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## SECTION 00 31 00 - AVAILABLE PROJECT INFORMATION

### PART 1 GENERAL

#### 1.1 EXISTING CONDITIONS

- A. Certain information relating to existing surface and subsurface conditions and structures is available to bidders but will not be part of Contract Documents, as follows:
- B. Geotechnical Report: Entitled Revised Geotechnical Engineering Report, ECS Project No 01:28328-A1 , dated January 28, 2020, revised June 19, 2020 and the Updated Building Foundation Summary dated June 17, 2020.
  - 1. Original copies are available for inspection at Owner's offices during normal business hours.
  - 2. This report and the accompanying Updated Building Foundation Summary dated 6/17/2020, identifies properties of below grade conditions and offers recommendations for the design of foundations, prepared primarily for the use of Architect.
  - 3. The recommendations described shall not be construed as a requirement of this Contract, unless specifically referenced in Contract Documents.
  - 4. This report, by its nature, cannot reveal all conditions that exist on the site. Should subsurface conditions be found to vary substantially from this report, changes in the design and construction of foundations will be made, with resulting credits or expenditures to the Contract Price accruing to Owner.

### PART 2 PRODUCTS (NOT USED)

### PART 3 EXECUTION (NOT USED)

END OF SECTION

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## SECTION 00 72 00 - GENERAL CONDITIONS

### PART 1 GENERAL

#### 1.1 FORM OF GENERAL CONDITIONS

- A. AIA A201-17 - General Conditions of the Contract for Construction, articles 1 through 15 inclusive, is the General Conditions of the Contract, and is incorporated as if included herein..

#### 1.2 RELATED REQUIREMENTS

- A. SECTION 00 73 00 - Supplementary Conditions.

#### 1.3 SUPPLEMENTARY CONDITIONS

- A. Refer to Document 00 73 00 - Supplementary Conditions for Amendments to these General Conditions.

END OF SECTION

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## SECTION 00 73 00 - SUPPLEMENTARY CONDITIONS

### PART 1 GENERAL

#### 1.1 SUMMARY

- A. These Supplementary Conditions amend and supplement the General Conditions defined in Document 00 72 00 - General Conditions and other provisions of Contract Documents as indicated below. Provisions that are not so amended or supplemented remain in full force and effect.
- B. The terms used in these Supplementary Conditions that are defined in the General Conditions have the meanings assigned to them in the General Conditions.

#### 1.2 MODIFICATIONS TO GENERAL CONDITIONS

- A. These Supplementary Conditions supplement and modify AIA A201- 2017 - General Conditions of the Contract for Construction and other provisions of the Contract Documents as indicated below. All provisions not modified remain in full force.
- B. The terms used in these Supplementary Conditions, which are defined in AIA A201- 2017, have the meanings assigned to them in the General Conditions.

### ARTICLE 1 - GENERAL PROVISIONS

#### 1.1 - BASIC DEFINITIONS

ADD the following subparagraphs:

1.1.9 Approved: When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.

1.1.10 Assigning Specialists: Certain Sections of the Specifications require that specific construction activities shall be performed by specialists who are recognized experts in those operations. The specialists must be engaged for those activities, and their assignments are requirements over which the Contractor has no choice or option. However, the ultimate responsibility for fulfilling Contract requirements remains with the Contractor.

1.1.11 Directed: A command or instruction by Architect. Other terms including "requested," "authorized," "selected," "approved," "required," and "permitted" have the same meaning as "directed."

1.1.12 Equal: Where the words equal, or equal, approved equal, satisfactory, and equivalent are used, it shall be understood that where a product or color is shown as being specific to a manufacturer, an equivalent product by another manufacturer may be provided. Manufacturers and materials specified are provided only to define standard of quality, type, function, dimension, appearance, and performance required for work result desired.

1.1.13 Furnish: Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.

1.1.14 Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."

1.1.15 Install: To unpack, assemble, erect, apply, place, finish, cure, protect, clean, and make ready for use of the Owner. Unless indicated otherwise, this is the responsibility of the Contractor.

1.1.16 Products: Means new material, machinery, components, equipment, fixtures, and systems forming the Work, but does not include machinery and equipment used for preparation, fabrication, conveying and erection of the Work. Products may also include existing materials or components required for reuse.

1.1.17 Professional, Architect, Engineer, Architect/Engineer: Wherever the terms "Professional", "Architect", "Engineer", or "Architect/Engineer" are used, it shall refer to the design professional who holds the prime contract with the owner for the applicable portion of the work being described. In general, these terms are used interchangeably in the context that the design professional is to be consulted at various times for submittal reviews, approvals, pre-construction reviews, work progress reviews, and other functions as defined in the contract documents.

1.1.18 Project Site: Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

1.1.19 Provide: To furnish and install the work, complete in place and ready for use.

1.1.20 Regulations: Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.

1.1.21 Required: Provide the materials and labor to properly complete the work acceptable to the Architect, Inspector and Owner.

1.1.22 Responsibility: Products specified for the Project shall be furnished and installed by the Contractor,

1.1.23 Written Notice: Written notice shall be deemed to have been duly served if delivered in person to the individual or to whom it is intended or to an officer or agent of the corporation for whom it is intended, or if delivered at or sent by certified mail to the last business address known at execution of contract.

## 1.2 - CORRELATION AND INTENT OF THE CONTRACT DOCUMENTS

ADD Paragraph 1.2.1.2 to Section 1.2.1:

1.2.1.2 In the case of conflicts or discrepancies between Drawings and Divisions 2–49 of the Specifications, or within or among the Contract Documents and not clarified by Addendum, the Architect will determine which takes precedence in accordance with Sections 4.2.11, 4.2.12, and 4.2.13

ADD the following subparagraphs:

1.2.4 Where structural or fire-resistive requirements are indicated but the specific means to be provided is not entirely detailed, the minimum acceptable work the Contractor may provide shall be in accordance with the building codes governing the work and are to be included in the Contract Sum.

1.2.5 Should the finished work not comply with the building codes governing the work, a Modification detailing and specifying the required work will be prepared for submittal to the building department for approval at no additional cost to the Owner, and the work of the modification shall not commence until such approval is secured.

1.2.5 General Conditions and Supplementary Conditions apply to all Sections of the Specifications. Contractor shall comply with the most stringent requirements where referred to in more than one portion of the Specifications.

1.2.6 Sections of Division 01 - General Requirements govern the execution of the work of all Sections of the Specifications.

1.2.7 Where materials, operations, equipment, devices, and similar components, are referred to in the singular number, it is the intent, unless noted otherwise, that such references shall include supplying all required materials, operations, equipment, devices, and similar components, as are required.

1.2.9 The Contractor warrants that Contractor has inspected the Project site and, based on these observations, is satisfied as to the nature and location of the work and any special conditions which are likely to be encountered at the Project site, and which may affect performance of the work.

## ARTICLE 2 - OWNER

### 2.2 INFORMATION AND SERVICES REQUIRED OF THE OWNER

DELETE Paragraph 2.3.6 in its entirety and REPLACE with the following paragraph:

2.3.6 The Contractor shall be furnished one printed and one reproducible copy of the Contract Documents approved by the Building Official (Building Permit set) from which to produce such copies as necessary for the execution of the Work.

**ADD the following subparagraphs to Paragraph 2.3:**

**2.3.7 The Owner will procure and bear cost of structural tests and special inspections as required by the applicable building code.**

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2.3.8 The Owner will procure and bear cost of filing and securing the Building Permit as required by the applicable building code.

## ARTICLE 3 - CONTRACTOR

### 3.1 GENERAL

ADD the following to Subparagraph 3.1.1:

"The Contractor shall not be deemed or construed to be an employee of the Owner, but shall always be deemed to be an independent contractor and shall have all the privileges and rights and be charged with all duties and obligations accorded to and placed by law on independent contractors."

### 3.2 REVIEW OF CONTRACT DOCUMENTS AND FIELD CONDITIONS BY CONTRACTOR

ADD Subparagraph 3.2.5

3.2.5 It shall be the responsibility of the Contractor to accurately locate all known concealed items and utilities and to protect them from injury. Damage to concealed items and utilities shall be the Contractor's responsibility and shall be immediately repaired by and at the expense of the Contractor. The Contractor shall coordinate with other contractors and all utility companies either private or public, and confirm that such items, services, and utilities that are to be removed or rerouted are properly capped or plugged, and sealed to prevent leakage.

ADD Subparagraph 3.2.6:

3.2.6 The Owner is entitled to reimbursement from the Contractor for amounts paid to the Architect for evaluating and responding to the Contractor's requests for information that are not prepared in accordance with the Contract Documents, if the Owner feels the request goes beyond a reasonable request, or where the requested information is available to the Contractor from a careful study and comparison of the Contract Documents, field conditions, other Owner-provided information, Contractor-prepared coordination drawings, or prior Project correspondence or documentation.

### 3.4 LABOR AND MATERIALS

ADD the following Subparagraph 3.4.4:

3.4.4 Accounting Records: This is an Open Book Contract. Accordingly, the Contractor shall check all materials, equipment, and labor entering into the Work and shall keep full and detail accounts and exercise such controls as may be necessary for proper financial management under this Contract, and the accounting and control systems shall be satisfactory to the Owner. The Owner and the Owner's accountants shall be afforded access to and shall be permitted to audit and copy the Contractor's records, books, correspondence, instructions, drawings, receipts, bids, subcontracts, purchase orders, vouchers, memoranda and other data relating to this Contract, and the Contractor shall preserve these for a period of three years after final payment, or for such longer period as may be required by law.

### 3.7 PERMITS, FEES, NOTICES AND COMPLIANCE WITH LAWS

DELETE Subparagraph 3.7.1 in its entirety and REPLACE with the following:

3.7.1 The Owner will secure and pay for the Building Permit and sewer and water connection charges, as applicable.

3.7.1.1 The Contractor shall obtain and pay for other permits related to City, including business licenses and hauling and dumping permits, as applicable.

ADD the following after Subparagraph 3.7.2:

3.7.2.1 The governing building code shall be the Virginia Statewide Building Code - 2015 which includes the 2015 editions of the ICC International Building Code (IBC) and the ICC International Residential Code (IRC), and locally adopted amendments.

### 3.9 SUPERINTENDENT

ADD the following after Subparagraph 3.9.1

3.9.1.1 The Owner shall have the right reasonably to object to any of the Contractor's and Subcontractor's personnel assigned to the Project, in which case the Contractor shall take all necessary action (which may include removal) to satisfy the Owner's objection.

### 3.12 SHOP DRAWINGS, PRODUCT DATA AND SAMPLES

MODIFY Subparagraph 3.12.8 to DELETE all occurrences of the word "approval" and REPLACE with the word "acceptance" in three places.

ADD the following Subparagraphs 3.12.11, 3.12.12 and 3.12.13:

3.12.11 Submittals processed by the Architect are not Modifications. The purpose of the submittal review is to establish a reporting procedure. It is intended for the Contractor's convenience in organizing the work and to permit the Architect to monitor the Contractor's progress and understanding of the design.

3.12.12 The process of review of the Contractor's submittals is not for the purpose of testing the Architect's perception. If deviations, discrepancies, or conflicts between the submittals and the Contract Documents are discovered, either prior to or after the submittals are processed by the Architect, the Contractor agrees that the Contract Documents shall control and shall be followed.

3.12.13 The Architect's review of Contractor's submittals will be limited to examination of an initial submittal and one (1) resubmittal. The Owner is entitled to obtain reimbursement from the Contractor for amounts paid to the Architect for evaluation of additional resubmittal.

### 3.13 USE OF SITE

ADD Subparagraphs 3.13.2 and 3.13.3

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3.13.2 The Contractor shall assume full responsibility for protection and safekeeping of products that are related to this construction project and stored on premises, and work performed prior to completion and acceptance of the project.

3.13.3 The Contractor shall move stored products which interfere with operations of Owner or other contractor, and shall obtain and pay for use of additional storage or work areas needed for construction operations.

### 3.18 INDEMNIFICATION

DELETE Subparagraph 3.18.1 in its entirety and REPLACE with the following:

3.18.1 To the fullest extent permitted by law and to the extent claims, damages, losses or expenses are not covered Insurance purchased by the Contractor, the Contractor shall indemnify and hold harmless the Owner, Architect, Architect's consultants and agents and employees of any of them from and against claims, damages, losses, and expenses, including but not limited to attorney's fees, arising out of or resulting from performance of the Work, provided that such claim, damage, loss or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property , but only to the extent cause by the acts or omissions of the Contractor, a Subcontractor, anyone directly or indirectly employed by them or anyone for whose acts they may be liable, regardless of whether or not such claim, damage, loss or expense is caused in part by a party indemnified hereunder. Such obligation shall not be construed to negate, abridge, or reduce other rights or obligations of indemnity which would otherwise exist as to a party or person described in this Paragraph 3.18.

## ARTICLE 4 - ARCHITECT

### 4.2 - ADMINISTRATION OF THE CONTRACT

ADD paragraph 4.2.2.1:

4.2.2.1 The Owner is entitled to reimbursement from the Contractor for amounts paid to the Architect for site visits made necessary by the fault of the Contractor or by defects and deficiencies in the Work.

MODIFY Subparagraph 4.2.9 to DELETE the words "conduct inspections" and REPLACE with "evaluate the work".

ADD paragraph 4.2.14.1:

4.2.14.1 Contractor's requests for information shall be prepared and submitted in accordance with Division 01 - General Requirements sections on the form included in the Contract Documents. The Architect will return without action requests for information that do not conform to requirements of the Contract Documents.

## ARTICLE 5 - SUBCONTRACTORS

No Modification

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## ARTICLE 6 - CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS

No Modification

## ARTICLE 7 - CHANGES IN THE WORK

### 7.1 GENERAL

**ADD the following Subparagraph 7.1.4 to Paragraph 7.1:**

**7.1.4 The combined overhead and profit included in the total cost to the Owner of a change in the Work shall be based on the following schedule:**

- .1 For the Contractor, for work performed by the Contractor's own forces, 15 percent of the cost.**
- .2 For the Contractor, for work performed by the Contractor's Subcontractors, 10 percent of the amount due the Subcontractors.**
- .3 For each Subcontractor involved, for work performed by that Subcontractor's own forces, 15 percent of the cost.**
- .4 For each Subcontractor involved, for Work performed by the Subcontractor's Sub-subcontractors 10 percent of the amount due the Sub-subcontractor.**
- .5 Cost to which overhead and profit is to be applied shall be determined in accordance with Subparagraph 7.3.6.**
- .6 In order to facilitate checking of quotations for extras or credits, all proposals, except those so minor that their propriety can be seen by inspection, shall be accompanied by a complete itemization of costs including labor, materials, and Subcontracts. Labor and materials shall be itemized in the manner prescribed above. Where major cost items are Subcontracts, they shall be itemized also. Changes shall not be approved without such itemization.**

## ARTICLE 8 - TIME

### 8.1 - DEFINITIONS

**DELETE Subparagraph 8.1.2 in its entirety and RREPLACE with the following:**

**8.1.2 Contract Time commences on the date of the Agreement and continues for the calendar days stipulated in the Agreement to substantially complete construction.**

**DELETE Subparagraph 8.1.4 in its entirety and REPLACE with the following:**

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

### 8.3 DELAYS AND EXTENSIONS OF TIME

**ADD the following subparagraphs to Subparagraph 8.3.1.**

- .1     The following will not be considered justifications for extension of time unless due to one of the causes stated in Paragraph 8.3 of the General Conditions.
- a. Delay caused by Subcontractor or supplier, except if the supplier is no longer in business and another supplier cannot be found in time to meet schedule.
  - b. Shortage of workmen.

## ARTICLE 9 - PAYMENTS AND COMPLETION

### 9.3 APPLICATIONS FOR PAYMENT

**ADD subparagraph 9.3.1.3:**

**9.3.1.3 Until the Work is 50 percent complete, the Owner shall pay 10 percent of the amount due the Contractor on account of progress payments. At the time the Work is 50 percent complete and thereafter, the Architect will authorize remaining partial payments to be paid in full.**

### 9.4 CERTIFICATES FOR PAYMENT

DELETE Subparagraph 9.4.1 in its entirety and REPLACE with the following:

9.4.1   The Architect will, within five days after receipt of the properly completed Contractor's Application for Payment, either issue to the Owner a Certificate for Payment, with a copy to the Contractor, for such amount as the Architect determines is properly due, or notify the Contractor and Owner in writing of the Architect's reasons for withholding certification in whole or in part as provided in Subparagraph 9.5.1.

### 9.8 - SUBSTANTIAL COMPLETION

ADD the following to the end of Subparagraph 9.8.1:

“Minor corrective work, the replacement of defective work or materials and the adjustment of control apparatus will not delay the determination that the Contract is Substantially Complete.”

DELETE Subparagraph 9.8.2 in it's entirety and replace with the following:

9.8.2   When the Contractor determines that the Work is complete in accordance with Contract Documents, the Contractor shall submit to the Owner and Architect a comprehensive list of items to be completed or corrected prior to final payment, with written certification that the Contract Documents have been reviewed, the Work has been inspected by the Contractor and by authorities having jurisdiction, and Project is ready for the Substantial Completion review. Failure to include an item on such a list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract Documents.

