.0	1.0	1.0	1.0
8"	2.5	3.5	1.8	1.0	1.0
10"	4.0	5.5	2.8	1.5	1.0
12"	6.0	8.0	4.0	2.0	1.5
14"	8.0	11.0	5.5	3.0	2.0
16"	10.0	14.2	7.0	4.0	3.0
18"	21.0	21.0	12.0	6.0	4.0

- B. Locked Mechanical Joint fittings shall be installed where vertical changes in direction are required and, if approved by the Owner and governing authority, can be installed in lieu of the above thrust blocking requirements.

**PART 3 EXECUTION**

**3.1 EXAMINATION**

- A. Verify existing conditions.
- B. Verify that building service connection and municipal utility water main size, location and depth are as indicated.

**3.2 PREPARATION**

- A. Ream pipe and tube ends and remove burro.

- B. Remove scale and dirt, on inside and outside, before assembly.
- C. Prepare pipe for connections to equipment with flanges or unions.

### **3.3 BEDDING**

- A. Excavate pipe trench and place bedding material in accordance with Section 31 23 00 for work of this Section.

### **3.4 INSTALLATION - PIPE AND FITTINGS**

- A. Maintain separation of water main from sanitary and storm sewer piping in accordance with state or local code.
- B. Install pipe and fittings in accordance with ANSI/AWWA C600.
- C. Install pipe to allow for expansion and contraction without stressing pipe or joints or as specified by pipe manufacturer.
- D. Install access fittings in accordance with local codes to permit disinfection of water system performed under this Section.
- E. Connections with Existing Pipelines: Where connections are made between new work and existing piping, make connection using suitable fittings for conditions encountered. Make each connection with existing pipe at time and under conditions which least interfere with operation of existing pipeline and in compliance with the local utility company.
- F. Form and place concrete for thrust blocks or other specified methods of retainage at each change of direction or end of pipe main.
- G. Establish elevations of buried piping in accordance with Section 31 23 00 for work in this Section.
- H. Backfill trench in accordance with Section 31 23 00.

### **3.5 INSTALLATION - VALVES AND HYDRANTS**

- A. Install gate valves as indicated on Drawings and supported on concrete pads with valve stem vertical and plumb. Install valve boxes in a manner that will not transmit loads, stress, or shock to valve body. Center valve box over operating nut of valve vertical and plumb. Securely fit valve box together leaving cover flush with finished surface.
- B. Install fire hydrant assemblies as indicated on Drawings in vertical and plum position with steamer/pumper nozzle pointed perpendicular to traffic where hydrant is adjacent to a street, roadway or parking lot drive or toward the protected building unless otherwise directed by local authorities. Support hydrant assembly on concrete pad and firmly braced on side opposite inlet pipe against undisturbed soil and concrete blocking. Place minimum of 6 cu. ft. of crushed stone or gravel around hydrant base and barrel after thrust blocking has cured at least 24 hours. Exercise care when backfilling and compacting so proper vertical position will not be altered.

### **3.6 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM**

Disinfect distribution system with chlorine before acceptance for domestic operation. Amount of chlorine shall be such as to provide dosage of not less than 50 parts/million. Thoroughly flush lines before introduction of chlorinating materials and after contact period of not less than 24 hours, system shall be flushed with clean water until residual chlorine content is not greater than 1.0 part/million. open and close valves in lines being disinfected several times during contact period. After disinfection, take water sample and bacteriologically test in accordance with AWWA specifications. Do not place distribution system in service until approval is obtained from applicable governing authorities.

### **3.7 SERVICE CONNECTIONS**

Provide water service connection in compliance with utility company requirements including reduced pressure backflow prevented if required and water meter with by-pass valves and sand strainer.

### **3.8 FIELD QUALITY CONTROL**

- A. Compaction testing of trench backfill shall be performed in accordance with Section 31 23 00.

B. Water distribution system pipe installed below grade and outside building shall be tested in accordance with following procedures:

1. The Contractor shall perform the testing of pipe materials, joints, and/or other materials incorporated into the construction of water mains and force mains to determine leakage and watertightness. All pressure pipeline shall be tested in accordance with Section 4 of AWWA C600-82. In the event any state or local code requires a more stringent test, the more stringent shall apply.

2. Pressure Test:  
After the pipe has been laid, all newly laid pipe or any valved section thereof shall be subjected to a hydrostatic pressure of at least 1.5 times the working pressure at the point of testing and not less than 1.25 times the working pressure at the highest point along the test section.

3. Leakage Test:  
The leakage test shall be conducted concurrently with the pressure test. Leakage is defined as the quantity of water that must be supplied into the newly laid pipeline, or any valved section thereof, to maintain pressure within 5 psi of the specified test pressure after the air in the pipeline has been expelled and the pipeline has been filled with water. Leakage shall not be measured by a drop in pressure in a test section over a period of time.