ADD the following to Subparagraph 9.8.3:

9.8.3.1 The Architect will perform no more than two (2) inspections to determine whether the Work or a designated portion thereof has attained Substantial Completion in accordance with the Contract Documents. If additional site visits by the Architect and the Architect's and Owner's consultants are required to review completion and correction of the Work, the costs of additional visits shall be reimbursed to the Owner by the Contractor by deducting such costs from the Final Payment.

#### 9.10 - FINAL COMPLETION AND FINAL PAYMENT

ADD the following to Subparagraph 9.10.1.

9.10.1.1 The Architect will perform no more than one inspection to determine whether the Work or a designated portion thereof has attained Final Completion in accordance with the Contract Documents. The Owner is entitled to reimbursement from the Contractor for amounts paid to the Architect for any additional inspections.

ADD the following Subparagraph 9.10.6.

9.10.6 A final payment constituting the entire unpaid balance of the Contract Sum, including the retained percentages shall be paid 30 days after final completion, of the Work in accordance with the Contract Documents. If, at the sole discretion of the Owner, it chooses to release said retainage prior to said time, this final payment may be reduced by 150 percent of the estimated dollar value of any defective or incomplete Work as determined by the Owner in its reasonable discretion. Those amounts withheld as identified for defective or incomplete Work shall be paid in a lump sum 30 days after (i) completion and approval of all such items, and (ii) acceptance of the Work by the Owner. Notwithstanding the preceding sentence, in the event Contractor does not complete the Work (whether in whole or in part), on any approved punch list for the Project (whether pertaining to all or any portion of the Project), within 30 days of the date of the list is approved by Owner, Owner may complete all such unfinished Work itself and apply all remaining retainages towards the costs and damages it incurs in connection with same. The above stated remedy is not exclusive, and neither it nor any approval by Owner of any punch list shall act to in any way waive any rights Owner has with respect to defective or incomplete Work.

#### ARTICLE 10 - PROTECTION OF PERSONS AND PROPERTY

No Modification

#### ARTICLE 11 - INSURANCE AND BONDS

ADD the following PARAGRAPH 11.6 - PROOF OF INSURANCE:

##### 11.6 PROOF OF INSURANCE

11.6.1 The Contractor shall furnish the Owner with insurance certificates as Proof of Carriage of Insurance in full compliance with all of the insurance requirements herein as a condition precedent to the execution of the Contract.

.1 Certificates and Insurance Policies shall include the following clause: "This policy shall not be canceled or reduced in required limits of liability or amounts of insurance until notice has been mailed to the Owner stating date of cancellation or reduction." Date of cancellation of reduction may not be less than 30 days after date of mailing notices.

.2 Certificates of Insurance shall state in particular the identity of those insured, the extent of insurance, the location and identity of the operation to which the insurance applies, the expiration date, and the cancellation and reduction notice.

## ARTICLE 12 - UNCOVERING AND CORRECTION OF WORK

### 12.1 - UNCOVERING OF WORK

ADD Subparagraph 12.1.3

12.1.3 After exposure, previously concealed items that conflict with the new work shall be rerouted or removed and then replaced, as required, to clear the new installation.

**ADD the following as a supplement to Subparagraph 12.2.2.1**

- a. Contractor shall warranty all work of this Contract for a period of two years after date of acceptance of work by Owner, including repair or replacement of such work, together with any other work which may be displaced or prove defective in workmanship or materials without any expense whatsoever to Owner, ordinary wear and tear, unusual abuse, or neglect excepted. Owner will give notice of observed defects with reasonable promptness. Contractor shall notify Owner upon completion of repairs.
- b. In the event of failure of Contractor to comply with the conditions stipulated above within one week after being notified in writing, the Owner may proceed to have defects repaired and made good at expense of Contractor, who shall pay costs and charges immediately upon demand.
- c. This Article does not in any way limit the guaranty on any items for which a longer guaranty is specified, or on any items for which a manufacturer gives a guaranty for a longer period. Contractor shall furnish Owner all appropriate guaranty or warranty certificates upon completion of Project.

## ARTICLE 13 - MISCELLANEOUS PROVISIONS

No Modification

## ARTICLE 14 - TERMINATION OR SUSPENSION OF THE CONTRACT

### 14.1 TERMINATION BY THE CONTRACTOR

MODIFY Subparagraph 14.1.1 as follows:

REPLACE the phase "period of 30 consecutive days" with "period of 90 consecutive days".

ADD at the end of clause .3 before the word "or": "subject to an additional grace period of 15 days;"

DELETE Subparagraph 14.1.3 in its entirety and REPLACE with the following:

14.1.3 If one of the reasons described in Subparagraph 14.1.1 or 14.1.2 exists, the Contractor may, after expiration of the time period provided in clause 14.1.1.3, upon seven days' written notice to the Owner and Architect, terminate the Contract and recover from the Owner payment for Work executed and for proven loss with respect to materials, equipment, tools, and construction equipment and machinery, including reasonable overhead, profit upon the Work performed and direct damages.

## ARTICLE 15 - CLAIMS AND DISPUTES

### 15.1 CLAIMS

ADD the following subparagraphs 15.1.6.3 and 15.1.6.4 to Paragraph 15.1.6:

15.1.6.3 Claims for increase in the Contract Time shall set forth in detail the circumstances that form the basis for the Claim, the date upon which each cause of delay began to affect the progress of the Work, the date upon which each cause of delay ceased to affect the progress of the Work and the number of days' increase in the Contract Time claimed as a consequence of each such cause of delay. The Contractor shall provide such supporting documentation as the Owner may require including, where appropriate, a revised construction schedule indicating all the activities affected by the circumstances forming the basis of the Claim.

15.1.6.4 The Contractor shall not be entitled to a separate increase in the Contract Time for each one of the number of causes of delay which may have concurrent or interrelated effects on the progress of the Work, or for concurrent delays due to the fault of the Contractor.

### 15.3 MEDIATION

DELETE Subparagraph 15.3.1 in its entirety and REPLACE with the following:

15.3.1 Any Claim arising out of or related to the Contract, except Claims relating to aesthetic effect and except those waived as provided for in Subparagraph 9.10.4, 9.10.5 and 15.1.7 shall if not resolved by negotiation under Paragraph 15.2, be subject to mediation as a condition precedent to arbitration or the institution of legal or equitable proceedings by either party.

### 15.4 ARBITRATION

DELETE Paragraph 15.4 - Arbitration in its entirety.

END OF SECTION

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## SECTION 01 10 00 - SUMMARY

### PART 1 GENERAL

#### 1.1 SUMMARY

A. Work Included: The Work of this Section includes, but is not limited to the following:

1. Project information.
2. Work covered by Contract Documents.
3. Phased construction.
4. Work by Owner.
5. Owner-furnished products.
6. Access to site.
7. Work restrictions.
8. Specification and drawing conventions.
9. Miscellaneous provisions.

#### 1.2 PROJECT INFORMATION

- A. Project Identification and Location:
- B. Block C – Condominiums - 255 Commons Dr, Falls Church, VA 22043
- C. Owner: Falls Church Gateway Partners, LLC (FCGP) c/o Hoffman & Associates
- D. Architect:
  1. SK+I Architecture, 4600 East-West Highway, Suite 700, Bethesda, MD 20814
- E. Construction Manager: Wherever the term Construction Manager appears throughout these specifications, the term shall be synonymous with “Contractor”, unless otherwise directed by the Architect or instructed per the Contract.

#### 1.3 WORK COVERED BY CONTRACT DOCUMENTS

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

1. Description of Work: Work of this project consists of new construction of a 11 story, multifamily/mixed use building constructed over a 2 level below-grade garage structure complete and ready for use. The building consists of 12 6 residential units with amenity areas, bio-retention and green roof spaces, and ground floor retail and civic spaces; Residential amenity spaces include common terraces.

- B. The cost of any additional work that is necessitated by failure of the Contractor to perform the work in accordance with the Contract Documents, shall be the responsibility of the Contractor, unless otherwise indicated in the Agreement between the Owner and Contractor/CM.

#### 1.4 CONTRACT

- A. Project will be constructed under a single prime contract.

#### 1.5 INTERRELATIONSHIP AND INTENT OF DOCUMENTS

- A. This Contract is intended to be an integral whole and shall be interpreted as internally consistent. What is required by any one Contract Document shall be considered as required by the Contract.
- B. Any work that may be required, implied or inferred by the Contract Documents, or any one or more of them, as necessary to produce a fully functioning and code compliant installation shall be provided by the Contractor and included in the Contract Sum.
- C. In the event of a conflict between the Contract Documents, the order of precedence identified in the contract shall govern and ultimately, the more stringent requirement or code shall apply.
- D. It is understood that the Contract Documents delineate the general intent of the Work and that the Contractor, Sub-Contractors and suppliers, shall provide whatever incidental labor and materials necessary to translate the intent of the documents into a finished and usable product, notwithstanding the same may have been inferred and/or omitted from the plans and specifications.
- E. The “Scope of Work” and “Summary”, usually placed in the beginning part of each Section of the Specifications is intended to designate the scope and locations of all items of the Work included therein, either generally or specifically. It is not intended to limit the Scope of the Work should plans, schedules, or notes indicate an increased scope. Inadvertent omission of an item from its proper section of the Specifications and its inclusion in another section shall not relieve the Contractor of the responsibilities for the specified item.
- F. Notice: The Contractor, its Subcontractors and material suppliers shall consult in detail the Project Manual, the General Conditions of the Contract, all Divisions and Sections of the Specifications, all Drawings, and all Addenda to the Project Manual for instructions and requirements pertaining to the Work, and at its and their cost shall provide all labor, materials, equipment and services necessary to furnish, install, and complete the Work in strict conformance with all provisions thereof.
- G. Acts and Omissions: The Contractor shall not be relieved of obligations to perform the Work in accordance with the Contract Documents either by activities or duties of the Professional in the Professional's administration of the Contract, or by tests, inspections, or approvals required by persons other than the Contractor.

- H. The Contractor shall have a continuing duty to read, carefully study, and compare each of the Contract Documents, the Shop Drawings, and the Product Data and shall give written notice to the Owner of any inconsistency, ambiguity, error or omission which the Contractor may discover with respect to these documents before proceeding with the affected Work. The issuance of the express or implied approval by the Owner or the Architect of the Contract Documents, Shop Drawings, or Product Data shall not relieve the Contractor of the continuing duties imposed hereby, nor shall any such approval be evidence of the Contractor's compliance with this Contract.

## 1.6 WORK PHASES

- A. The Work shall be conducted in a single phase unless otherwise defined in the Contract, with each and every component of the Project being completed before scheduled Substantial Completion Date as defined in the Contract.
- B. Before commencing Work, submit a schedule showing the sequence, commencement and completion dates, and move-out and -in dates of Owner's personnel for all items/components of the Work.

## 1.7 OWNER-FURNISHED PRODUCTS

- A. Owner will furnish products indicated. The Work includes receiving, unloading, handling, storing, protecting, and installing Owner-furnished products and making building services connections.
- B. Owner-Furnished Products:
  1. FFE

## ACCESS TO AND USE OF SITE

- A. General: Contractor shall have limited use of the Project site for construction operations during construction period. Contractor's use of Project site is limited to the nature of the operations happening concurrently at the site and by Owner's right to perform work or to retain other contractors on portions of Project. Use of and access to the project site shall be coordinated with the requirements of the project in its entirety, including needs of Ownership, AHJ, adjacent construction, and any relevant site-specific needs not delineated under this Contract.
- B. Use of Site: Limit use of Project site to work in areas indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.
  1. Driveways, Walkways and Entrances: Keep roadways, driveways, loading areas, and entrances serving the site and premises clear and available to public and other contractors and their employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials.
  2. Schedule deliveries to minimize disturbance to adjacent building and facilities and for use of driveways and entrances by construction operations.
  3. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.

4. Deliveries are to be scheduled and coordinated with the needs of the project site, and must fall within the requirements of all applicable permits and hours of operation.
  5. Contractor to provide an approved Site Logistics Plan prior to commencing Work. Contractor to notify Owner seven (7) days prior to any modifications to the approved Site Logistics Plan being submitted to the AHJ.
- C. **Dust Control:** Maintain a program of dust control throughout the construction operations. Use water sprays and other methods that will keep dust from rising. Dust must be controlled by utilizing chutes and enclosed dumpsters when removing debris from the building. During periods of high winds take additional control measures so that dust does not spread beyond the Limit of Work line.
- D. Construction Parking and Staging:
1. **Parking for Contractors and employees is limited at the Project Site.**
  2. Staging area, trailers, dumpsters and storage of materials shall be within the Contract limit lines described in the documents. Contractor shall furnish all labor required for loading and unloading of materials.
  3. **Temporary parking for loading and/or unloading shall be arranged with prior approval by the Owner's Representative.**
  4. Contractor shall keep access routes and parking areas used for the work clean of debris and other obstructions resulting from the work on a daily basis.
  5. Un-needed materials are to be removed promptly from site to facilitate a clean and safe work environment. No long - term storage of materials is permitted.
- E. **Truck Wash-off:** Set up and maintain an area within the construction fence for washing truck tires so that soil is contained with the Limit of Work line. Line truck washing area with free draining crushed stone and provide water and hoses. No truck shall leave the site without the tires being washed off. Contractor is responsible for any required street cleaning as a result of their work.

## 2.2 WORK RESTRICTIONS

- A. Work Restrictions, General: Comply with restrictions on construction operations.
1. Comply with limitations on use of public streets and with other requirements of authorities having jurisdiction.
  2. Use access routes as agreed upon by the Owner and Authorities Having Jurisdiction.
  3. Comply with any additional applicable agreements made between Ownership , adjacent School(s), City, and local community, as they pertain to the execution of this work.
- B. **On-Site Work Hours:** Limit work in the existing building and the site to normal business working hours (7 a.m. to 7 p.m.), Monday through Saturday, and excluding local and federal Holidays, or other governing agency requirements.

## 2.3 SPECIFICATION FORMATS AND CONVENTIONS

- A. Specification Format: The Specifications are organized into Divisions and Sections using the 3 Part SectionFormat and CSI/CSC's "MasterFormat" numbering system.
  - 1. Section Identification: The Specifications use Section numbers and titles to help cross-referencing in the Contract Documents. Sections in the Project Manual are in numeric sequence; however, the sequence is incomplete because all available Section numbers are not used. Consult the table of contents at the beginning of the Project Manual to determine numbers and names of Sections in the Contract Documents.
  - 2. Division 1: Sections in Division 1 govern the execution of the Work of all Sections in the Specifications.
- B. 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. Abbreviated Language: Language used in the Specifications and other Contract Documents is abbreviated. Words and meanings shall be interpreted as appropriate. Words implied, but not stated, shall be inferred as the sense requires. Singular words shall be interpreted as plural, and plural words shall be interpreted as singular where applicable as the context of the Contract Documents indicates.
  - 2. Imperative mood and streamlined language are generally used in the Specifications. Requirements expressed in the imperative mood are to be performed by Contractor. Occasionally, the indicative or subjunctive mood may be used in the Section Text for clarity to describe responsibilities that must be fulfilled indirectly by Contractor or by others when so noted.
- C. 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.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

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## SECTION 01 23 00 - ALTERNATES

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Description of Alternates.
- B. Procedures for pricing Alternates.
- C. Documentation of changes to Contract Price and Contract Time.

#### 1.2 ACCEPTANCE OF ALTERNATES

- A. Alternates quoted on Bid Forms will be reviewed and accepted or rejected at Owner's option. Accepted Alternates will be identified in the Owner-Contractor Agreement.
- B. Coordinate related work and modify surrounding work to integrate the Work of each Alternate.

#### 1.3 SCHEDULE OF ALTERNATES

- A. Alternate No. 1 - Residential Closet System:
  - 1. Base Bid Item: Section 06 20 00 - Rubbermaid FastTrack System
  - 2. Alternate Item: Section 06 20 00 - Vista Collection by Modular Closets.

### PART 2 PRODUCTS - NOT USED

### PART 3 EXECUTION - NOT USED

END OF SECTION

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## SECTION 01 25 00 - SUBSTITUTION PROCEDURES

### PART 1 GENERAL

#### 1.1 SUMMARY

A. Work Included: The Work of this Section includes, but is not limited to the following:

1. Administrative and procedural requirements for substitutions.

#### 1.2 DEFINITIONS

A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Architect.

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 SUBMITTALS

A. Substitution Requests: Submit PDF electronic files under required spec section submittal number. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles for originally specified item.

1. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
  - a. Form: Submit a completed Substitution Form (sample following this Section).
  - b. Statement indicating why specified product or fabrication, or installation cannot be provided, if applicable.
  - c. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by Owner and separate contractors, that will be necessary to accommodate proposed substitution. To be verified by GC.
  - d. Detailed comparison of significant qualities of proposed substitution 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.
  - e. Product Data, including drawings and descriptions of products and fabrication and installation procedures. Provide detailed comparison of both the specified and proposed products.

- f. Samples, where applicable or requested. Provide both the specified and proposed samples for review.
  - g. Certificates and qualification data, where applicable or requested.
  - h. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.
  - i. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
  - j. Detailed comparison of Contractor's construction schedule using proposed substitution 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.
2. Action: If necessary, Architect will request additional information or documentation for evaluation within 7 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. Form of Acceptance: Change Order, with the Contractor being responsible for all coordination as defined herein and within the Contract Documents.
    - b. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

#### 1.4 PROCEDURES

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

### PART 2 PRODUCTS

#### 2.1 SUBSTITUTIONS

- A. Substitutions for Cause: Submit requests for substitution immediately upon 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. Substitution request is fully documented and properly submitted.
  - b. Requested substitution will not adversely affect Contractor's construction schedule.
  - c. Requested substitution has received necessary approvals of Authorities Having Jurisdiction (AHJ).
  - d. Requested substitution is compatible with other portions of the Work.
  - e. Requested substitution has been coordinated with other portions of the Work.
  - f. Requested substitution provides specified warranty.
  - g. 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: Owner will consider requests for substitution, based on the Architect's recommendation, if received within 60 days after commencement of the Work. Requests received after that time may be considered or rejected at the sole discretion of the Owner.
  1. Conditions: Architect, if directed by the Owner, 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 3 EXECUTION (NOT USED)

END OF SECTION

## SECTION 01 26 00 - CONTRACT MODIFICATION PROCEDURES

### PART 1 GENERAL

#### 1.1 SUMMARY

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

#### 1.2 RELATED WORK

- A. Section 01 31 00 - Project Management and Coordination: Procedures for RFIs (Requests for Information).

#### 1.3 MINOR CHANGES IN THE WORK

- A. Architect will issue through Owner's Representative supplemental instructions authorizing Minor Changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on Architect's Supplemental Instructions (ASI).
- B. Requests for Information (RFIs) that require a change to the Contract Documents and have no impact on cost will be issued as sketches or revisions in the form of an ASI.
- C. Requests for Information (RFIs) that require a change to the Contract Documents that has a cost impact will be issued as sketches or revision in the form of a Proposal Request (PR).

#### 1.4 PROPOSAL REQUESTS

- A. Owner Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time on Owner's Construction Change Directive (CCD). If necessary, the description will include supplemental or revised Drawings and Specifications.
  1. Proposal Requests issued by Architect are for information only. Do not consider them instructions either to stop work in progress or to execute the proposed change.
  2. Within 7 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 unforeseen conditions require modifications to the Contract, Contractor may propose changes by submitting a request for a change to the Owner as outlined in the Contract.

#### 1.5 CHANGE ORDER PROCEDURES

- A. On Owner's approval of a Proposal Request, Contractor will issue a Change Order for signatures of Owner on form approved by the Owner's Representative. Architect will review for entitlement only but will not be responsible to determine if the quantities are correct or if the associated costs are fair and reasonable.

#### 1.6 CONSTRUCTION CHANGE DIRECTIVE (CCD)

- A. Construction Change Directive: Owner may issue a Construction Change Directive. 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.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

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## SECTION 01 29 00 - 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 RELATED REQUIREMENTS:

- A. Section 01 32 00 - "Construction Progress Documentation" for administrative requirements governing the preparation and submittal of the Contractor's construction schedule.
- B. Section 01 81 13 - "Sustainable Design Requirements - LEED v4 Homes and Multifamily Midrise" for administrative requirements governing submittal of cost breakdown information required for sustainable design documentation.
- C. Requirements from contract, including additional lender requirements

#### 1.3 DEFINITIONS

- A. Schedule of Values: A statement furnished by Contractor allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

#### 1.4 SCHEDULE OF VALUES

- A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule.
  1. Submit the schedule of values to Architect and the Owner within 45 days after Notice to Proceed as a formal submittal.
  2. Any revisions or modifications to the approved baseline schedule of value at the earliest possible date but no later than seven (7) days before the date scheduled for submittal of initial Applications for Payment
  3. Sub-schedules for Phased Work: Where the Work is separated into phases requiring separately phased payments, provide sub-schedules showing values coordinated with each phase of 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. Identification: Include the following Project identification on the schedule of values:
    - a. Project name and location.
    - b. Name of Architect.
    - c. Architect's Project number.

- d. Contractor's name and address.
- e. Date of submittal.
2. Arrange schedule of values consistent with format of AIA Document G703.
3. Arrange the schedule of values in tabular form to indicate the following for each item listed:
  - a. Related Specification Section or Division.
  - b. Description of the Work.
  - c. Name of subcontractor.
  - d. Name of manufacturer or fabricator.
  - e. Name of supplier.
  - f. Change Orders (numbers) that affect value.
  - g. Dollar value of the following, as a percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent. Round dollar amounts to whole dollars, with total equal to Contract Sum.
    - 1) Labor.
    - 2) Materials.
    - 3) Equipment.
4. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Provide enough line items for the Owner/Architect to properly review and evaluate the costs associated with the material received or the work completed.
  - a. 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.
  - b. Differentiate between items stored on-site and items stored off-site.
5. 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.
6. Purchase Contracts: Provide a separate line item in the schedule of values for each purchase contract. Show line-item value of purchase contract. Indicate Owner payments or deposits, if any, and balance to be paid by Contractor.
7. Overhead Costs: Include total cost of general overhead and profit.

- a. 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.
- 8. Closeout Costs. Include separate line items under Contractor and subcontracts for Project closeout requirements that includes O&M's, as-builts, warranties, training and punchlist in an amount totaling a minimum of five percent of the Contract Sum and subcontract amount.
- 9. Schedule of Values Revisions: Revise the schedule of values when Change Orders result in a change in the Contract Sum. Include a breakdown by subcontractor for each approved Change Order.

## 1.5 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 Construction Manager 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 as described in the Agreement. 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 Owner.
- D. Application for Payment Forms: Use AIA Document G702 and AIA Document G703 as form for Applications for Payment.
  - 1. Other Application for Payment forms proposed by the Contractor shall be acceptable to Architect and Owner. Submit forms for approval with initial submittal of schedule of values.
- 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
  - 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 approved Change Orders issued before last day of construction period covered by application.
  - 4. Stored Materials: Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed. Differentiate between items stored on-site and items stored off-site.

5. Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment for stored materials.
  6. Provide supporting documentation that verifies amount requested, such as paid invoices and photos. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.
  7. Provide summary log and supporting documentation for stored materials indicating the following:
    - a. Value of materials previously stored and remaining stored as of date of previous Applications for Payment.
    - b. Value of previously stored materials put in place after date of previous Application for Payment and on or before date of current Application for Payment.
    - c. Value of materials stored since date of previous Application for Payment and remaining stored as of date of current Application for Payment.
  8. Provide other supporting documentation as required by the Lender.
- F. Transmittal: Submit one signed and notarized copy of each Application for Payment to Architect for signature. Submission 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, including lower-tier subcontractors.
  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. Combined Contractor's construction schedule (preliminary if not final) incorporating Work of multiple contracts, with indication of acceptance of schedule by each Contractor.
  5. Products list (preliminary if not final).
  6. Sustainable design action plans, including preliminary project materials cost data.
  7. Schedule of unit prices.
  8. Certificates of insurance, insurance policies, and endorsement naming Architect and Consultants as Additional Insured on Contractor's CGL Policy.
  9. Submittal schedule (preliminary if not final).
  10. List of Contractor's staff assignments.
  11. List of Contractor's principal consultants.
  12. Copies of building permits.
  13. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
  14. Initial progress report.
  15. Report of preconstruction conference.
  16. Certificates of insurance and insurance policies.
  17. Performance and payment bonds.
  18. Data needed to acquire Owner's insurance.
  19. Initial settlement survey and damage report if required.
  20. **Claims for Additional Cost:** If the Contractor wishes to make Claim for an increase in the Contract Sum, the Contractor shall give written notice of such claim to the Professional and the Owner within twenty-one (21) days after the occurrence of the event or first appearance of the condition giving rise to such Claim and before proceeding to execute the Work. The failure by the Contractor to give such notice within the time permitted and prior to executing the Work shall constitute a waiver of claim for additional compensation.
- 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. Application For All Other Monthly Payments: Administrative actions and submittals that must coincide with each subsequent Application for Payment include the following:
  1. Application shall be provided in tabbed binder as well as PDF file.
  2. List of subcontractors (Provide current list and note changes since previous month).
  3. Schedule of Values.
  4. Contractor's Construction Schedule (Provide updated construction schedule and note changes since previous month).
  5. Products list.
  6. Schedule of unit prices.
  7. Submittals Schedule (Provide current submittal schedule and note changes since previous month).
  8. List of Contractor's staff assignments.
  9. List of Contractor's principal consultants.
  10. Copies of new building permits.
  11. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
  12. Current monthly progress report.
  13. Report of preconstruction conference held during past month.
  14. Certificates of insurance and insurance policies (update as required).
  15. Lien Waivers from Each Subcontractor (G706 and G706 A).
- K. 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

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## SECTION 01 31 00 - PROJECT MANAGEMENT AND COORDINATION

### PART 1 GENERAL

#### 1.1 SUMMARY

- A. In this Section it is understood that the Contractor is responsible for specified items or tasks unless otherwise written. The Contractor may assign an item or task to a designated Sub-Contractor.
- B. Minimum administrative and supervisory requirements necessary for coordination of work on the project to be fulfilled by the Contractor include but are not necessarily limited to the following:
  - 1. Coordination and meetings.
  - 2. Administrative and supervisory personnel.
  - 3. Records and reports.
  - 4. Digital project management procedures.
  - 5. Limitations for use of site.
  - 6. Special reports.
  - 7. General installation provisions.
  - 8. Cleaning and protection.
  - 9. Conservation and salvage.
  - 10. Receipt, review and distribution of submittals.
  - 11. Project Schedule.
  - 12. Prepare monthly progress report with milestone schedule and analysis of project, summary of work, recently completed work, ongoing work and work to begin, with photos and identification of certified issues.
  - 13. Schedule of submittals.
  - 14. Site logistics.
  - 15. Contractor's Staged Construction Analysis
  - 16. Site traffic control.
  - 17. Site Access.
  - 18. Preparation and distribution of punch list.
  - 19. BIM requirements.

- C. Each Trade Contractor must participate in these coordination requirements, where applicable, even though certain items of work may be assigned to a specific Sub-Contractor, and even though the Contractor may provide certain general work for overall coordination purposes.
- D. Provide Web Based Project Management Software System for the Review and Distribution of RFIs, ASIs, PRs, and Submittals. Software must be approved by Architect and be fully exportable to \*.DOC, \*.XLS, and \*.PDF.
- E. The structure shown on the Contract Documents is designed to withstand the design loads and associated movements only after all structural elements are installed and fully connected. Based on preliminary understanding of the building behavior in the temporary condition and extensive cross-disciplinary discussions during the Design Assist/Preconstruction process, it is understood that structural movements that occur in the temporary condition may affect the work of other trades. An evaluation of these movements must be executed by the party having contractual authority over all the trades whose work will affect or be affected by building movements ("Contractor")
- F. Therefore, loads and movements that occur in the temporary condition shall be evaluated and covered by the Contractor's Staged Construction Analysis (CSCA).

#### 1.2 RELATED REQUIREMENTS:

- A. Section 013200 "Construction Progress Documentation" for preparing and submitting Contractor's construction schedule.
- B. Section 017300 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
- C. Section 017700 "Closeout Procedures" for coordinating closeout of the Contract.
- D. Section 019113 "General Commissioning Requirements" for coordinating the Work with Owner's Commissioning Authority.

#### 1.3 DEFINITIONS

- A. RFI: Request from Contractor seeking information, interpretation or clarification of the Contract Documents.

#### 1.4 COORDINATION

- 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 with other contractors to ensure maximum accessibility for required maintenance, service, and repair.
  3. Make adequate provisions to accommodate items scheduled for later installation.
  4. Where availability of space is limited, coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair of all components, including mechanical and electrical.
  5. Provide coordinated shop drawings of all portions of the work where not provided by subcontractors to insure the coordinated installation of all portions of the Work.
- B. Coordination: Each contractor shall coordinate its construction operations with those of other contractors and entities to ensure efficient and orderly installation of each part of the Work. Each contractor shall coordinate its own operations with 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 with other contractors to ensure maximum performance and accessibility for required maintenance, service, and repair.
  3. Make adequate provisions to accommodate items scheduled for later installation.
- C. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.
1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.
- D. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and activities of other contractors 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.
  9. Project closeout activities.
  10. Obtaining Building permits and Certificate of Occupancy.
- E. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. Refer to other Sections for disposition of salvaged materials that are designated as Owner's property.

## 1.5 SUBMITTALS

- A. Refer to Section 01 33 00 for general submittal procedures in addition to the requirements indicated below.
- B. Coordination Drawings: Within 60 days of Notice to Proceed, provide coordination drawings for the integration of the Work, including information developed by the Contractor during construction, and detailed information contained in related shop drawings or product data. Show sequencing and relationship of separate units of work which must interface in a restricted manner to fit in the space provided, or function as indicated. Coordination drawings are considered shop drawings and must be definitive in nature. Submitted coordination drawings are for information only and typically will not be returned to Contractor.
- C. Architect will not take any action but may define coordination conflicts or problems and inform Contractor of such conflicts or problems.
  1. Where schedule of issued trade contracts precedes other work prepare coordination drawings pertinent to each issued trade contract within 30 days from the date the required coordination information becomes available.
  2. Prepare and submit Coordination Drawings when required by other Sections.
  3. Content: Project-specific information, drawn accurately to scale. Do not base Coordination Drawings on reproductions of the Contract Documents or standard printed data. Include the following information, as applicable:
    - a. Prepare and submit coordinated composite layouts of the mechanical systems and equipment for all areas, drawn at a scale not less than 1/4" per foot showing on both plan and elevation, including, but not limited to, all equipment, ducts, pipe sleeves, piping including plumbing and sprinkler system, lighting, special supports and other items contained within the space and finished ceiling. Show mechanical and electrical services as well as architectural and structural features drawn to scale. Provide composite drawings for all areas such as corridors, specialty spaces, mechanical rooms, shafts, tunnels, and all congested areas. Distribute copies of composite drawings to all trades to assure a complete, coordinated installation of work within the space available. Include elevation drawings indicating finish ceiling heights, and heights above finished floor to bottom of ductwork, piping and conduit.

- 1) Include routing and coordination of all MEP services through concrete foundation walls, concrete core walls, and structural steel frame and roof framing to assure coordination with the work of other subcontractors.
  - b. Indicate functional and spatial interrelationships of components of architectural, structural, civil, mechanical, and electrical systems.
  - c. Indicate required installation sequences.
  - d. Indicate dimensions shown on the Contract Drawings and make specific note of dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Architect for resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.
  - e. Submit certificate guaranteeing that coordination drawings have been done and are being utilized at the project site.
  - f. Call attention in advance to Architect of any dimensional or detail information needed to complete the coordination drawings.
  - g. At the Contractor's written request, Architect's Digital files may be provided to Contractor for Contractor's use in connection with Project, pending Owner's and Subcontractor's signed acceptance of release waiver. Refer to Attachment A at the end of this section. Refer to Division 1 Section "Submittal Procedures" for requirements.
  - h. Develop tracking mechanism for resubmission of rejected or approved as noted submittals
4. Sheet Size: At least 8-1/2 by 11 inches but no larger than 30 by 40 inches.
  5. Number of Copies: Submit PDF files of each submittal.
    - a. Submit PDF files where Coordination Drawings are required for operation and maintenance manuals.
    - b. Provide one complete electronic set of approved submittals at Substantial Completion as part of Operations & Maintenance Submission.
- D. Refer to individual Sections for Coordination Drawing requirements for Work in those Sections.
- E. Key Subcontractor Personnel Names: With proposals, submit key personnel proposed including project foreman of each trade related in designated scope. All Contractors must have an English speaking foreman on site at all times work is occurring. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home and office telephone numbers. Provide names, addresses, and telephone numbers of individuals.
- F. 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.

## 1.6 ADMINISTRATIVE AND SUPERVISORY PERSONNEL

- A. General: Within 15 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities, list addresses and cellular telephone numbers and e-mail addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project

1. Post copies of list in project meeting room, in temporary field office, in web-based Project software directory, and in prominent location in built facility. Keep list current at all times.

## 1.7 DIGITAL PROJECT MANAGEMENT PROCEDURES

- A. Architect's Digital Data Files: Refer to Section 01 3300 "Submittal Procedures."
- B. Web-Based Project Software: Use Contractor's web-based file server for purposes of managing RFIs, Submittals and File Transfers until Final Completion.
- C. Web-Based Project Software: Use Contractor's web-based Project software site for purposes of hosting and managing Project communication and documentation until Final Completion.
1. Web-based Project software site 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.

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- 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 software user licenses for use of Owner and Architect, including 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 web-based Project software packages under their current published licensing agreements:**
- a. Autodesk; [Constructware].
  - b. Corecon Technologies, Inc.
  - c. Meridian Systems; Prolog.
  - d. Newforma, Inc.
  - e. Procore Technologies, Inc.
  - f. Viewpoint, Inc.; Viewpoint for Project Collaboration.
- D. 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.