No pipeline installation will be accepted if the leakage is greater than that determined by the following formula:

$$L = \frac{SDP}{133200}$$

133200

L = allowable leakage, (gallons per hour)

S = length of pipe tested, (feet)

D = nominal diameter of pipe, (inches)

P = average test pressure during test, (psig)

4. Visible Leakage:  
All visible leaks shall be repaired regardless of the amount of leakage.

5. Acceptance of Installation:  
If any test of pipe laid in place discloses leakage greater than that specified, the Contractor shall, at his own expense, locate the leak and make repairs as necessary until the leakage is within the specified allowance.

Contractor shall supply all water for testing at no expense to the Owner.

6. Contractor shall furnish one copy of results of meter test and hydrostatic pressure test to the Owner and utility company upon completion of water distribution backfilling operations.

**END SECTION #33 11 00**

**SECTION #33 31 00 - SANITARY SEWER SYSTEM****PART 1 GENERAL****1.1 SECTION INCLUDES**

Furnish labor, materials, services, equipment, and other necessary items required for accompanying the construction of the sanitary sewer systems. This shall include, but not be limited to, the following:

Sanitary sewer drainage piping, Fittings and Accessories, Cleanouts, and Bedding.

Set lines, elevations, and grades for sanitary sewer system work and control system for duration of work, including careful maintenance of benchmarks, property corners, monuments, or other reference points.

**1.2 RELATED REQUIREMENTS**

- A. Construction Drawings
- B. Specifications Section 31 23 00 Excavation, Backfilling, and Compacting for Utilities
- C. Specifications Section 33 39 00 Sewer Structures
- D. Local governing authority and code requirements
- E. All necessary construction permits

**1.3 REFERENCES**

- A. ANSI/ASTM A74 - Cast Iron Soil Pipe and Fittings.
- B. ANSI/ASTM C12 - Practice for Installing Vitrified Clay Pipe Lines.
- C. ANSI/ASTM C14 - Concrete Sewer, Storm Drain, and Culvert Pipe.
- D. ANSI/ASTM C76 - Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.
- E. ANSI/ASTM C425 - Compression Joints for Vitrified Clay Pipe and Fittings.
- F. ANSI/ASTM C443 - Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.
- G. ANSI/ASTM D698 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, Using 5.5 lb (2.49 Kg) Rammer and 12 inch (304.8 mm) Drop.
- H. ANSI/ASTM D3034 - Type PSM Polyvinyl Chloride (PVC) Sewer Pipe and Fittings.
- I. ASTM A746 - Ductile Iron Gravity Sewer Pipe.
- J. ASTM C564 - Rubber Gaskets for Cast Iron Soil Pipe and Fittings,
- K. ASTM C700 - Vitrified Clay Pipe, Extra Strength, Standard Strength and perforated.
- L. ASTM D1785 - Polyvinyl Chloride (PVC) Plastic Pipe, Schedules 40, 80 and 120.
- M. ASTM D2922 - Test Methods for Density of Soil and Soil- Aggregate in Place by Nuclear Methods (Shallow Depth).
- N. ASTM D3017 - Test Methods for Moisture Content of Soil and Soil-Aggregate Mixtures.

**1.4 DEFINITION**

- A. Bedding: Fill placed under, beside and directly over pipe, prior to subsequent backfill operations.

**1.5 SUBMITTALS**

- A. Product Data: Provide catalog materials indicating pipe, pipe accessories, and fittings.
- B. Manufacturer's Installation Instructions: Indicate special procedures required to install Products specified.
- C. Manufacturer's Certificate: Certify that products meet or exceed ASTM designations.

**1.6 COORDINATION**

- A. Coordinate the Work with termination of sanitary sewer connection outside building, connection to municipal sewer utility service, and trenching.

**PART 2**

**SANITARY SEWER SYSTEM**  
SECTION #33 31 00 – 1

**PART 2 PRODUCTS****2.1 SEWER PIPE MATERIALS**

- A. Polyvinyl Chloride Sanitary Sewer
1. Pipe and fittings shall comply with ASTM D 3034, rated SDR 35 unless otherwise specified by the local utility. Pipe shall be continually marked with manufacturer's name, pipe size, cell classification, SDR rating, and ASTM D 3034 classification.
  2. Pipe joints shall be integrally molded bell ends per ASTM D 3034, Table 2, with factory supplied elastomeric gaskets and lubricant.
  3. Corrugated Polyvinyl Chloride sewer pipe and fittings shall comply with ASTM F 949. Pipe must be marked with manufacturer's name, pipe size, cell classification and ASTM F 949 Classification. Pipe must be installed per the manufacturer's installation requirements. Acceptable manufacturer: CON'RECH, INC. "A-2000" PVC sewer pipe or Owner-approved equivalent.

**2.2 PIPE ACCESSORIES**

- A. Pipe Joints: Mechanical clamp ring type, stainless steel expanding and contracting sleeve, neoprene ribbed gasket for positive seal.
- B. Fittings: Same material as pipe molded or formed to suit pipe size and end design, in required tee, bends, elbows, cleanouts, reducers, traps and other configurations required.

**2.3 CLEANOUTS**

- A. Lid and Frame: Heavy Duty cast iron construction, manufactured by Mueller Lid Design: Closed Lid.
- B. Shaft Construction: Cast Iron shaft of internal diameter as specified on plans with 2500 psi concrete collar for cleanouts.

**PART 3 EXECUTION****3.1 EXAMINATION**

Verify that trench cut and excavation is ready to receive work and excavations, dimensions, and elevations are as indicated on civil engineering drawings.

**3.2 PREPARATION**

- A. Hand trim excavations to required elevations. Correct over excavation with fine aggregate.
- B. Remove large stones or other hard matter which could damage pipe or impede consistent backfilling or compaction.

**3.3 BEDDING**

- A. Excavate pipe trench and place bedding material in accordance with Section 31 14 00 for work of this Section.

**3.4 INSTALLATION – PIPE**

- A. Install pipe, fittings, and accessories in accordance with ASTM C12, ASTM C14 and/or manufacturer's instructions and state or local requirements.
- B. Lay pipe to slope gradients noted on civil engineering drawings.
- C. Install pipe on bedding in accordance with Section 31 14 00 for work in this Section.
- D. Refer to Section 31 14 00 for trenching requirements. Do not displace or damage pipe when compacting.
- E. Refer to Section 33 39 00 for manhole requirements.

- F. Connect to building sanitary sewer outlet and municipal sewer system as indicated on the drawings.

**3.5 INSTALLATION – CLEANOUTS**

- A. Form bottom of excavation clean and smooth to correct elevation.
- B. Form and place cast-in-place concrete base pad, with provision for sanitary sewer pipe to be installed to proper elevations.

**3.6 FIELD QUALITY CONTROL**

- A. Compaction testing will be performed in accordance with ANSI/ASTM D698, ASTM D2922 or ASTM D3017.
- B. Test sanitary sewer pipe system installed below grade and outside building in accordance with the following procedures:

- 1. The Contractor shall perform the testing of manhole construction, pipe materials, joints and/or other materials incorporated into the construction of the sanitary sewer system to determine leakage and watertightness. In the event any state or local code requires a more stringent test, the more stringent shall apply.

- 2. Manhole Testing:  
The Owner and/or Governing Agency shall determine the method of manhole testing set forth below. The test method selected will be determined by the depth of each manhole, groundwater level, concrete honeycombing, or other conditions which make the selected test suitable for determining the physical condition and watertightness of the manhole.

2.1 Manhole Exfiltration Testing:

All incoming and outgoing sewer lines shall be plugged the manhole filled with water up to the top of the poured concrete or above the highest precast barrel joint. If the water loss exceeds the maximum allowable as shown below; the manhole shall have failed the test.

Depth of Manhole	Maximum Allowable Water Loss
0-8 feet	1 inch over 5 minutes
greater than 8 feet	1/8 gallon per vertical foot over 5 minutes

- 2.2 Manhole Vacuum Testing:  
The manhole vacuum test shall be performed with suitable apparatus made for such purpose and shall draw a vacuum of 10 inches of Mercury (Hg). The test shall pass if the vacuum remains at 10" of Mercury (Hg) or drops to not less than 9" of Mercury (Hg) in one minute.

- 3. Flexible Pipe Deflection Testing:

- 3.1 Allowable Deflection:  
The maximum allowable pipe deflection shall not exceed **(5)** five percent of the nominal inside diameter.

- 3.2 Mandrel:  
The mandrel (go/no-go) device shall be cylindrical in shape and constructed with either 9 or 16 evenly spaced arms or prongs. Mandrels with less arms will be rejected as not sufficiently accurate. The contact length of the mandrel's arms shall equal or exceed the nominal inside diameter of the sewer to be inspected. Critical mandrel dimensions shall carry a tolerance of plus or minus 0.01 inch. The mandrell and all necessary equipment for the mandrell test shall be provided by the Contractor.

- 3.3 Procedure:  
The mandrel shall be hand-pulled by the contractor through all flexible pipe sewer lines no earlier than 30 days after the trench has been completely backfilled. Any sections of the sewer not passing the mandrel shall be uncovered and the Contractor shall rebed, reround, or replace the sewer to the satisfaction of the Owner and/or Governing Agency. Any repaired section shall be retested.

- 3.4 Mandrell O.D. (outside diameter):

The outside diameter of the mandrell shall be set according to the following table:

NOMINAL DIAMETER (IN.)	MANDRELL O.D. (IN.)
6"	5.40
8"	7.12
10"	8.87
12"	10.55
15"	12.89
18"	15.30

3.5 Contractor's Warranty:

The Owner and/or Governing Agency reserves the right to mandrell test any flexible pipe sewer line before acceptance, and also prior to expiration of the first year of operation. If a previously accepted line fails a mandrell test performed during the first year of operation, the defects must be corrected at the Contractor's expense.