## 1.8 PROJECT MEETINGS

- A. General: Mandatory construction meetings shall take place on site each week, unless otherwise indicated.

1. Attendees: General Contractor shall inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times a minimum of 10 working days prior to meeting.
  2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
  3. Prepare and distribute accurate RFI Log, Submittal Log, and updated Submittal Schedule 24 hours before the meeting.
  4. Prepare and distribute an updated milestone schedule and monthly look-ahead for items requiring a physical presence by the Architect or Owner.
  5. Contractor's response to the current Field Observation Report.
  6. Prepare and distribute urgent or hot Construction or Administrative items to be discussed 24 hours before the meeting.
  7. Minutes: The Contractor shall record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned within three days of the meeting.
- B. Quality Control Pre-Construction Conference: Schedule and conduct a quality control pre-construction conference to review the detailed quality control and construction requirements for all materials and/or systems as appropriate, not less than 10 working days prior to commencement of the applicable portion of the work.
1. The Contractor shall require responsible representatives of each party concerned with that portion of the work to attend the conference, including but not limited to the following:
    - a. Contractor's superintendent.
    - b. Materials supplier(s) or fabricator.
    - c. Installation subcontractor(s).
    - d. Agency responsible for Contractor-furnished testing.
    - e. Contractor's dedicated quality control superintendent.
  2. The Architect, responsible Engineer and Owner's Testing Agency will be present and shall be notified by the Contractor at least 5 working days prior to the scheduled date of each such conference. Representatives from the Owner's Testing Agency shall include the specific individuals who will be performing the testing and inspection as well as the Project Manager for the Testing Agency.
  3. Reporting: Minutes of each conference shall be recorded by the Contractor and shall be distributed to each party in attendance within 5 working days of the meeting. One copy of these minutes shall also be transmitted to the Owner's representative for information.

4. Records: Contractor shall maintain correct records on an appropriate form for all inspections and tests performed, instructions received from the Architect, responsible Engineer or Testing Agency, and actions taken as a result of those instructions. These records shall include evidence that the required inspections or tests have been performed (including type and number of inspections or tests, nature of defects, causes for rejection, etc.), proposed or directed remedial action and corrective action taken. Contractor shall document inspections and tests as required by each section of the Specifications. Contractor shall provide updated daily report records to the Architect not less than bi-weekly.
- C. Preconstruction Conference: A preconstruction conference shall take place before starting construction, at a time convenient to Owner and Architect, but no later than 15 days after execution of the Agreement. The conference shall be held at Project site or another convenient location. The meeting shall be conducted to review responsibilities and personnel assignments. Conferences to be held at least 30 days prior to the start of construction or installation.
  1. Attendees: Authorized representatives of Owner, Architect, and their consultants; construction superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. All participants at the conference shall be familiar with Project and authorized to address matters relating to the Work.
  2. Agenda: Discuss items of significance that could affect progress, including the following:
    - a. Tentative construction schedule.
    - b. Phasing.
    - c. Critical work sequencing and long-lead items.
    - d. Designation of key personnel and their duties.
    - e. Procedures for processing field decisions and Change Orders.
    - f. Procedures for RFIs, ASIs, PRs, CCDs, and Issuance of Bulletins.
    - g. Use of web based project software
    - h. Procedures for testing and inspecting.
    - i. Procedures for processing Applications for Payment.
    - j. Distribution of the Contract Documents.
    - k. Sustainable design and construction requirements
    - l. Submittal procedures.
    - m. Preparation of Record Documents.
    - n. Preparation of operating and maintenance manuals.

- o. Use of the premises.
  - p. Work restrictions.
  - q. Work hours
  - r. Owner's occupancy requirements.
  - s. Responsibility for temporary facilities and controls (which have been agreed in advance of contract signing).
  - t. Construction waste management and recycling
  - u. Procedures for moisture and mold control.
  - v. Procedures for disruptions and shutdowns.
  - w. Procedures for rodent control
  - x. Parking availability.
  - y. Office, work, and storage areas.
  - z. Equipment deliveries and priorities.
    - aa. First aid.
    - bb. Security.
    - cc. Progress cleaning.
    - dd. Working hours.
    - ee. Ownership of materials.
    - ff. Deliveries, times, special provisions and scheduling.
  - 3. Minutes: Contractor is responsible for conducting meeting will record and distribute meeting minutes.
- D. Sustainable Design Requirements Coordination Conference: Owner will schedule and conduct a sustainable design coordination conference before starting construction, at a time convenient to Owner, Architect, and Contractor.
- 1. Attendees: Authorized representatives of Owner, Owner's Commissioning Authority, Construction Manager, Architect, and their consultants; Contractor and its superintendent and sustainable design coordinator; 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 meeting sustainable design requirements, including the following:
    - a. Sustainable design Project checklist.
    - b. General requirements for sustainable design-related procurement and documentation.
    - c. Project closeout requirements and sustainable design certification procedures.
    - d. Role of sustainable design coordinator.
    - e. Construction waste management.
    - f. Construction operations and sustainable design requirements and restrictions.
  3. Minutes: Contractor is responsible for conducting meeting will record and distribute meeting minutes.
- E. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity that requires coordination with other construction. Conferences to be held at least 20 days prior to the start of construction or installation.
1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect and Owner 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. The Contract Documents.
    - b. Options.
    - c. Related RFIs.
    - d. Purchases.
    - e. Deliveries.
    - f. Submittals.
    - g. Review of mockups (i.e. unit and skin mockups) .
    - h. Possible conflicts.
    - i. Trade responsibilities.
    - j. Compatibility problems.
    - k. Time schedules.

1. Weather limitations.
  - m. Manufacturer's written recommendations.
  - n. Warranty requirements.
  - o. Compatibility of materials.
  - p. Acceptability of substrates.
  - q. Temporary facilities and controls.
  - r. Space and access limitations.
  - s. Regulations of authorities having jurisdiction.
  - t. Testing and inspecting requirements.
  - u. Installation procedures.
  - v. Coordination with other work.
  - w. Required performance results.
  - x. Protection of adjacent work.
  - y. Protection of construction and personnel safety.
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 parties who should have been present.
  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.
- F. Project Closeout Conference: Schedule and conduct Construction Manager will schedule and conduct a project closeout conference, at a time convenient to Owner and Architect, but no later than 90 days prior to the scheduled date of Substantial Completion.
1. Conduct the conference to review requirements and responsibilities related to Project closeout.
  2. Attendees: Authorized representatives of Owner, Owner's Commissioning Authority, Construction Manager, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the meeting. Participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.

3. Agenda: Discuss items of significance that could affect or delay Project closeout, including the following:
  - a. Preparation of Record Documents.
  - b. Procedures required prior to inspection for Substantial Completion and for final inspection for acceptance.
  - c. Procedures for completing and archiving web-based Project software site data files.
  - d. Submittal of written warranties.
  - e. Requirements for completing sustainable design documentation.
  - f. Requirements for preparing operations and maintenance data.
  - g. Requirements for delivery of material samples, attic stock, and spare parts.
  - h. Requirements for demonstration and training.
  - i. Preparation of Contractor's punch list.
  - j. Procedures for processing Applications for Payment at Substantial Completion and for final payment.
  - k. Submittal procedures.
  - l. Coordination of separate contracts.
  - m. Owner's partial occupancy requirements.
  - n. Installation of Owner's furniture, fixtures, and equipment.
  - o. Responsibility for removing temporary facilities and controls.
4. Minutes: Entity conducting meeting will record and distribute meeting minutes.

**G. Progress Meetings:** Progress meetings shall take place at weekly intervals.

1. Attendees: In addition to representatives of Owner and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
2. Agenda: Review and correct or approve minutes of previous progress meeting. Report on outstanding issues from the 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) Status of submittals.
  - 4) Deliveries.
  - 5) Off-site fabrication.
  - 6) Access.
  - 7) Site utilization.
  - 8) Temporary facilities and controls.
  - 9) Work hours.
  - 10) Hazards and risks.
  - 11) Progress cleaning.
  - 12) Quality and work standards.
  - 13) Status of correction of deficient items.
  - 14) Field observations.
  - 15) RFI's
  - 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.

3. Minutes: Meeting minutes shall be recorded.

4. Reporting: Minutes of the meeting shall be distributed to each party present and to parties who should have been present.
- H. Coordination Meetings: Mandatory Project coordination meetings shall take place at weekly intervals. Project coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and preinstallation conferences.
  1. Attendees: In addition to representatives of Owner and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
  2. Agenda: Review and correct or approve minutes of the previous coordination meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project
  3. Combined Contractor's Construction Schedule: Review progress since the last coordination meeting. Determine whether each contract is on time, ahead of schedule, or behind schedule, in relation to Combined Contractor's Construction Schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
    - a. Schedule Updating: Revise Combined Contractor's Construction Schedule after each coordination meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with report of each meeting.
    - b. Review present and future needs of each contractor present, including the following:
      - 1) Interface requirements.
      - 2) Sequence of operations.
      - 3) Status of submittals.
      - 4) Deliveries.
      - 5) Off-site fabrication.
      - 6) Access.
      - 7) Site utilization.
      - 8) Temporary facilities and controls.
      - 9) Work hours.
      - 10) Hazards and risks.
      - 11) Progress cleaning.

- 12) Quality and work standards.
- 13) Change Orders.
4. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

## 1.9 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. Use applicable Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.
    - b. Coordinate the addition of trade-specific information to coordination drawings in a sequence that best provides for coordination of the information and resolution of conflicts between installed components before submitting for review.
    - c. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
    - d. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
    - e. Show location and size of access doors required for access to concealed dampers, valves, and other controls.
    - f. Indicate required installation sequences.
    - g. Indicate dimensions shown on 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, raised access floor 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. Mechanical and Plumbing Work: Show the following:
  - a. Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.
  - b. Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
  - c. Fire-rated enclosures around ductwork.
7. Electrical Work: Show the following:
  - a. Runs of vertical and horizontal conduit 1-1/4 inches (32 mm) in diameter and larger.
  - b. Light fixture, exit light, emergency battery pack, smoke detector, and other fire-alarm locations.
  - c. Panel board, switch board, switchgear, transformer, busway, generator, and motor-control center locations.
  - d. Location of pull boxes and junction boxes, dimensioned from column center lines.
8. Fire-Protection System: Show the following:
  - a. Locations of standpipes, mains piping, branch lines, pipe drops, and sprinkler heads.
9. 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.
10. Coordination Drawing Prints: Prepare coordination drawing prints according to requirements in Section 013300 "Submittal Procedures."

- C. Coordination Digital Data Files: Prepare coordination digital data files according to the following requirements:
1. File Preparation Format: Same digital data software program, version, and operating system as original Drawings.
  2. File Preparation Format: DWG operating in Microsoft Windows operating system.
  3. File Submittal Format: Submit or post coordination drawing files using PDF format.
  4. **BIM File Incorporation: Construction Manager will incorporate Contractor's coordination drawing files into BIM established for Project.**
    - a. **Construction Manager will perform three-dimensional component conflict analysis as part of preparation of coordination drawings. Resolve component conflicts prior to submittal. Indicate where conflict resolution requires modification of design requirements by Architect.**
  5. Architect will furnish Contractor one set of digital data files of Drawings for use in preparing coordination digital data files. Architect will furnish Contractor one set of digital data files with each supplemental instruction or change order document issuance.
    - a. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Drawings.
    - b. Digital Data Software Program: Drawings are available in .
    - c. Contractor shall execute a data licensing agreement in the form of Agreement provided by the Architect.

#### 1.10 REQUESTS FOR INTERPRETATION (INFORMATION) (RFIS)

- A. Procedure: Immediately on discovery of the need for interpretation of the Contract Documents, and if not possible to request interpretation at Project meeting, prepare and submit an RFI in the form specified.
1. RFIs shall originate with Contractor. RFIs submitted by entities other than Contractor will be returned with no response.
  2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.
  3. Limit RFI to one subject.
  4. The Professional shall be, in the first instance, the interpreter of the requirements of the Contract Documents.
- B. Content of the RFI: Include a detailed, legible description of item needing interpretation and the following:
1. Project name.

2. Name of Contractor.
  3. Name of Architect.
  4. RFI number, numbered sequentially.
  5. Specification Section number and title and related paragraphs, as appropriate.
  6. Drawing number and detail references, as appropriate.
  7. Field dimensions and conditions, as appropriate.
  8. Contractor's suggested solution(s). If Contractor's solution(s) impact the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
  9. Contractor's signature.
  10. Attachments: Include drawings, descriptions, measurements, photos, Product Data, Shop Drawings, and other information necessary to fully describe items needing interpretation.
    - a. Supplementary drawings prepared by Contractor shall include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments.
- C. RFIs: Refer to request for Information Form following this Section.
1. Identify each page of attachments with the RFI number and sequential page number.
- D. Software-Generated RFIs: Software-generated form with substantially the same content as indicated above.
1. Attachments shall be electronic files in Adobe Acrobat PDF format.
- E. Architect's Action: Architect will review each RFI, determine action required, and return it. Allow seven working days for Architect's response for each RFI. RFIs received after 1:00 p.m. will be considered as received the following working day. If a response is required in less than seven working days, the required response date and reason for the reduced review period is to be clearly identified on the RFI.
1. The following RFIs will be returned without action:
    - a. Requests for approval of submittals.
    - b. Requests for approval of substitutions.
    - c. Requests for coordination information already indicated in the Contract Documents.
    - d. Requests for adjustments in the Contract Time or the Contract Sum.
    - e. Requests for interpretation of Architect's actions on submittals.
    - f. Incomplete RFIs, inaccurately prepared RFIs, or RFIs with numerous errors.

2. Architect's action may include a request for additional information, in which case Architect's time for response will start again.
  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 Division 01 Section "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 10 days of receipt of the RFI response.
- 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 seven days if Contractor disagrees with response.
- G. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly. Use CSI Log Form 13.2B, or other form approved by the Owner. Prepare log with not less than the following:
1. Project name.
  2. Name and address of Contractor.
  3. Name and address of Architect and Construction Manager.
  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 and Construction Manager's response was received.
  8. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.
  9. Identification of related Field Order, Work Change Directive, and Proposal Request, as appropriate.

## 1.11 BIM REQUIREMENTS

- A. The Drawing component of the Contract Documents have been prepared using 2 dimensional representation of a 3 dimensional Building Information Model. This Building Information Model, if provided by the Architect, may be used for information purposes only. The Building Information Model, including any metadata incorporated within, does not form part of the Contract Documents.
- B. **BIM File: Develop a Building Information Model for the Project using information from each subcontractor based on Contract Documents provided by the Architect.**

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- a. The minimum Level of Development that is provided by the Architect in their Building Information Model and the minimum Level of Development that the Contractor is required to provide in their Building Information Model is defined in Attachment "A".
  - b. Contractor is responsible for creating, coordinating and integrating data from each sub-contract into the Building Information Model, regardless of the information or capability of the sub-contractor.
2. Perform three-dimensional component conflict analysis as part of preparation of coordination drawings and the work effort of the Contractor during Construction Administration phase of the Work. Resolve component conflicts prior to submittal of coordination drawings. Indicate where conflict resolution requires modification of design requirements by Architect.
  3. Maintain and update the Building Information Model throughout the progress of the Work including the incorporation of approved submittals, revisions required for trade coordination, and incorporation of ASI's and approved PR's.
  4. Within 30 days of award Architect will furnish Contractor a three-dimensional digital model for the Contractor's use in preparing its coordinated Building Information Model. Additional updates of the Architect's Building Information Model shall be provided as an Additional Service.
    - a. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Drawings.
  5. Contractor shall execute the attached Digital Use Agreement, Attachment "A".

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

ATTACHMENT A - DIGITAL USE AGREEMENT

(INSERT ARCHITECT'S DIGITAL USE AGREEMENT.)