4. Air Testing of Gravity Sewers:  
4.1 Procedure:

- 4.1.1 Plug all pipe outlets with suitable test plugs. Brace each plug securely.
- 4.1.2 Pipe air supply to the pipeline to be tested in such a manner that the air supply may be shut off, pressure observed, and air pressure released from the pipe without workmen entering the manhole.
- 4.1.3 Add air slowly to the portion of pipe under test until the internal pressure of the line is raised to approximately 4 psig, but less than 5 psig.
- 4.1.4 Shut the air supply off and allow at least two minutes for the air pressure to stabilize
- 4.1.5 When the pressure has stabilized and is at or above the starting test pressure of 3.5 psi, start the test.
- 4.1.6 Determine the time in seconds with a stopwatch for the pressure to fall 0.5 psig so that the pressure at the end of the time is at or above 3.0 psig.
- 4.1.7 Compare the observed time with the minimum allowable times in the chart below for pass/fail determination.

1 Pipe Diameter (in.)	2 Minimum Time (min:sec.)	3 Length for Minimum Time (ft.)	4 Time for Longer Length (sec.)	SPECIFICATION TIME FOR LENGTH (L) SHOWN (MIN:SEC)							
				100 ft	150 ft	200 ft	250 ft	300 ft	350 ft	400 ft	450 ft
4	1:53	597	.190L	1:53	1:53	1:53	1:53	1:53	1:53	1:53	1:53
6	2:50	398	.427L	2:50	2:50	2:50	2:50	2:50	2:50	2:51	3:12
8	3:47	298	.760L	3:47	3:47	3:47	3:47	3:48	4:26	5:04	5:42
10	4:43	239	1.187L	4:43	4:43	4:43	4:57	5:56	6:55	7:54	8:54
12	5:40	199	1.709L	5:40	5:40	5:42	7:08	8:33	9:58	11:24	12:50
15	7:05	159	2.671L	7:05	7:05	8:54	11:08	13:21	15:35	17:48	20:02
18	8:30	133	3.846L	8:30	9:37	12:49	16:01	19:14	22:26	25:38	28:51

SANITARY SEWER SYSTEM  
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21	9:55	114	5.235L	9:55	13:05	17:27	21:49	26:11	30:32	34:54	39:16
24	11:20	99	6.837L	11:24	17:57	22:48	28:30	34:11	39:53	45:35	51:17
27	12:45	88	8.653L	14:25	21:38	28:51	36:04	43:16	50:30	57:42	46:54
30	14:10	50	10.683L	17:48	26:43	35:37	44:31	53:25	62:19	71:13	80:07
33	15:35	72	12.926L	21:33	32:19	43:56	53:52	64:38	75:24	86:10	96:57
36	17:00	66	15.384L	25:39	38:28	51:17	64:06	76:55	89:44	102:34	115:23

- 4.2 Safety Precautions:
  - The low pressure air test may be dangerous to personnel if, through lack of understanding or carelessness, a line is over pressurized or plugs are installed improperly. It is extremely important that the various plugs be installed so as to prevent the sudden expulsion of a poorly inflated plug. As an example of the hazard, a force of 250 pounds; exerted on an 8 inch plug by an internal pressure of 5 psi. Observe the following safety precautions:
    - 4.2.1 No person shall be allowed in the manholes during the test or when a plugged pipe is under pressure.
    - 4.2.2 Gauges, air piping manifolds, and valves, shall be located at the top of the ground.
    - 4.2.3 Install and brace all plugs securely.
    - 4.2.4 Do not over pressurize the lines.
- 4.3 Ground Water Elevation:
  - If the pipeline to be tested is below the ground water level, the starting test pressure shall be increased by 0.433 psi for each foot the groundwater level is above the invert of the sewer pipe. In no case shall the starting test pressure exceed 9.0 psig.
- 4.4 Acceptance of Installation:
  - No gravity sewer or manhole will be accepted that does not comply with the minimum requirements of tests described in this specification.
- 4.5 Test Equipment:
  - All necessary equipment to perform the air test in accordance with this specification shall be provided by the contractor. The test gauge shall preferably have incremental division of 0.10 psi and have an accuracy of at least plus or minus 0.04 psi. In no case shall a test gauge be used which has incremental divisions of greater than 0.25 psi. The gauge shall be of sufficient size in order to determine this accuracy.
- 4.6 Contractor shall furnish one copy of gravity sewer and manhole test results to the Owner and Governing Agency upon completion of gravity sewer system backfilling operations.

**END OF SECTION #33 31 00**

**SECTION #33 39 00 - SEWER STRUCTURES****PART 1 GENERAL****1.1 SECTION INCLUDES**

- A. Monolithic concrete manhole barrel with the option of monolithic concrete or masonry transition to lid frame, covers, anchorage and accessories.
- B. Modular pre-cast concrete manhole barrel with tongue-and-groove joints and with the option of pre-cast concrete or masonry transition to lid frame, covers, anchorage and accessories.
- C. Masonry manhole barrel with masonry transition to lid frame, covers, anchorage and accessories.
- D. Pre-cast Polyethylene manhole assemblies.

**1.2 RELATED SECTIONS**

- A. Section 31 23 00 - Excavation, Backfill, and Compacting for Utilities
- B. Section 33 41 00 - Storm Sewer Systems
- C. Section 33 31 00 - Sanitary Sewer Systems
- D. Construction Drawings

**1.3 REFERENCES**

- A. ANSI/AS7M C55 - Concrete Building Brick.
- B. ASTM A48 - Gray Iron Castings.
- C. ASTM C478 – Pre-cast Reinforced Concrete Manhole Sections.
- D. ASTM C923 - Resilient Connectors Between Reinforced Concrete Manhole Structures and Pipes.
- E. AS7M D1248 – Pre-cast Polyethylene Manholes.
- F. International Masonry Industry All-Weather Council (IMIAC): Recommended Practices and Guide Specification for Cold Weather Masonry Construction.