**EXHIBIT # (CONFIRM) : BUILDING INFORMATION MODELING LEVEL OF DEVELOPMENT MATRIX**

Reference: BIMForum, Level of Development Specification, Version 2016 (October 19, 2016)

Model Elements	Schematic Design		Design Development		Construction Documents		Construction	
	LOD	MEA	LOD	MEA	LOD	MEA	LOD	MEA
A: Substructure								
A10 Foundations	2D	S	200	S	300	S	350	TC
A20 Subgrade Enclosures	2D	S	200	S	300	S	350	TC
A40 Slabs-on-Grade	2D	S	200	S	300	S	350	TC
B: Shell								
B10 Superstructure	2D	S	200	S	300	S	350	TC
B20 Exterior Vertical Enclosures	2D	A	200	A	300	A	350	TC
B30 Exterior Horizontal Enclosures	2D	A	200	A	300	A	350	TC
C: Interiors								
C10 Interior Construction	2D	A	200	A	300	A	350	TC
C20 Interior Finishes	-	NA	200	A	300	A	350	TC
D: Services								
D10 Conveying	2D	A	2D	A	2D	A	350	TC
D20 Plumbing	2D	M	200	M	300	M	350	TC
D30 HVAC	2D	M	200	M	300	M	350	TC
D40 Fire Protection	2D	M	200	M	300	M	350	TC
D50 Electrical	2D	M	2D	M	200	M	350	TC
D5040 Lighting	2D	A	200	A	200	A	350	TC
D60 Communications	2D	M	2D	M	200	M	350	TC
D70 Electronic Safety and Security	2D	M	2D	M	200	M	350	TC
D80 Integrated Automation	2D	M	2D	M	200	M	350	TC
E: Equipment and Furnishings								
E10 Equipment	2D	A	2D	A	200	A	350	TC
E20 Furnishings	2D	A	2D	A	200	A	350	TC
F: Special Construction & Demolition								
F10 Special Construction *	2D	Varies	200	Varies	300	Varies	350	TC

F20 Facility Remediation	2D	O	2D	O	2D	O	2D	TC
F30 Demolition	2D	A/S	2D	A/S	2D	A/S	2D	TC
G: Building Sitework								
G10 Site Preparation	2D	C	2D	C	2D	C	350	TC
G20 Site Improvements	2D	C	2D	C	2D	C	350	TC
G30 Liquid and Gas Site Utilities	2D	C	2D	C	2D	C	350	TC
G40 Electrical Site Improvements	2D	C	2D	C	2D	C	350	TC
G4050 Site Lighting	2D	A	2D	A	300	A	350	TC
G50 Site Communications	2D	C	2D	C	2D	C	350	TC
G60 Miscellaneous Site Construction	2D	C	200	C	300	C	350	TC

Key	
LOD:	Level of Development
MEA:	Model Element Author responsible for developing the Model Element to the specified LOD
A:	Architect
C:	Civil Engineer
S:	Structural Engineer
M:	MEP/FP/IT/Sec/AV Engineer
L:	Landscape Architect
TC:	Trade Contractor
O:	Owner or Owner's Consultant
SC:	Specialist Consultant
2D:	Two dimensional CAD or Revit drawings.
*	To be provided by the related Specialist Consultant.
Note: LOD requirements are general and may be superseded by the Construction Managers BIM Execution Plan, if accepted in writing by the Architect.	

## SECTION 01 32 00 - CONSTRUCTION PROGRESS DOCUMENTATION

### PART 1 GENERAL

#### 1.1 SUMMARY

- A. This Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
1. Preliminary Construction Schedule (for all subcontractors).
  2. Contractor's Construction Schedule (for all subcontractors).
  3. Submittals Schedule (for all subcontractors).
  4. Daily construction reports.
  5. Material tracking reports.
  6. Field condition reports.
  7. Special reports.
  8. Quality Control Walk

#### 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 activities are activities on the critical path. They must start and finish on the planned early start and finish times.
  2. Predecessor Activity: An activity that precedes another activity in the network.
  3. Successor Activity: An activity that follows another activity in the network.
- B. Cost Loading: The allocation of the Schedule of Values for the completion of an activity as scheduled. The sum of costs for all activities must equal the total Contract Sum, unless otherwise approved by Architect and/or Ownership.
- C. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine when activities can be performed and the critical path of Project.
- D. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.
- E. Event: The starting or ending point of an activity.

- F. Float: The measure of leeway in starting and completing an activity.
  - 1. Float time belongs to Project.
  - 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.
  - 4. Float time should always be shown in any distributed schedule.
- G. Fragnet: A partial or fragmentary network that breaks down activities into smaller activities for greater detail.
- H. Major Area: A story of construction, a separate building, or a similar significant construction element.
- I. Milestone: A key or critical point in time for reference or measurement.
- J. Network Diagram: A graphic diagram of a network schedule, showing activities and activity relationships.
- K. Resource Loading: The allocation of manpower and equipment necessary for the completion of an activity as scheduled.

### 1.3 SUBMITTALS

- A. Refer to Section 01 33 00 for general submittal procedures.
- B. Qualification Data: For scheduling consultant.
- C. Submittals Schedule: Submit three copies of schedule. Arrange the following information in a tabular format:
  - 1. Scheduled date for first submittal.
  - 2. Show 1st Submittal 75 days prior to date of which approval is required to commence fabrication or installation.
  - 3. Specification Section number and title.
  - 4. Submittal category (action or informational).
  - 5. Name of subcontractor.
  - 6. Description of the Work covered.
  - 7. Scheduled date for Architect's and Construction Manager's final release or approval.
  - 8. Submittal Schedule shall be submitted as a submittal and follow the submittal procedures in Division 01 Section "Submittal Procedures".

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9. Submittal schedules shall be submitted at least 20 working days prior to commencing submittals.
- a. This schedule shall include a list, in order of date to be submitted, of all drawings and other required submittal items scheduled to be submitted. The schedule shall list the proposed submittals for each week, as well as their formats. Once shop drawing submissions have commenced any modification or addition to this schedule must be submitted for action at least twenty (20) working days before the modification or addition is proposed to take place.
  - b. If at any time the total number of shop drawings received in any one week period exceeds the amount in the approved schedule by more than 10% for that week, the Design Professionals have the right to add two days to the average turnaround time for each 20% increment in excess of the scheduled quantity for that week's submissions. For example if the weekly total exceeds the schedule by 10% to 20%, two days may be added; if it is exceeded by 21% to 40%, four days may be added. The return dates for subsequent submittals may be extended based on the additional review time stated above.
  - c. For the purposes of developing a schedule, assume the following review rate, Shop drawings – 10 full size sheets per week.
- D. Mock-up Schedule: Submit three copies of schedule. Arrange the following information in a tabular format:
- 1. Scheduled date for each mock up required by each trade.
  - 2. Specification Section number and title.
  - 3. Submittal category (action or informational).
  - 4. Name of subcontractor.
  - 5. Description of the Work covered.
  - 6. Scheduled date for Architect's and Construction Manager's final release or approval.
  - 7. Mock-Up Schedule shall be submitted as a submittal and follow the submittal procedures in Division 01 Section "Submittal Procedures".
- E. Preliminary Construction Schedule: Submit in Adobe Acrobat PDF format and native .xer.
- 1. Approval of cost-loaded preliminary construction schedule will not constitute approval of Schedule of Values for cost-loaded activities.
- F. Contractor's Construction Schedule:
- 1. Submit an electronic copy of schedule, in PDF and native .xer labeled to comply with requirements for submittals. Include type of schedule (Initial or Updated) and date on label.

- G. CPM Reports: Concurrent with CPM schedule, submit each of the following reports. Format for each activity in reports shall contain activity number, activity description, cost and resource loading, original duration, remaining duration, early start date, early finish date, late start date, late finish date, and total float in calendar days.
1. Activity Report: List of all activities sorted by activity number and then early start date, or actual start date if known.
  2. Logic Report: List of preceding and succeeding activities for all activities, sorted in ascending order by activity number and then early start date, or actual start date if known.
  3. Total Float Report: List of all activities sorted in ascending order of total float.
  4. Earnings Report: Compilation of Contractor's total earnings from the Notice to Proceed until most recent Application for Payment.
  5. Schedule Maintenance Report: Submit monthly update to all revisions of the schedule including but not limited to of all logic, calendar, and duration revisions

H. Daily Construction Reports: Transmit by close of business daily.

I. Material Tracking Reports: Transmit at monthly intervals.

J. Field Condition Reports: Transmit two copies at time of discovery of differing conditions.

K. Special Reports: Transmit two copies at time of unusual event. Unusual events should include any theft, damage, or other unexpected conditions or Force Majeure events.

#### 1.4 COORDINATION

- A. Coordinate preparation and processing of schedules and reports with performance of construction activities and with scheduling and reporting of separate contractors.
- B. Coordinate Contractor's Construction Schedule with the Schedule of Values, list of subcontracts, Submittals Schedule, progress reports, payment requests, and other required schedules and reports.
  1. Secure time commitments for performing critical elements of the Work from parties involved.
  2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

#### 1.5 QUALITY ASSURANCE

- A. Scheduling Consultant Qualifications: An experienced specialist in CPM scheduling and reporting, with capability of producing CPM reports and diagrams within 24 hours of Architect and/or Ownership's request.

- B. Prescheduling Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." Review methods and procedures related to the Preliminary Construction Schedule and Contractor's Construction Schedule, including, but not limited to, the following:
1. Review software limitations and content and format for reports.
  2. Verify availability of qualified personnel needed to develop and update schedule.
  3. Discuss constraints, including phasing, work stages, area separations, interim milestones and partial Owner occupancy.
  4. Review delivery dates for Owner-furnished products.
  5. Review schedule for work of Owner's separate contracts.
  6. Review time required for review of submittals and resubmittals.
  7. Review requirements for tests and inspections by independent testing and inspecting agencies.
  8. Review time required for completion and startup procedures.
  9. Review and finalize list of construction activities to be included in schedule.
  10. Review submittal requirements and procedures.
  11. Review procedures for updating schedule.

## PART 2 PRODUCTS

### 2.1 SUBMITTALS SCHEDULE

- A. Preparation: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, resubmittal, ordering, manufacturing, fabrication, and delivery when establishing dates.
1. Coordinate Submittals Schedule with list of subcontracts, the Schedule of Values, and Contractor's Construction Schedule.
  2. Initial Submittal: Submit concurrently with preliminary bar-chart schedule. Include submittals required during the first 60 days of construction. List those required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
    - a. Show submittals on the Preliminary Construction Schedule, instead of tabulating them separately.
  3. Final Submittal: Submit concurrently with the first complete submittal of Contractor's Construction Schedule.

## 2.2 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

- A. Procedures: Comply with procedures contained in AGC's "Construction Planning & Scheduling."
- B. Time Frame: Extend schedule from date established for the Notice of Award the Notice to Proceed to date of 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.
  - 2. Timeframe should include any and all relevant Local and Federal holidays, as well as a mutually agreed upon number of projected lost days due to weather, prior to acceptance of the baseline.
- C. Activities: Treat each story or separate area as a separate numbered activity for each principal element of the Work, including General Conditions. Comply with the following:
  - 1. Activity Duration: Define activities so no activity is longer than 10 days, unless specifically allowed by Architect.
  - 2. Procurement Activities: Include procurement process activities for the following long lead items and major items, requiring a cycle of more than 60 days, as separate activities in schedule.  
Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
  - 3. Submittal Review Time: Include review and resubmittal times indicated in Division 1 Section "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's Construction Schedule with Submittals Schedule.
  - 4. Startup and Testing Time: Include not less than 90 days for startup and testing.
  - 5. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect's and Construction Manager's administrative procedures necessary for certification of Substantial 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. Work under More Than One Contract: Include a separate activity for each contract.
  - 3. Work by Owner: Include a separate activity for each portion of the Work performed by Owner.
  - 4. Products Ordered in Advance: Include a separate activity for each product.
  - 5. Owner-Furnished Products: Include a separate activity for each product. Include delivery date indicated in Division 1 Section "Summary." Delivery dates indicated stipulate the earliest possible delivery date.

6. Work Restrictions: Show the effect of the following items on the schedule:
  - a. Limitations of continued occupancies.
  - b. Uninterruptible services.
  - c. Partial occupancy before Substantial Completion.
  - d. Use of premises restrictions.
  - e. Provisions for future construction.
  - f. Seasonal variations.
  - g. Environmental control.
  - h. Work performed by other contractors not under this scope of work
  - i. Phased occupancies and turnover
  - j. Partial floor/area restrictions due to occupancy
  - k. Early occupancies for tenant fit-out if applicable (contractor access)
  - l. Adjacencies to occupied structures affecting workflow
7. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:
  - a. Subcontract awards.
  - b. Submittals.
  - c. Purchases.
  - d. Mockups.
  - e. Fabrication.
  - f. Sample testing.
  - g. Deliveries.
  - h. Installation.
  - i. Tests and inspections.
  - j. Adjusting.
  - k. Curing.
  - l. Startup and placement into final use and operation.

- m. Punchlist, acceptance and occupancy.
- 8. Area Separations: Identify each major area of construction for each major portion of the Work. Indicate where each construction activity within a major area must be sequenced or integrated with other construction activities to provide for the following:
  - a. Structural completion.
  - b. Permanent space enclosure
  - c. Completion of mechanical installation
  - d. Completion of electrical installation
  - e. Building envelope and water tightness
  - f. Vertical transportation
  - g. Permanent power
  - h. Conditioned air
  - i. Substantial Completion.
- 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. Milestones shall be developed for each bid package prior to its issue for bid. Modify milestone as required by the Owner.
- F. Cost Correlation: At the head of schedule, provide a cost correlation line, indicating planned and actual costs. On the line, show dollar volume of the Work performed as of dates used for preparation of payment requests.
  - 1. Refer to Division 1 Section "Payment Procedures" for cost reporting and payment procedures.
  - 2. Contractor shall assign cost to construction activities on the CPM schedule. Costs shall not be assigned to submittal activities unless specified otherwise but may, with Architect's approval, be assigned to fabrication and delivery activities. Costs shall be under required principal subcontracts for testing and commissioning activities, operation and maintenance manuals, punch list activities, Project Record Documents, and demonstration and training (if applicable), in the amount of 5 percent of the Contract Sum.
  - 3. Each activity cost shall reflect an accurate value subject to approval by Architect.
  - 4. Total cost assigned to activities shall equal the total Contract Sum.

- G. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis using fragnets to demonstrate the effect of the proposed change on the critical path of the overall project schedule. Contractor requests for additional time shall not be accepted unless validated and accepted via schedule fragnet.
- H. Computer Software: Prepare schedules using a program that has been developed specifically to manage construction schedules, or that has been accepted by the Owner in writing.

## 2.3 PRELIMINARY CONSTRUCTION SCHEDULE

- A. Bar-Chart Schedule: Submit preliminary horizontal bar-chart-type construction schedule within seven 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. Outline significant construction activities for first 60 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.
- C. Update monthly and submit with payment applications. Provide both CMP and fully updated schedule for review.

## 2.4 CONTRACTOR'S CONSTRUCTION SCHEDULE (CPM SCHEDULE - P6)

- A. General: Prepare network diagrams using AON (activity-on-node) format.
- B. Preliminary Network Diagram: Submit diagram within 14 days of date established for the Notice to Proceed. Outline significant construction activities for the first 60 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.
- C. CPM Schedule: Prepare Contractor's Construction Schedule using a computerized, cost- and resource-loaded, time-scaled CPM network analysis diagram for the Work.
  1. Develop network diagram in sufficient time to submit CPM schedule so it can be accepted for use no later than 30 days after date established for the Notice to Proceed.
    - a. Failure to include any work item required for performance of this Contract shall not excuse Contractor from completing all work within applicable completion dates, regardless of Architect's approval of the schedule.
  2. Conduct educational workshops to train and inform key Project personnel, including subcontractors' personnel, in proper methods of providing data and using CPM schedule information.
  3. Establish procedures for monitoring and updating CPM schedule and for reporting progress. Coordinate procedures with progress meeting and payment request dates.
  4. Use "one workday" as the unit of time. Include list of nonworking days, projected weather days, and holidays incorporated into the schedule.

- D. CPM Schedule Preparation: Prepare a list of all activities required to complete the Work. Using the preliminary 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. Time delay for curing (concrete, waterproof, tile, etc).
    - i. Work by Owner that may affect or be affected by Contractor's activities.
    - j. Testing and commissioning.
  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.
- E. Initial Issue of Schedule: Prepare initial network diagram from a list of straight "early start-total float" sort. Identify critical activities. Prepare tabulated reports showing the following:
1. Contractor or subcontractor and the Work or activity.
  2. Description of activity.
  3. Principal 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.
- G. Value Summaries: Prepare two cumulative value lists, sorted by finish dates.
1. In first list, tabulate activity number, early finish date, dollar value, and cumulative dollar value.
  2. In second list, tabulate activity number, late finish date, dollar value, and cumulative dollar value.
  3. In subsequent issues of both lists, substitute actual finish dates for activities completed as of list date.
  4. Prepare list for ease of comparison with payment requests; coordinate timing with progress meetings.
    - a. In both value summary lists, tabulate "actual percent complete" and "cumulative value completed" with total at bottom.
    - b. Submit value summary printouts one week before each regularly scheduled progress meeting.

## 2.5 REPORTS

- A. Daily Construction Reports: In addition to the requirements of the General Conditions, 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.
  7. Accidents.
  8. Meetings and significant decisions.
  9. Unusual events (refer to special reports).
  10. Stoppages, delays, shortages, and losses.
  11. Meter readings and similar recordings.
  12. Emergency procedures.
  13. Orders and requests of authorities having jurisdiction.
  14. Change Orders received and implemented.
  15. Construction Change Directives received and implemented.
  16. Services connected and disconnected.
  17. Equipment or system tests and startups.
  18. Partial Completions and occupancies.
  19. Substantial Completions authorized.
- B. Material Tracking Reports: At monthly intervals, prepare and submit a comprehensive list of materials delivered to and stored at Project site. List shall be cumulative, showing materials previously reported plus items recently delivered. Include with list a statement of progress on and delivery dates for materials or items of equipment fabricated or stored away from Project site.
- C. Field Condition Reports: Immediately on discovery of a difference between field conditions and the Contract Documents, prepare and submit a detailed report. Submit with a request for interpretation on CSI Form 13.2A. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

## 2.6 SPECIAL REPORTS

- A. General: Submit special reports directly to Owner within one day of an occurrence. Distribute copies of report to parties affected by the occurrence.

- B. Reporting Unusual Events: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, response by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.

## PART 3 EXECUTION

### 3.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

- A. Scheduling Consultant: Engage a consultant to provide planning, evaluation, and reporting using CPM scheduling.
1. In-House Option: Architect may waive the requirement to retain a consultant if Contractor employs skilled personnel with experience in CPM scheduling and reporting techniques. Submit qualifications.
  2. Meetings: Scheduling consultant shall attend all meetings related to Project progress, alleged delays, and time impact.
- B. 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 Actual Completion percentage for each activity.
- C. 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.

END OF SECTION

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## SECTION 01 32 30 - PHOTOGRAPHIC DOCUMENTATION

### PART 1 GENERAL

#### 1.1 SUMMARY

- A. This Section includes administrative and procedural requirements for the following:
1. Preconstruction photographs.
  2. Periodic construction photographs.
  3. Final Completion construction photographs.

#### 1.2 SUBMITTALS

- A. Refer to Section 01 33 00 for general submittal procedures.
- B. Key Plan: Submit key plan of Project site and buildings with notation of vantage points marked for location and direction of each photograph. Indicate elevation or story of construction. Include the same label information as the corresponding set of photographs.
- C. Construction Photographs: Submit digital images of each photographic view as part of Contractor's monthly reporting:
1. Identification: Include the following information:
    - a. Name of Project.
    - b. Name of Photographer.
    - c. Name of Architect
    - d. Name of Contractor.
    - e. Date photograph was taken if not date stamped by camera.
    - f. Description of vantage point, indicating location, direction (by compass point), and elevation or story of construction.
  2. Description of vantage point, indicating location, direction (by compass point), and elevation or story of construction.

#### 1.3 COORDINATION

- A. Auxiliary Services: Cooperate with photographer and provide auxiliary services requested, including access to Project site and use of temporary facilities, including temporary lighting required to produce clear, well-lit photographs without obscuring shadows.

#### 1.4 USAGE RIGHTS

- A. Obtain and transfer copyright usage rights from photographer to Owner for unlimited reproduction of photographic documentation.

### PART 2 PRODUCTS

#### 2.1 PHOTOGRAPHIC MEDIA

- A. Digital Images: Provide images in JPG or PDF format, produced by a digital camera with minimum sensor size of 12 megapixels, and at an image resolution of not less than 1600 by 1200 pixels.

### PART 3 EXECUTION

#### 3.1 PHOTOGRAPHS, GENERAL

- A. Field Office Prints: Retain one set of files of progress photographs in the field office at Project site, available at all times for reference. Identify photographs the same as for those submitted to Architect.

#### 3.2 CONSTRUCTION PHOTOGRAPHS

- A. Photographer: Engage a qualified photographer to take construction photographs.
- B. General: Take photographs using the maximum range of depth of field, and that are in focus, to clearly show the Work. Photographs with blurry or out-of-focus areas will not be accepted.
  1. Maintain key plan with each set of construction photographs that identifies each photographic location.
  2. Project photographs to be grouped by date and location.
- C. Digital Images: Submit digital images exactly as originally recorded in the digital camera, without alteration, manipulation, editing, or modifications using image-editing software.
  1. Date and Time: Include date and time in filename for each image.
  2. Field Office Images: Maintain digital record of all photo images stored and accessible to Architect/Ownership via Project Management software.
  3. Submit a complete set of digital image electronic files with each submittal of prints as a Project Record Document. Identify electronic media with date photographs were taken. Submit images that have the same aspect ratio as the sensor, uncropped.
- D. Preconstruction Photographs: Before commencement of demolition, take color, digital photographs of Project site and surrounding properties, including existing items to remain during construction, from different vantage points, as directed by Architect.
  1. Take photographs of existing adjoining areas to accurately record physical conditions at start of construction.

- E. Periodic Construction Photographs: Take color, digital photographs monthly, coinciding with the cutoff date associated with each Application for Payment. Select both interior and exterior vantage points as necessary to show status of construction and progress since last photographs were taken.
- F. **Concealed Work Photographs:** Photographically document and submitted for record all work that is to be concealed. Tag all photos to specific locations (EG: room numbers) on the project site. Include photos of but not limited to the following:
  - 1. Underground utilities
  - 2. Embedded objects in concrete
  - 3. In-wall MEP, blocking, etc.
  - 4. Concealed waterproofing/water barriers
  - 5. Concealed structure (structural steel; structural lintels; post-tensioning; stud-rails, etc.)
- G. **Architect-Directed Construction Photographs:** At monthly intervals, Architect will instruct photographer to take 24 additional color, digital photographs and general directions on vantage points. Photographer shall select actual vantage points and take photographs to show the status of construction and progress since last photographs were taken.
- H. **Time-lapse Construction Photos:** Provide remote mounted, internet enabled and accessible time-lapse construction camera mounted in a mutually agreeable location with Ownership, from Ox-Blue or similar, to provide constantly updating documentation of project conditions. Contractor to provide Owner with full usage and access to time lapse construction camera. Contractor is not permitted to provide access to the time lapse construction camera to any other entity without the written consent of the Owner.  
Contractor to provide Owner with digital copies of all photo documentation taken from time-lapse camera. Photo documentation should be taken at intervals no less than 15 minutes.
- I. Final Completion Construction Photographs: Take twenty color professional photographs after date of Substantial Completion for submission as Project Record Documents. Architect will direct photographer for desired vantage points.
  - 1. Do not include date stamp.
- J. Additional Photographs: Owner or Architect may issue requests for additional photographs, in addition to periodic photographs specified.

END OF SECTION

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## SECTION 01 33 00 - SUBMITTAL PROCEDURES

### PART 1 GENERAL

#### 1.1 SUMMARY

- A. Procedures and general requirements for submitting shopdrawings documentation, testing and reports as specified in the specifications.

#### 1.2 DEFINITIONS

- A. Action Submittals: Written and graphic information and physical samples that require Architect's responsive action.
- B. Informational Submittals: Written and graphic information and physical Samples that do not require Architect's responsive action. Submittals may be rejected for not complying with requirements.

#### 1.3 SUBMITTAL PROCEDURES

- A. Transmit each submittal with AIA G810 - Transmittal Letter or Architect-accepted form.
- B. Sequentially number transmittal forms.
  - 1. Refer to SK+I submittal naming sequence: 000000-00-0 = Section number-submittal number-revision number.
  - 2. Mark revised submittals with original number and sequential numeric suffix.
- C. Identify: Project, Contractor, Subcontractor and supplier, pertinent Drawing and detail number, and Specification Section number appropriate to submittal.
- D. Apply Contractor's stamp, signed or initialed, certifying that review, approval, verification of products required, field dimensions, adjacent construction Work, and coordination of information is according to requirements of the Work and Contract Documents.
- E. Schedule submittals to expedite Project, and deliver printed submittal material and samples to Architect at business address, and post electronic submittals as PDF files to PIM Service . Coordinate submission of related items.
- F. For each submittal for review, allow 15 days excluding delivery time to and from Contractor.
- G. Clearly identify variations in Contract Documents and product or system limitations that differ from specification information, or may be detrimental to successful performance of completed Work.
- H. Allow space on submittals for Contractor and Architect review stamps.
- I. When revised for resubmission, identify changes made since previous submission.
- J. Distribute copies of reviewed submittals as appropriate. Instruct parties to promptly report inability to comply with requirements.

- K. Submittals not requested will not be recognized nor processed.
- L. Incomplete Submittals: Architect will not review. Complete submittals for each item are required. Delays resulting from incomplete submittals are not the responsibility of Architect.

#### 1.4 ELECTRONIC FILE SHARING

- A. Upon written request from the General Contractor, the Architect is willing to provide AutoCAD and/or Revit model Drawing files for coordination and use in preparation of shop drawings related to the Work subject to the terms and conditions outlined.
- B. A completed Electronic File Agreement form will be sent to the Contractor for signature and returned. Upon receipt of the completed signed agreements, the Architect will issue the requested drawing files to the Contractor. The General Contractor will manage the process of distributing appropriate drawings to his subcontractors. Refer to Section 01 31 00 for the Digital Use Agreement.
- C. Electronic CAD Files and/or Revit models of Project Drawings: May only be used to expedite production of Shop Drawings for the Project. Use for other Projects or purposes is not allowed.
- D. Electronic CAD Files and/or Revit models of Project Drawings: Distributed only under the following conditions:
  - 1. Use of files is solely at receiver's risk. Architect does not warrant accuracy of files. Receiving files in electronic form does not relieve receiver of responsibilities for measurements, dimensions, and quantities set forth in Contract Documents. In the event of ambiguity, discrepancy, or conflict between information on electronic media and that in Contract Documents, notify Architect of discrepancy and use information in hard-copy Drawings and Specifications.
  - 2. CAD files and/or Revit models do not necessarily represent the latest Contract Documents, existing conditions, and as-built conditions. Receiver is responsible for determining and complying with these conditions and for incorporating addenda and modifications.
  - 3. User is responsible for removing the design teams' title block information, any information not normally provided on Shop Drawings, and removing references to Contract Documents. Shop Drawings submitted with information associated with other trades or with references to Contract Documents will not be reviewed and will be immediately returned.
  - 4. Receiver shall not hold Architect responsible for data or file clean-up required to make files usable, nor for error or malfunction in translation, interpretation, or use of this electronic information.
  - 5. Receiver shall understand that even though Architect has computer virus scanning software to detect presence of computer viruses, there is no guarantee that computer viruses are not present in files or in electronic media.
  - 6. Receiver shall not hold Architect responsible for such viruses or their consequences, and shall hold Architect harmless against costs, losses, or damage caused by presence of computer virus in files or media.

## 1.5 PRECONSTRUCTION SUBMITTALS

- A. Submittals which are required at the Preconstruction Meeting prior to commencing work on site.
  - 1. Certificates of insurance
  - 2. Surety bonds
  - 3. Construction Progress Schedule
  - 4. List of proposed subcontractors
  - 5. List of proposed products
  - 6. Approved Submittal log (Proposed submittal log provided no later than 30 days after Notice to Proceed.)
  - 7. Schedule of Values
  - 8. Health and safety plan
  - 9. Work plan
  - 10. Quality control(QC) plan
  - 11. Environmental protection plan

## 1.6 CONSTRUCTION PROGRESS SCHEDULES

- A. Submit initial schedules within 15 days after date of Owner-Contractor Agreement. After review, resubmit required revised data within fifteen days.
- B. Submit revised Progress / Planning Schedules with each Application for Payment.
- C. Refer to Section 01 32 00 - Construction Progress Documentation for schedule format and requirements.
- D. Indicate estimated percentage of completion for each item of Work at each submission.
- E. Submittal Log: Submit updated schedule of submittal dates for shop drawings, product data, and samples, including review for coordination of Separate Contract and dates reviewed submittals will be required from Architect. Indicate decision dates for selection of finishes.
- F. Revisions To Schedules:
  - 1. Indicate progress of each activity to date of submittal, and projected completion date of each activity.
  - 2. Identify activities modified since previous submittal, major changes in scope, and other identifiable changes.

- G. Prepare narrative report to define problem areas, anticipated delays, and impact on Schedule. Report corrective action taken, or proposed, and its effect including effect of changes on schedules of separate contractors.

#### 1.7 PROPOSED PRODUCT / SUBCONTRACTOR LIST

- A. Within 15 days after date of Owner-Contractor Agreement, submit list of major SubContractors proposed for the project. Information shall include products proposed for use, with name of manufacturer, trade name, and model number of each product.
- B. For products specified only by reference standards, indicate manufacturer, trade name, model or catalog designation, and reference standards.

#### 1.8 ACTION SUBMITTALS

- A. After review, produce copies and distribute in accordance with SUBMITTAL PROCEDURES article and for record documents described in Section 01 78 39 - Project Record Documents.

##### B. Product Data

1. Product Data: Action Submittal: Submit to Architect for review for assessing conformance with information given and design concept expressed in Contract Documents.
2. Post electronic submittals as PDF electronic files to PIM service.
3. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project.
4. Indicate product utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.
5. After review, produce copies and distribute according to "Submittal Procedures" Article and for record documents described in Section 01 70 00 - Execution and Closeout Requirements.

##### C. Shop Drawings

1. Action Submittal: Submit to Architect for assessing conformance with information given and design concept expressed in Contract Documents.
2. Indicate special utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.
3. When required by individual Specification Sections, provide Shop Drawings signed and sealed by a professional Engineer responsible for designing components shown on Shop Drawings.
  - a. Include signed and sealed calculations to support design.
  - b. Submit Shop Drawings and calculations in form suitable for submission to and approval by authorities having jurisdiction.

- c. Make revisions and provide additional information when required by authorities having jurisdiction.
4. Post electronic shop drawing submittals as PDF electronic files to PIM service.
5. After review, produce copies and distribute according to "Submittal Procedures" Article and for record documents described in Section 01 70 00 - Execution and Closeout Requirements.

D. Samples

1. Action Submittal: Submit to Architect for assessing conformance with information given and design concept expressed in Contract Documents.
2. Samples for Selection as specified in Product Selections:
  - a. Submit to Architect for aesthetic, color, and finish selection.
  - b. Submit Samples of finishes, textures, and patterns for Architect selection.
3. Submit Samples to illustrate functional and aesthetic characteristics of products, with integral parts and attachment devices. Coordinate Sample submittals for interfacing work.
4. Include identification on each Sample, with full Project information.
5. Submit number of Samples specified in individual Specification Sections or in quantities required for the Contractors records and use plus a minimum of one sample to be retained by the Architect.
6. Reviewed Samples that may be used in the Work are indicated in individual Specification Sections.
7. After review, samples required by the Contractor will be returned and distributed according to "Submittal Procedures" Article and for record documents described in Section 01 78 39 - Project Record Documents.

1.9 OTHER SUBMITTALS

- A. Closeout Submittals: Comply with Section 01 77 00 - Closeout Procedures.
- B. LEED Supporting Documentation: Comply with Section 01 81 13 - Sustainable Design Requirements.

1.10 INFORMATIONAL SUBMITTAL

- A. Submit data for Architect's knowledge as Contract administrator or for Owner.
- B. Submit information for assessing conformance with information given and design concept expressed in Contract Documents to the PIM service.
- C. Test Reports
  1. Submit test reports for information for assessing conformance with information given and design concept expressed in Contract Documents.

D. Certificates

1. Informational Submittal: Submit certification by manufacturer, installation/application Subcontractor, or Contractor to Architect.
2. Indicate material or product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.
3. Submit certified statement, signed and sealed by professional engineer responsible for design attesting to the following:
  - a. Conformity to applicable codes.
  - b. Conformity to criteria in Contract Documents.
  - c. Component parts were designed or selected for locale and application intended.
4. Certificates may be recent or previous test results on material or product, but must be acceptable to Architect.

E. Manufacturer's Instructions

1. Submit printed instructions for delivery, storage, assembly, installation, startup, adjusting, and finishing, to Architect for information.
2. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.

F. Manufacturer's Field Reports

1. Submit report within 5 days of observation, unless noted otherwise in the specification section, to Architect for information.
2. Submit reports for information for assessing conformance with information given and design concept expressed in Contract Documents.

G. Erection Drawings

1. Submit Drawings for information assessing conformance with information given and design concept expressed in Contract Documents.
2. Data indicating inappropriate or unacceptable Work may be subject to action by Architect or Owner.

1.11 CONTRACTOR REVIEW

- A. Review for compliance with Contract Documents and approve submittals before transmitting to Architect.
- B. Contractor: Responsible for:

1. Determination and verification of materials including manufacturer's catalog numbers.
  2. Determination and verification of field measurements and field construction criteria.
  3. Checking and coordinating information in submittal with requirements of Work and of Contract Documents.
  4. Determination of accuracy and completeness of dimensions and quantities.
  5. Confirmation and coordination of dimensions and field conditions at Site.
  6. Construction means, techniques, sequences, and procedures.
  7. Safety precautions.
  8. Coordination and performance of Work of all trades.
- C. Stamp, sign or initial, and date each submittal to certify compliance with requirements of Contract Documents.
- D. Do not fabricate products or begin Work for which submittals are required until approved submittals have been received from Architect.