**1.4 SUBMITTALS**

- A. Shop Drawings: Indicate reference to drawings of manhole locations, elevations, piping with sizes, locations and elevations of penetrations.
- B. Product Data: Provide data for manhole covers, manhole steps, component construction, features, configuration, and dimensions.

**PART 2 PRODUCTS****2.1 MATERIALS**

- A. Manhole Barrel: Reinforced pre-cast concrete, in accordance with ASTM C478 with gaskets in accordance with ASTM C923.
  - 1. Construct manholes of pre-cast concrete sections as required by Drawings to size, shape, and depth indicated, but never less than 4'-0" inside diameter.
- B. Manhole Barrel: Non-reinforced cast-in-place concrete .
  - 1. Cast-in place Manholes shall be constructed of 3500 psi concrete.
  - 2. Forms shall be made of steel sheets accurately shaped and fabricated of sufficient strength to form dense watertight walls to true dimensions.
  - 3. Concrete shall be deposited in evenly distributed layers of about 18 inches, with each layer vibrated to bond it to the preceding layer.
- C. Fiberglass Manholes:  
Fiberglass Wetwell:  
General: Fiberglass reinforced polyester wetwells shall be manufactured from commercial grade polyester resin or other suitable polyester or vinyl ester resin, with fiberglass reinforcements.

Materials:

Resins: The resins used shall be a commercial grade unsaturated polyester resin.

Reinforcing Materials: The reinforcing materials shall be commercial Grade "E" type glass in the form of mat, continuous roving, chopped roving, roving fabric, or a combination of the above, having a coupling agent that will provide a suitable bond between the glass reinforcement and the resin.

Surfacing Materials: If reinforcing materials is used on the surface exposed to the contained substance, it shall be a commercial grade chemical-resistant glass that will provide a suitable bond with the resin and leave a resin rich surface.

Fillers and Additives: Fillers, when used, shall be inert to the environment and wetwell construction. Additives, such as thixotropic agents, catalysts, promoters, etc. may be added as required by the specific manufacturing process to be used. The resulting reinforced plastic material must meet the requirement of this specification.

Fabrication:

Exterior Surface: The exterior surface shall be relatively smooth with no sharp projections. Hand-work finish is acceptable if enough resin is present to eliminate fiber show. The exterior surface shall be free of blisters larger than 1/2 inch in diameter, delamination and fiber show.

Interior Surface: The interior surface shall be resin rich with no exposed fibers. The surface shall be free of crazing, delamination, blisters larger than 1/2 inch in diameter, and wrinkles of 1/8 inch or greater in depth. Surface pits shall be permitted up to 6/square feet if they are less than 3/4 inch in diameter and less than 1/16 inch deep.

Defects not Permitted:

- a. Exposed fibers: glass fibers not wet out with resin.
- b. Resin runs: Runs of resin and sand on the surface.
- c. Dry areas: Areas with glass not wet out with resin.
- d. Delamination: Separation in the laminate.
- e. Blisters: Light colored areas larger than 1/2 inch in diameter.
- f. Crazing: Cracks caused by sharp objects.
- g. Pits or Voids: Air pockets
- h. Wrinkles: Smooth irregularities in the surface.
- i. Sharp Projection: Fiber or resin projections necessitating gloves for handling.

Physical Requirements:

Load Rating: The complete wetwell shall have a minimum dynamic-load rating of 16,000 ft-lbs when tested in accordance with Testing Methods. To establish this rating, the complete wetwell shall not leak, crack, or suffer other damage when load tested to 40,000 ft-lbs and shall not deflect vertically downward more than 1/4 inch at the point of load application when loaded to 24,000 lbs.

Stiffness: The wetwell cylinder shall have a minimum pipe-stiffness values shown in the table below:

Stiffness Requirements	
Length, ft.	F/AY, psi
10 to 20	2.01
21 to 30	3.02
31 to 40	5.24

Physical Properties:

	<u>Hoop Direction</u>	Axial	<u>Direction</u>
a. Tensile Strength (psi)	18,000	5,000	
b. Tensile Modulus (psi)	0.8 x 10 <sup>6</sup>		0.7 x 10 <sup>6</sup>
c. Flexural Strength (psi)	26,000	4,500	
d. Flexural Modulus (psi)			
(no ribs – 48", 60", 72")	1.4 x 10 <sup>6</sup>	0.7 x 10 <sup>6</sup>	
(with ribs – 96", 144")	0.7 x 10 <sup>6</sup>		0.7 x 10 <sup>6</sup>

Test Methods: Test shall be performed as specified in ASTM D 3753 latest edition.