## 1.12 ARCHITECT REVIEW

- A. **Do not make "mass submittals" to Architect. "Mass submittals" are defined as six or more submittals or items in one day or 15 or more submittals or items in one week. If "mass submittals" are received, Architect's review time stated above will be extended as necessary to perform proper review. Architect will review "mass submittals" based on priority determined by Architect after consultation with Owner and Contractor.**
- B. Informational submittals and other similar data are for Architect's information, do not require Architect's responsive action, and will not be reviewed or returned with comment.
- C. Submittals made by Contractor that are not required by Contract Documents may be returned without action.
- D. Submittal approval does not authorize changes to Contract requirements unless accompanied by Change Order, Architect's Supplemental Instruction, or Construction Change Directive.
- E. Owner may withhold monies due to Contractor to cover additional costs beyond the second submittal review.
- F. Contractor to customize the PIM service system response items to align with the Design Teams response actions listed below shown in quotations.
- G. Architect's and consultants' actions on items submitted for review:
  1. Authorizing purchasing, fabrication, delivery, and installation:

- a. "No Exceptions Taken".
- b. "Revise as Noted, Resubmission not required".
  - 1) At Contractor's option, submit corrected item, with review notations acknowledged and incorporated.
- 2. Not Authorizing fabrication, delivery, and installation:
  - a. "Revise as noted, Resubmission is Required".
    - 1) Resubmit revised item, with review notations acknowledged and incorporated.
    - 2) Non-responsive resubmittals may be rejected.
  - b. "Rejected, Resubmit as Specified".
    - 1) Submit item complying with requirements of Contract Documents.

H. Architect's and consultants' actions on items submitted for information:

1. Items for which no action was taken:

- a. "No Action Taken" - to notify the Contractor that the submittal has been received for record only.

**PART 2 PRODUCTS - NOT USED**

**PART 3 EXECUTION - NOT USED**

END OF SECTION

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## SECTION 01 35 44 - BIOHAZARD DISINFECTION

### PART 1 GENERAL

#### 1.1 SUMMARY

- A. Procedures and materials required for disinfecting buildings and spaces after exposure to biohazards including infectious diseases.

#### 1.2 ABBREVIATIONS

- A. Personal Protective Equipment: PPE.

#### 1.3 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate with local and State health departments to ensure that current cleaning and disinfecting protocols and guidelines are followed, including identification of new potential biohazard cases.

#### 1.4 SUBMITTALS

- A. Refer to Section 01 33 00 for general submittal procedures.
- B. Informational Submittals:
  - 1. Product Data: Manufacturer's descriptive data for materials proposed for use.

#### 1.5 QUALITY ASSURANCE

- A. Firm Qualifications:
  - 1. Minimum 2 years' experience in work of this Section.
  - 2. Successful completion of at least 3 projects of similar scope and complexity with past 2 years.
- B. Education:
  - 1. Educate staff and workers performing cleaning, laundry, and trash pickup activities to recognize symptoms of biohazard infections and provide instructions on what to do if they develop symptoms within 14 days after their last possible exposure to the virus.
  - 2. Instruct staff and workers to immediately notify their supervisor and local health department if they develop symptoms of biohazard infections.
  - 3. Develop policies for worker protection and provide training to all cleaning staff on site prior to performing cleaning tasks. Include as a minimum:
    - a. When to use PPE.
    - b. What PPE is necessary.

- c. How to properly put on, use, and remove PPE.
- d. How to properly dispose of PPE.
- 4. Ensure that workers are trained on hazards of cleaning chemicals used, in accordance with OSHA's Hazard Communication standard (29 CFR 1910.1200).
- C. Comply with OSHA's Standards on Bloodborne Pathogens (29 CFR 1910.1030), including proper disposal of regulated waste and PPE (29 CFR 1910.132).
- D. Disinfecting Cleaners:
  - 1. Listed on Environmental Protection Agency (EPA) List N for use against biohazards.
  - 2. Proven against all pandemic influenza strains and human coronavirus.

## PART 2 PRODUCTS

### 2.1 DISINFECTANT CLEANERS

- A. Disinfectant Cleaners; use one or more of following based on project conditions:
  - 1. Benefect Botanical Decon 30 by Benefect Corporation. [www.benefect.com](http://www.benefect.com)
  - 2. Fiberlock Shockwave by Fiberlock Technologies. [www.fiberlock.com](http://www.fiberlock.com)
  - 3. Fiberlock IAQ 2000 or 2500 by Fiberlock Technologies. [www.fiberlock.com](http://www.fiberlock.com)
  - 4. Or approved equal. Refer to Section 01 25 00 for acceptance and submittal procedures for substitutions.

### 2.2 APPLICATION EQUIPMENT

- A. Apply disinfectant cleaners by foaming applicator, airless sprayer, electrostatic sprayer, or cold mister/fogger as directed by manufacturer.

### 2.3 PERSONAL PROTECTIVE EQUIPMENT

- A. Gloves and Gowns:
  - 1. Compatible with cleaning and disinfectant products being used.
  - 2. If gowns are not available, use coveralls, aprons, or work uniforms.
- B. Additional equipment may be required based on cleaning and disinfectant products being used and whether there is a risk of splash.

### 2.4 MIXES

- A. Mix materials in accordance with manufacturer's instructions.

## PART 3 EXECUTION

### 3.1 PREPARATION

- A. Work with their local and State health departments to ensure use of cleaning and disinfecting protocols and guidelines are followed, including for identification of new potential cases of biohazard infection.
- B. Cleaning Staff: Wear disposable gloves and gowns for all tasks in cleaning process, including handling trash.
- C. Open outside doors and windows and use ventilating fans to increase air circulation in the area.
- D. Wait 24 hours or as long as practical before beginning cleaning and disinfection.
- E. Close off areas visited by ill persons.
- F. Open outside doors and windows and use ventilating fans to increase air circulation in the area.
- G. Wait 24 hours or as long as practical before beginning cleaning and disinfection.

### 3.2 CLEANING AND DISINFECTION

- A. Clean and disinfect all surfaces in all areas and shared electronic equipment used by ill persons, focusing on frequently touched surfaces.
- B. Clean and disinfect surfaces beginning at farthest point in space, working to nearest exit, and from high to low.
- C. Do not apply disinfectant cleaners to HVAC equipment and ducts except cleaning and disinfecting is allowed for:
  1. Drip pans and coils.
  2. Occupant side of grilles and registers.
- D. Non-Porous Surfaces:
  1. If surfaces are dirty, clean using detergent or soap and water prior to disinfection.
  2. Follow manufacturer's instructions for cleaning and disinfection products for concentration, application method, and contact time.
  3. Provide adequate ventilation during and after application.
- E. Porous Surfaces:
  1. Remove visible contamination if present.
  2. Do not shake dirty laundry to prevent dispersing virus through the air.
  3. Dirty laundry that has been in contact with an ill person can be washed with other people's items.

4. Clean and disinfect hampers and other containers used for transporting laundry according to requirements above for hard or soft surfaces as applicable.
  5. Clean with disinfectant cleaner approved by manufacturer for use on surface to be cleaned.
  6. After cleaning:
    - a. For items can be laundered, launder items in accordance with manufacturer's instructions using warmest appropriate water setting, then dry items completely.
    - b. For items that cannot be laundered clean with disinfectant cleaner approved by manufacturer for use on surface to be cleaned.
- F. Electronics:
1. Remove visible contamination if present.
  2. Clean with disinfectant cleaner approved by manufacturer for use on surface to be cleaned.

### 3.3 PERSONAL SANITATION PROCEDURES

- A. Remove gloves after cleaning a room or area occupied by ill persons.
- B. Remove gloves and gowns carefully; avoid contamination of wearer and surrounding area.
- C. Launder reusable (washable) clothing after use. Clean hands after handling dirty laundry.
- D. Immediately replace personal protective equipment having tears or breaches in that could result in potential exposures.
- E. Clean hands often, including immediately after removing gloves and after contact with an ill person, by washing hands with soap and water for 20 seconds.
- F. If soap and water are not available and hands are not visibly dirty, use an alcohol-based hand sanitizer containing minimum 60 percent alcohol. If hands are visibly dirty, always wash using soap and water.

END OF SECTION

## SECTION 01 40 00 - QUALITY REQUIREMENTS

### PART 1 GENERAL

#### 1.1 SUMMARY

- A. This Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
  - 1. Specific quality-assurance and -control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
  - 2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and -control procedures that facilitate compliance with the Contract Document requirements.
  - 3. Requirements for Contractor to provide quality-assurance and -control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.

#### 1.2 DEFINITIONS

- A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.
- B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by Architect.
- C. Mockups: Full-size, physical assemblies that are constructed on-site. Mockups are used to verify selections made under sample submittals, to demonstrate aesthetic effects and, where indicated, qualities of materials and execution, and to review construction, coordination, testing, or operation. Approved mockups establish the standard by which the Work will be judged.
- D. Laboratory Mockups: Full-size, physical assemblies that are constructed at testing facility to verify performance characteristics.
- E. Preconstruction Testing: Tests and inspections that are performed specifically for the Project before products and materials are incorporated into the Work to verify performance or compliance with specified criteria.
- F. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with industry standards.

- G. Source Quality-Control Testing: Tests and inspections that are performed at the source, i.e., plant, mill, factory, or shop.
- H. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- I. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.
- J. 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, and similar operations.
  - 1. Using a term such as "carpentry" does not imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as "carpenter." It also does not imply that requirements specified apply exclusively to trades people of the corresponding generic name.
- K. Experienced: When used with an entity, "experienced" means having successfully completed a minimum of five previous projects similar in size and scope to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

### 1.3 CONFLICTING REQUIREMENTS

- A. General: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer uncertainties and requirements that are different, but apparently equal, to Architect for a decision before proceeding.
- B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.
- C. The "Scope of Work" or "SUMMARY" usually placed in the front part of each Section of the Specifications, is intended to designate the scope and locations of all items of the Work included therein, either generally or specifically. It is not intended to limit the Scope of Work should plans, schedules, or notes indicate an increased scope. Inadvertent omission of an item from its proper section of the Specifications and its inclusion in another section shall not relieve the Contractor of responsibilities for the item specified.

### 1.4 EXAMINATION OF CONTRACT DOCUMENTS

- A. The Contractor will be held to have examined the Contract Documents and Modifications thereto, as they may affect subdivisions of the Work and to have informed itself, its Subcontractors, Sub-subcontractors, and materialmen of all conditions thereof affecting the prosecution of the Work.

- B. The Scope of Work for the Contract is not necessarily limited to the description of each section of the Specifications and the illustrations shown on the drawings. Include all minor items not expressly indicated in the Contract Documents, or as might be found necessary as a result of the field conditions, in order to complete the Work as it is intended to provide a fully functional system, without any gaps between the various subdivisions of Work of the Contractor, or between the Work of Subcontractors.
- C. Any failure by the Contractor to become acquainted with available information will not relieve the Contractor from responsibility for properly estimating the difficulty or cost of successfully performing the Work or mutually agreed changes thereto.

## 1.5 SUBMITTALS

- A. Refer to Sectio 01 33 00 for general submittal procedures.
- B. Contractor Quality Management Plan: Provide to the Owner and Architect for approval no later than 30 days after the Notice to Proceed a detailed quality management plan, which should include but is not limited to the following:
  - 1. Staffing Plan (Identify the Individual directly responsible for Quality Assurance)
  - 2. Program components for water tightness, deficiency tracking, material protection, contract and regulatory conformance, etc.,
- C. Qualification Data: 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.
- D. Schedule of Tests and Inspections: Prepare in tabular form and include the following:
  - 1. Specification Section number and title.
  - 2. Description of test and inspection.
  - 3. Identification of applicable standards.
  - 4. Identification of test and inspection methods.
  - 5. Number of tests and inspections required.
  - 6. Time schedule or time span for tests and inspections.
  - 7. Entity responsible for performing tests and inspections.
  - 8. Requirements for obtaining samples.
  - 9. Unique characteristics of each quality-control service.
  - 10. Schedule and list of all mock-ups required by each trade including the date of required approvals in accordance with the proposed project schedule.

- E. Reports: Prepare and submit certified written reports that include the following:
  - 1. Date of issue.
  - 2. Project title and number.
  - 3. Name, address, and telephone number of testing agency.
  - 4. Dates and locations of samples and tests or inspections.
  - 5. Names of individuals making tests and inspections.
  - 6. Description of the Work and test and inspection method.
  - 7. Identification of product and Specification Section.
  - 8. Complete test or inspection data.
  - 9. Test and inspection results and an interpretation of test results.
  - 10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
  - 11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
  - 12. Name and signature of laboratory inspector.
  - 13. Recommendations on retesting and reinspection.
- F. Test reports shall include a description of deficiencies noted, and corrective action undertaken to resolve such deficiencies.
- G. Deficiencies observed shall immediately be brought to the attention of the Contractor's field superintendent, and trade foreman. In the event deficiencies are not corrected, or if an interpretation of the contract documents is required, the Testing Agency shall immediately notify the Architect, Owner, and applicable engineer.
- H. The Testing Agency shall maintain a deficiency list of all items not corrected and shall reinspect the area after the deficiency has been corrected. The list shall include a description of the deficiency, the date and time the deficiency was observed, who was notified, the date of reinspection and description of corrective action taken. Distribute the deficiency list at least once per month.
- I. At the end of the project, the Testing Agency shall submit a final signed report stating whether the work tested and inspected conforms to the contract documents.
- J. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

## 1.6 QUALITY ASSURANCE

- A. General: Qualifications paragraphs in this Article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
- B. Contractor Qualifications: A dedicated individual working in tandem with the Contractor's Project Engineers and Superintendents whose sole role is to enforce quality control and quality assurance who is experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance. The Contractor shall submit qualifications to the Architect, Owner, and applicable Engineer for review and approval.
- C. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
- D. 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.
- E. 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.
- F. 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 to those indicated for this Project in material, design, and extent.
- G. Specialists: Certain sections of the Specifications 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. Requirement for specialists shall not supersede building codes and regulations governing the Work.
- H. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 548; and with additional qualifications specified in individual Sections; and where required by authorities having jurisdiction, that is acceptable to authorities.
  - 1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
  - 2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.

3. Tests shall be made by an accredited testing agency with a minimum of 5 years experience in the specific type of testing to be performed. Except as otherwise provided, sampling and testing of all materials and the laboratory methods and testing equipment shall be in accordance with the latest standards and tentative methods of the Local Code Standards.
  4. For each type of inspection and testing service to be performed, the Testing Agency shall submit certification, signed and sealed by the Agency's professional engineer, of compliance with all applicable requirements. of the following:
    - a. ASTM E329, "Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction."
    - b. "Recommended Requirements for Independent Laboratory Qualifications" published by the American Council of Independent Laboratories.
  5. Furnish written certification to the Architect, Owner, and applicable Engineer that all equipment to be used has been calibrated in accordance with applicable ASTM standards within the last year and is in proper working order.
  6. Testing Agency Personnel Qualifications: Testing and inspection services shall be performed only by trained and experienced technicians currently qualified for the work they are to perform. Documentation of such training and experience shall be submitted to the Owner, Architect, and applicable Engineer upon request.
  7. Each independent inspection and testing agency engaged on the Project shall be authorized by authorities having jurisdiction to operate in the state where the Project is located.
  8. Where Building Code compliance is required, testing agency shall be recognized as approved by the authorities having jurisdiction.
- I. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- J. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:
1. Contractor responsibilities include the following:
    - a. Provide test specimens representative of proposed products and construction.
    - b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
    - c. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.
    - d. Build site-assembled test assemblies and mockups using installers who will perform same tasks for Project.

- e. Build laboratory mockups at testing facility using personnel, products, and methods of construction indicated for the completed Work.
  - f. When testing is complete, remove test specimens, assemblies, mockups, and laboratory mockups; do not reuse products on Project.
2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect, Owner, and applicable Engineer with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.
- K. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:
- 1. Refer to Section 01 43 89 - Mockups for specific requirements for exterior wall and residential unit mockups.
  - 2. Build mockups in location and of size indicated or, if not indicated, as directed by Architect, Owner, and applicable Engineer.
  - 3. Notify Architect, Owner, and applicable Engineer seven days in advance of dates and times when mockups will be constructed.
  - 4. Demonstrate the proposed range of aesthetic effects and workmanship.
  - 5. Obtain Architect, Owner, and applicable Engineer's approval of mockups before starting work, fabrication, or construction.
    - a. Allow seven days for initial review and each re-review of each mockup.
  - 6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
  - 7. Demolish and remove mockups when directed, unless otherwise indicated.

## 1.7 QUALITY CONTROL

- A. Contractor Responsibilities:
- 1. Execute approved Quality Management Plan.
- B. 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 inspecting they are engaged to perform.

2. Costs for retesting and reinspection of 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.
  3. Costs for additional testing or testing materials required for Contractor's means and methods are the sole responsibility of the Contractor.
- C. **Tests and inspections not explicitly assigned to Owner are Contractor's responsibility.** Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
1. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these 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 24 hours in advance of time when Work that requires testing or inspecting 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 inspecting 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.
- D. Manufacturer's Field Services: Where indicated or necessitated by work that failed to comply or otherwise is modified from the Manufacturer's specifications, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Division 01 Section "Submittal Procedures."
- E. Retesting/Reinspection: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspection, for construction that replaced Work that failed to comply with the Contract Documents.
- F. Testing Agency Responsibilities: Cooperate with Architect, Owner, applicable Engineer, and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
1. Notify Architect, Owner, applicable Engineer, and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
  2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.