Required Thicknesses for Buried Fiberglass Manholes

Fiberglass manholes shall meet the following thickness requirements:

Diameter (in)	Wet Soil Depth (max) (ft)	Min. Thickness (in)	Min. Thickness Allowed (in)
48	10	.25	.375
	20	.3125	.375
	30	.375	.375
60	10	.375	.375
	20	.4375	.4375
	30	.5	.5000

Installation:

Fiberglass manholes will be confined to installations behind the curb, or out of heavy traffic lanes only. Further, the fiberglass manhole shall not be used for depths greater than ten (10) feet.

The manholes shall be installed according to the manhole details shown in the plans.

After the manhole has been installed into the concrete base as shown, the excavated area will be backfilled with sand.

- D. Manhole Barrel: Pre-cast Polyethylene in accordance with ASTM D 1248. Manholes shall be manufactured with factory-molded steps. The nominal cylinder internal diameter shall be 4811 and shall be designed to accept concrete filled polyethylene manhole lids and standard cast iron frames with lid or grate. Manholes shall have compressive strength which meets ASTM D 2412 standards. Acceptable Manufacturers: Advanced Drainage Systems (ADS) or Owner-Approved equivalent manufacturer.
- E. Concrete Brick Units: ANSI/ASTM C55, Grade N Type I- Moisture Controlled, normal weight, of same Grade, Type and weight as block units, nominal modular size of 3 5/8 x 7 5/8 x 2 1/4 inches.
- F. Mortar and Grout: Mortar for finishing and sealing shall be Class "C". Honeycombing less than two (2) inches deep shall be repaired using Class "D" mortar.
- G. Brick Transition Reinforcement: Formed steel 8 gage wire with galvanized finish.

## 2.2 COMPONENTS

- A. Lid and Frame: ASTM A48, Class 30B Heavy Duty Cast iron construction, machined flat bearing surface, removable lid, closed or open as specified on plans; sealing gasket; manufactured by Neenah Foundry Company or approved equal.
- B. Manhole Steps: Neenah Foundry Company catalog No. R- 1982-F for pre-cast or catalog No. R-1980-0 for brick/cast-in-place manholes or M.A. Industries PS-1 or approved equal.
- C. Base Pad: Cast-in-place concrete.

## 2.3 CONFIGURATION

- A. Barrel Construction: Concentric with eccentric cone top section.
- B. Shape: Cylindrical.
- C. Clear Inside Dimensions: 48 inch diameter or as indicated on plans.
- D. Design Depth: As indicated on plans.
- E. Clear Lid Opening: 22 inches minimum.
- F. Pipe Entry: Provide openings as indicated on plans.
- G. Main and Lateral Pipes: Neatly cut off main and lateral pipes flush with inside of manhole or inlet where they enter structure walls, and point up irregularities and rough edges with non-shrinking grout.
- H. Inverts: Shape inverts for smooth flow across structure floor as shown on Drawings. Use concrete and mortar to obtain proper grade and contour and finish surface with fine textured wood float.

**PART 3 EXECUTION****3.1 EXAMINATION**

- A. Verify items provided by other sections of Work are properly sized and located.
- B. Verify that built-in items are in proper location, and ready for roughing into work.
- C. Verify excavation for manholes is correct.

**3.2 PREPARATION**

Coordinate placement of inlet and outlet pipe or duct sleeves as indicated on plans.

**3.3 PLACING PRE-CAST MANHOLE BARREL SECTIONS**

- A. Place base pad to proper elevation and location and trowel top surface level for placement of manhole barrel.
- B. Place manhole barrel plumb and level to correct elevations and anchor to base pad.
  - 1. After completion of slab foundation the first joint of manhole barrel shall be lowered into position, grooved end first and set level and plumb on concrete base. Align and adjust to proper grade prior to placing and forming invert which shall be poured immediately after setting of first section of manhole barrel.
  - 2. Prior to setting subsequent manhole barrel sections, apply primer to tongue and groove ends and allow to set in accordance with manufacturer recommendations. Place "Ram-nek", or equivalent, plastic rope on tongue end. Lower next section into position, and remove excess material from interior of structure. Add additional material on exterior of joint, if necessary, for completely watertight joint.

**3.4 MASONRY MANHOLE BARREL CONSTRUCTION**

- A. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.
- B. Lay masonry units in running bond. Course 3 brick units and 3 mortar joints to equal 8 inches.
- C. Form flush mortar joints.
- D. Lay masonry units in full bed of mortar, with full head joints, uniformly jointed with other work.
- E. Install joint reinforcement 16 inches o.c.
- F. Place joint reinforcement in first and second horizontal joints above base pad and below lid frame opening.
- G. As work progresses, build-in fabricated metal items.
- H. Cut and fit masonry for pipes in accordance with 2.03-6 of this Section.
- I. Set cover frames and covers level without tipping, to correct elevations.

**END OF SECTION #33 39 00**

**SECTION #33 41 00 - STORM SEWER SYSTEMS****PART 1 GENERAL****1.1 SECTION INCLUDES**

- A. Site storm sewerage drainage piping, fittings and accessories, and bedding.
- B. Connection of building storm water drainage system to municipal sewers.
- C. Catch basins, paved area drainage, site surface drainage, and stormwater detention facilities.

**1.2 RELATED REQUIREMENTS**

- A. Section 31 23 00 - Excavation, Backfill, and Compacting for Utilities
- B. Section 31 35 00 - Slope Protection and Erosion Control
- C. Section 33 39 00 - Sewer Structures
- D. Section 33 31 00 - Sanitary Sewerage System
- E. Local governing authority and code requirements.
- F. All necessary construction permits.
- G. Construction Drawings

**1.3 REFERENCES**

- A. AASTHO M294 and M252 - Corrugated Polyethylene pipe smooth interior.
- B. AASHTO M36 - Metallic (Zinc or Aluminum) Coated Corrugated Steel Culverts and Underdrains.
- C. AASHTO T180 - Moisture-Density Relations of Soils Using a 10-lb (4.54 kg) Rammer and an 18-in. (457 mm) Drop.
- D. ANSI/ASTM A74 - Cast Iron Soil Pipe and Fittings.
- E. ANSI/ASTM C12 - Practice for Installing Vitrified Clay Pipe Lines.
- F. ANSI/ASTM C14 - Concrete Sewer, Storm Drain, and Culvert Pipe.
- G. ANSI/ASTM C76 - Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.
- H. ANSI/ASTM C425 - Compression Joints for Vitrified Clay Pipe and Fittings.
- I. ANSI/ASTM C443 - Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.
- J. ASTM C564 - Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
- K. ANSI/ASTM D1557 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10 lb (4.54 Kg) Rammer and 18 inch (457 mm) Drop.
- L. ANSI/ASTM D3034 - Type PSM Polyvinyl Chloride (PVC) Sewer Pipe and Fittings.
- M. ASTM C700 - Vitrified Clay Pipe, Extra Strength, Standard Strength and Perforated.
- N. ASTM D2922 - Test Methods for Density of Soil and Soil- Aggregate in Place by Nuclear Methods (Shallow Depth)
- O. ASTM D3017 - Test Methods for Moisture Content of Soil and Soil-Aggregate Mixtures.

**1.4 DEFINITIONS**

Bedding: Fill placed under, beside and directly over pipe, prior to subsequent backfill operations.

**1.5 PROJECT RECORD DOCUMENTS**

- A. Accurately record actual locations of pipe runs, connections, catch basins, cleanouts, and invert elevations.
- B. Identify and describe unexpected variations to subsoil conditions and location of uncharted utilities.

**1.6 COORDINATION**

Coordinate the Work with termination of storm sewer connection outside building including connection to municipal storm sewer system.

## **PART 2 PRODUCTS**

### **2.1 STORM SEWER PIPE MATERIALS AND ACCESSORIES**

- A. Reinforced Concrete Pipe: Comply with requirements of ASTM C 76, Class III unless another class type is indicated on Drawings, installed with flexible plastic (Bitumen) gaskets at all joints. Gaskets shall comply with AASHTO M-198 751, Type B, and shall be installed in strict accordance with pipe manufacturer's recommendations
- B. Polyvinyl Chloride (PVC) Pipe: Only permitted when specifically indicated on Drawings. Pipe and fittings shall comply with ASTM D 3034, rated SDR 35. Pipe shall be continually marked with manufacturer's name, pipe size, cell classification, SDR rating, and ASTM D 3034 classification. Pipe joints shall be integrally molded bell ends in accordance with ASTM D 3034, Table 2, with factory supplied elastomeric gaskets and lubricant.
- C. Corrugated Polyethylene Pipe (CPP) Smooth Interior: Only permitted when specifically indicated on Drawings and shall conform with AASHTO Designation M294 and M252. Pipe must be installed in accordance with pipe manufacturers installation Guidelines for Culvert Storm Drainage Applications. Acceptable manufacturers: Advanced Drainage Systems, Inc. "ADS N-1211 & HANCOR, INC. "Hi-Q" or approved equal.
- D. Polyvinyl Chloride (PVC) large diameter closed profile gravity sewer pipe, UNL-B-9: Only permitted when specifically indicated on drawings. Pipe and fittings shall comply with ASTM F-794. Pipe must be installed in accordance with pipe manufacturers installation guidelines. Acceptable manufacturer: Carlon "Vylon H.C." or approved equal.
- E. Polyvinyl Chloride (PVC) 8" through 30" diameter, smooth interior, open profile gravity sewer pipe. Only permitted when specifically indicated on drawings. Pipe and fittings shall comply with ASTM F-794 and Uni-Bell Uni-B-9. Pipe must be installed in accordance with pipe manufacturers installation guidelines. Acceptable manufacturer: Extrusion Technologies, Inc. "Ultra-Rib" or approved equal.
- F. ADS HP Storm 12" – 60" Pipe: This specification describes the 12 – through 60 – inch (300 to 1500 mm) ADS HP Storm pipe for use in gravity-flow storm drainage applications. Pipe requirements:
  - 12 – through 30-inch (300 to 750 mm) pipe shall have a smooth interior and annular exterior corrugations and meet to exceed ASTM F2736 and AASHTO M330.
  - 36 – through 60-inch (900 to 1500 mm) pipe shall have a smooth interior and annular exterior corrugations and meet or exceed ASTM F2881 and AASHTO M330.
  - Manning's "n" value for use in design shall be 0.012.

#### Joint Performance:

Pipe shall be joined with a gasketed integral bell & spigot joint meeting the requirements of ASTM F2736 or F2881, for the respective diameters.

12-through 60-inch (300 to 1500 mm) shall be watertight according to the requirements of ASTM D3212. Spigots shall have gaskets meeting the requirements of ASTM F477. Gasket shall be installed by the pipe manufacturer and covered with a removable, protective wrap to ensure the gasket is free from debris. A joint lubricant available from the manufacturer shall be used on the gasket and bell during joint assembly.

12-through 60-inch (300 to 1500 mm) diameters shall have a reinforced bell with a polymer composite band installed by the manufacturer.

#### Fittings:

Fittings shall conform to ASTM F2736, ASTM F2881 and AASHTO M330, for the respective diameters. Bell & spigot connections shall utilize a spun-on, welded or integral bell and a spigot with gaskets meeting ASTM F477. Bell & spigot fittings joint shall meet the watertight joint performance requirements of ASTM D3212. Corrugated couplings shall be split collar, engaging at least 2 full corrugations.

#### Field Pipe and Joint Performance:

To assure watertightness, field performance verification may be accomplished by testing in accordance with ASTM F2487. Appropriate safety precautions must be used when field testing any pipe material. Contact the manufacturer for recommended leakage rates.

#### Material Properties:

Polypropylene compound for pipe and fitting production shall be impact modified copolymer meeting the material requirements of ASTM F2736, Section 4, ASTM F2881, Section 5 and AASHTO M330, Section 6.1 for the respective diameters.

Installation:

Installation shall be in accordance with ASTM D2321 and ADS recommended installation guidelines, with the exception that minimum cover in traffic areas for 12 – through 48 – inch (300 to 1200 mm) diameters shall be one foot (0.3 m) and for 60 – inch (1500 mm) diameters, the minimum cover shall be 2 feet (0.6 m) in single run applications. Backfill for minimum cover situations shall consist of Class 1, Class 2 (minimum 90% SPD) or Class 3 (minimum 95%) material. Maximum fill heights depend on embedment material and compaction level. Contact your local ADS representative or visit our website at [www.ads-pipe.com](http://www.ads-pipe.com) for a copy of the latest installation guidelines.

Pipe Dimensions:

Nominal Diameter in.	12	15	18	24	30	36	42	48	60
(mm)	(300)	(375)	(450)	(600)	(750)	(900)	(1050)	(1200)	(1500)
Average Pipe I.D. in.	12.1	14.9	18.0	24.1	30.1	35.7	41.8	47.3	59.3
(mm)	(307)	(378)	(457)	(612)	(765)	(907)	(1062)	(1201)	(1506)
Average Pipe O.D. in.	14.5	17.6	21.2	28.0	35.4	41.1	47.2	53.8	66.5
(mm)	(368)	(447)	(538)	(711)	(899)	(1044)	(1199)	(1367)	(1689)
Minimum Pipe Stiffness at 5% Deflection*#/in/in.(kN/m <sup>2</sup> )	75	60	56	50	46	40	35	35	30
	(520)	(411)	(385)	(343)	(320)	(275)	(240)	(240)	(205)

**2.2 INLETS, CATCH BASINS AND JUNCTION BOXES**

- A. Lid and frame per details shown on plans.
- B. Structure construction in accordance with details shown on plans.

**PART 3 EXECUTION**

**3.1 EXAMINATION**

Verify that trench cut and excavation is ready to receive work and excavations, dimensions, and elevations are as indicated on civil engineering drawings.

**3.2 PREPARATION**

- A. Hand trim excavations to required elevations. Correct over excavation with fine aggregate.
- B. Remove large stones or other hard matter which could damage piping or impede consistent backfilling or compaction.

**3.3 BEDDING**

- A. Excavate pipe trench and place bedding material in accordance with Section 02222 for work of this Section.

**3.4 INSTALLATION – PIPE**

- A. Install pipe, fittings, and accessories in accordance with ASTM C12, ASTM D2321 or manufacturer's instructions and state or local requirements.
- B. Install pipe on bedding in accordance with Section 31 23 00 for work in this Section.
- C. Lay pipe to slope gradients noted on construction drawings.
- D. Refer to Section 31 23 00 for trenching requirements. Do not displace or damage pipe when compacting.
- E. Refer to Section 33 39 00 for manhole requirements.

**3.5 INSTALLATION - CATCH BASINS, INLETS AND JUNCTION BOXES**

- A. Form bottom of excavation clean and smooth to correct elevation.
- B. Form and place cast-in-place concrete base pad, with provision for storm sewer pipe to be placed at proper elevation.



- C. Form and place cast-in-place concrete walls, sleeved at proper elevation to receive storm sewer pipe in accordance with details shown on the plans.
- D. Form and place cast-in-place top of structure in accordance with details shown on the plans.

**END OF SECTION #33 41 00**