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- 3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
  - 4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
  - 5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
  - 6. Do not perform any duties of Contractor.
- G. Contractor Coordination: Contractor to cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
- 1. Access to the Work.
  - 2. Incidental labor and facilities necessary to facilitate tests and inspections.
  - 3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
  - 4. Facilities for storage and field curing of test samples.
  - 5. Delivery of samples to testing agencies.
  - 6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
  - 7. Security and protection for samples and for testing and inspecting equipment at Project site.
  - 8. Furnish tools, samples of materials, design mixes, equipment and assistance as requested.
  - 9. **Provide and maintain, for the sole use of the Testing Agency, adequate facilities for the safe storage and proper curing of concrete test cylinders on the project site for the first 24 hours after casting as required by ASTM C31, Method of Making and Curing Concrete Test Specimens in the Field.**
    - a. **Build and store masonry test prisms in a manner acceptable to the Testing Agency. Prisms to be tested shall remain at the job site until moved by Testing Agency personnel.**
    - b. **Notify Testing Agency at least 10 working days in advance of any qualification testing for welding required herein.**
    - c. **Notify Testing Agency at least 24 hours prior to expected time for operations requiring testing or inspection services.**
    - d. **Provide regular updates of the project schedule including anticipated testing or inspection services so that the Testing Agency has a clear understanding of the timing and flow of the work.**

- e. Make arrangements with the Testing Agency and pay for additional samples and tests made for the Contractor's convenience or for retesting of failed samples.
  - f. For deficiencies requiring corrective action, submit in writing a description of the deficiency and a proposed correction to the Architect, Owner, and applicable Engineer. After review and approval, the proposed corrective action shall be implemented and inspected by the Testing Agency. It is the Contractor's responsibility to ascertain that the deficiency is corrected and inspected prior to the work being covered.
  - g. Retention of an independent Testing Agency by the Owner shall in no way relieve the Contractor of responsibility for performing all work in accordance with contract or other regulatory requirements.
- H. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
1. Schedule times for tests, inspections, obtaining samples, and similar activities.
- I. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents. Submit schedule within 30 days of date established for the Notice to Proceed.
1. Distribution: Distribute schedule to Owner, Architect, applicable Engineer, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

## 1.8 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, and 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, Owner, applicable Engineer, 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, Owner, and applicable Engineer 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 reinspection of corrected work.

## PART 2 PRODUCTS

### 2.1 GENERAL

- A. Do not use any materials or equipment represented by samples until tests, if required, have been made and the materials or equipment found to be acceptable. Any product which becomes unfit for use after acceptance shall not be incorporated into the work.

## PART 3 EXECUTION

### 3.1 TEST AND INSPECTION LOG

- A. 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, Owner, and applicable Engineer.
  - 4. Identification of testing agency or special inspector conducting test or inspection.
- B. Maintain log at Project site. Post changes and modifications as they occur. Provide access to test and inspection log for Architect, Owner, and applicable Engineer's reference during normal working hours.

### 3.2 REPAIR AND PROTECTION

- A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
  - 1. Provide materials and comply with installation requirements specified in other Specification Sections. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible.
- 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

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## SECTION 01 43 89 - MOCK UPS

### PART 1 GENERAL

#### 1.1 SUMMARY

- A. Section includes requirements for exterior wall and residential unit mockups.
- B. Refer to Section 01 40 00 - Quality Requirements for general mockup review and inspection requirements.

#### 1.2 REFERENCES

- A. The publications listed below form a part of this section to the extent referenced. The publications are referred to within the text by the basic designation only.
  - 1. AAMA 501.1 (2005) Standard Test Method for Water Penetration of Windows, Curtain Walls and Doors Using Dynamic Pressure
  - 2. ASTM E283/E283M (2019) Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen
  - 3. ASTM E3223/E3223M (2020) Standard Guide for Specifying and Testing Field-Constructed Exterior Building Wall System Mockups in New Construction
  - 4. ASTM E331 (2000; R 2009) Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference

#### 1.3 DEFINITIONS

- A. In-Place Mock-Up: Mock up assemblies constructed in place of building wall assemblies and identified interior room types.
- B. Pre-Installation Mock-Up: These mock-ups may be constructed off-site and be portions of wall, floor, or ceiling systems demonstrating the construction, fabrication, installation, interface, and functionality of various components and equipment prior to actual construction, fabrication, and installation of said components, systems, or equipment for the project.
- C. Exterior Wall Technical Mock-Up: This mock-up is constructed on-site in location designated and shall be as indicated on the drawings. Mockup shall demonstrate the construction, fabrication, installation, interface, and functionality of various materials and components composing the exterior prior to actual construction, fabrication, and installation of said materials and components for the project.

#### 1.4 QUALITY ASSURANCE

- A. Sections Referenced: The Quality of the Work of Mock-Ups shall be as specified in various specification sections for materials listed within this Section for materials used in mock-up assemblies and be consistent with anticipated end products. The Developer and Architect shall have final say and interpretation of quality, level of workmanship and appearance.
- B. Pre installation Conference
  - 1. All installers of Work on Mock-up assemblies shall convene at the Site prior to actual assembly of mock-ups. The Contractor shall arrange with the Architect for the location and time of meeting.
  - 2. Prior to installation of associated mock-up work, meet at project site with the Developer, Architect, Contractor, installer, installer's of related work.
  - 3. Meeting shall identify required performance of the Work and review of the Construction Documents and all details, including testing procedures as required.
  - 4. Contractor shall record discussion, including agreement or disagreement on significant matters. Furnish copies of report to all parties present within 5 days after meeting date.
    - a. If substantial disagreements exist at conclusion of meeting, determine how disagreements will be resolved, and set date and time to reconvene meeting.

#### 1.5 MOCK-UPS REQUIRED BY SECTIONS

- A. Mockups: Before installing portions of the Work requiring mockups, build mockups as may be specified in individual Sections for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:
- B. Build mockups in location and of size indicated.
- C. The Contractor shall notify the Developer and Architect a minimum 7 days in advance of dates and times when mockups will begin construction and anticipated construction time.
- D. Demonstrate the proposed range of aesthetic effects and workmanship.
- E. The Contractor shall obtain approval by the Developer and Architect of mockups a minimum of 30 days prior to starting work, fabrication, or construction of components or systems for the actual building.
- F. Protect and maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
- G. Demolish and remove mockups when directed, unless otherwise indicated.

#### 1.6 EXTERIOR WALL TECHNICAL MOCK-UPS

- A. Construct and test the exterior wall technical mockup in accordance with ASTM E3223.

- B. The Exterior Wall Technical Mock-Ups shall serve as standard for acceptance of the work for all features of the exterior wall systems. The Contractor shall coordinate the participating sub-contractors Work for the Mock-ups.
- C. Provide all structural and architectural materials required for the exterior wall systems in the finished building construction. Include all materials required for a watertight, thermally efficient, functional building.
- D. Included are but not limited to, the following:
  - 1. Framing, metal.
  - 2. Exterior sheathing and air barriers.
  - 3. Brick veneer and flashing details.
  - 4. Exterior cladding systems.
  - 5. Window installation.
  - 6. Storefront systems with sample door installation.
  - 7. Glazed curtain wall and window system.
  - 8. Glass and glazing.
  - 9. Composite metal wall panel system.
  - 10. Roofing with parapet details
  - 11. Single ply membrane roofing
  - 12. Louvers
- E. Provide all trim, flashing, insulation, sheathing, air barriers, joint sealants, and similar materials.
- F. Construct technical mock-up for exterior wall construction condition as required in the Contract documents. Actual configuration and size as indicated.
- G. The final approved Exterior Mock-ups shall be maintained and protected from damage during construction in an undisturbed condition as the standard for judging the completed Work.
- H. Individual Sections identify many sample panels: After the Architect's approval of all "Sample Panels" for color, texture and detail reveals of the exterior wall components, before starting actual building construction, build technical mock-up for review and approval of the technical and aesthetic merit.
- I. Build technical mock-up on firm frost foundation or new foundation wall, as required, in location as directed by the Architect. Provide and design additional supporting structure for Technical mock-up, as required. Mock-up shall be independent of building construction.

- J. Mock-up assemblies shall incorporate all of the technical and aesthetic elements consistent with the actual building construction. Where mock-up drawings and details do not indicate known elements of the actual construction, notify the Developer and Architect and provide for them for inclusion into the mock-up.
  - 1. Where actual materials and products are not available for inclusion into the mock-up, provide materials/ product of comparable performance as approved by the Architect. Item will be labeled with waterproof marker and label on the actual item as "Not specified but used for mock-up".
  - 2. The Contractor shall provide to the Developer and Architect complete listing of materials not available at the time of Mock-up construction.
- K. If mock-up is unacceptable to the Developer and Architect, provide new or reworked mock-ups as required to obtain the Developer's and Architect's approval.
- L. Mock-up shall be completed and approved a minimum of 30 days prior to the start of that portion of the work.

#### 1.7 TESTING OF TECHNICAL MOCKUP

- A. Testing of mock-up by an approved testing agency. Mock-up to be tested for air infiltration ASTM E283/E283M, Static Water Penetration (ASTM E331) and Dynamic Water Penetration (AAMA 501.1). Commencement of work on the building shall not proceed until all mock-up testing has been passed and documented.

#### 1.8 RESIDENTIAL UNIT MOCK-UPS

- A. Full Residential Unit: Provide for a full residential unit mockup to be inspected in two phases:
  - 1. Mock up shall include a designated unit type, the Residential Unit door and Hallway door recess at a minimum.
  - 2. Location: Residential Unit Mockup location shall be coordinated among the Developer, Architect and Contractor as deemed appropriate.
  - 3. Phase 1: Rough framing and installation of utility rough-ins.
  - 4. Phase 2: Complete installation of interior finishes, cabinets and equipment indicated for the designated unit.
- B. Rooms shall be constructed with applicable materials and components required for the final construction Work. Where impractical, as defined by the Contractor, provide materials appropriate to provide sufficient aesthetic, functional and constructable simulation.
- C. Provide built in casework and finishes to the level as known at time of mock-up construction to provide simulation of final unit.
  - 1. If items are not known or still in route, provide those items, as they become available. Approval of rooms, modules and associated components shall be as these things become available.

2. Approval of portions of rooms shall be by the Developer and the Architect as to whether to hold the room for final approval until after inclusion of late arrival items.

D. Required Inspections

1. Inspection 1: to review framing and utilities roughin prior to closing the walls.
2. Inspection 2: to review wall, floor and ceiling finishes, mechanical, electrical and plumbing installation; cabinet installation.

E. This mock-up includes complete floor, wall, and ceiling systems for the Developer and Architect's approval. Do not start finishes in other units until mock-up has been inspected and approved by the Architect.

1. Approved in-place mock-up shall establish the standard of quality for this project and be incorporated into the building.

**1.9 FIRST IN-PLACE MOCK-UP**

A. Wall systems shall include and demonstrate, but are not limited to, the following components:

1. CMU walls with the following items:

- a. 1. With high performance coating system,

B. Ceiling systems shall include and demonstrate, but are not limited to, the following components:

1. Gypsum board ceiling with high performance coating.

2. Gypsum board ceiling interface with:

- a. CMU wall.
- b. Sprinkler head.
- c. Light fixture; including proper sealing and gasketing and demonstrating bulb change out.
- d. Mechanical air diffuser.
- e. Electrical outlet

**1.10 DELIVERY, STORAGE, AND HANDLING**

A. Store all materials to prevent deterioration, contamination of dirt, dust, debris, water, and staining

B. Do not use materials, which, in the Architect's opinion, have become unsuitable.

C. Additional requirements may be specified under specific specification sections that stipulate the product or material to be used on the mock-up.

## 1.11 PROJECT CONDITIONS

- A. Comply with individual specifications for environmental conditions required for application and installation of specific materials. In case of the Interior Mock-ups, maintain a controlled environment throughout its use until when deemed unnecessary by the Developer/Architect or when the mock-up is to be permanently removed.
- B. Protect materials and assemblies from the exterior weather elements and other construction activities during cure times and during initial review of complete assembly.

## 1.12 SEQUENCE AND SCHEDULING

- A. Sequence construction of the Mock-ups as related to anticipated actual construction sequence.

## PART 2 PRODUCTS

### 2.1 MATERIALS AND PRODUCTS

- A. As required by individual specifications sections to construct mock-up assemblies specified.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Examine surfaces to receive work under this Section before installation for defects or conditions adversely affecting quality and execution of the installation.
  - 1. Notify the Architect in writing of unsatisfactory conditions.
- B. Do not proceed with installation work until unsatisfactory conditions are reviewed, and corrected in an acceptable manner.
- C. Examination of building materials:
  - 1. Verify all materials are clean and free of foreign substances and from defects.
  - 2. Examine materials for compliance with appropriate specification sections for materials.

### 3.2 PROTECTION

- A. Protect materials and systems per each individual specification section prior to, during and after construction of each type of Mock-up. Provide a safety zone area around the Exterior Mockup from any construction equipment, other materials and activity so not to damage the Mock-up in any way.
- B. Protect interior mockups from any outside source of dust, debris, damage or water throughout the life of the Mock-ups.

### 3.3 CLEANING

- A. Mock-up cleaning shall be performed in accordance with industry standard cleaning procedures, but in no case more stringent than the manufacturer's cleaning instructions, and as specified without the use of acids, toxic or caustic agents. Where non-toxic cleaning is not adequate to clean the assembly, remove materials and products from the mock-up and replace with new.
- B. Remove cleaning supplies and tools from the Site upon completion of the cleaning operation.
- C. Masonry and concrete cleaning to be performed before permanent joint seals are installed unless written approval is obtained from both sealant manufacturer and installer that sealant work may precede cleaning work.

**END OF SECTION**

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## SECTION 01 50 00 - TEMPORARY FACILITIES AND CONTROLS

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. This Section includes requirements for temporary utilities, support facilities, and security and protection facilities.

#### 1.2 DEFINITIONS

- A. Permanent Enclosure: As determined by Architect, permanent or temporary roofing is complete, insulated, and weathertight; exterior windows are installed and all openings are closed with permanent construction or substantial temporary closures.

#### 1.3 USE CHARGES

- A. General: Installation and removal of temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities to use temporary services and facilities without cost, including, but not limited to, Owner's construction forces, Architect, occupants of Project, testing agencies, and authorities having jurisdiction.
- B. Sewer Service: Contractor will pay sewer-service use charges for sewer usage by all entities for construction operations.
- C. Water Service: Contractor will pay water-service use charges for water used by all entities for construction operations.
- D. Electric Power Service: Contractor will pay electric-power-service use charges for electricity used by all entities for construction operations.
- E. Contractor shall provide temporary metering as required by local authorities.

#### 1.4 SUBMITTALS

- A. See Section 01 33 00 for general submittal procedures.
- B. Site Plan: Show temporary facilities, utility hookups and staging areas.
- C. Erosion- and Sedimentation-Control Plan: Show compliance with requirements of EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent.
- D. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire-prevention program.
- E. Moisture-Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage.
  - 1. Describe delivery, handling, and storage provisions for materials subject to water absorption or water damage.

2. Indicate procedures for discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and replacing water-damaged Work.
  3. Indicate sequencing of work that requires water, such as sprayed fire-resistive materials and describe plans for dealing with water from wet operations. Show procedures for verifying that wet construction has dried sufficiently to permit installation of finish materials.
- F. Should materials subject to the moisture protection plan requirements become saturated, provide remediation plan for review and approval that includes the following:
1. Moisture penetration identification and graphic drawing showing the locations affected
  2. Third party testing to confirm the extent of the above
  3. Plan for removal and replacement, performed either by a third party or the affected contractor
  4. Third party inspection confirming that all areas affected have been fully remediated.
  5. Reference article Moisture and Mold Control below for additional information
- G. Dust- and HVAC-Control Plan: Submit coordination drawing and narrative that indicates the dust- and HVAC-control measures proposed for use, proposed locations, and proposed time frame for their operation. This section should include measures to be taken to mitigate airborne dust and debris both inside the building and outside during the construction phases. Identify further options if proposed measures are later determined to be inadequate. Include the following:
1. Locations of dust-control partitions at each phase of work.
  2. HVAC system isolation schematic drawing.
  3. Location of proposed air-filtration system discharge.
  4. Waste handling procedures.
  5. Other dust-control measures.
  6. Details of isolating dust from occupied portions of the building.

## 1.5 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.

## 1.6 FIELD CONDITIONS

- A. Temporary Use of Permanent Facilities: Contractor shall assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

## PART 2 PRODUCTS

### 2.1 MATERIALS

- A. Lumber and Plywood: Comply with requirements in Section 06 10 53 - Miscellaneous Rough Carpentry.
- B. Portable Chain-Link Fencing: Minimum 2-inch, 0.148-inch thick, galvanized-steel, chain-link fabric fencing; minimum 6 feet high with galvanized-steel pipe posts; minimum 2-3/8-inch OD line posts and 2-7/8-inch OD corner and pull posts, with 1-5/8-inch OD top and bottom rails. Provide concrete bases for supporting posts.
- C. Gypsum Board: Minimum 1/2 inch thick by 48 inches wide by maximum available lengths; regular-type panels with tapered edges. Comply with ASTM C 36/C 36M.
- D. Insulation: Unfaced mineral-fiber blanket, manufactured from glass, slag wool, or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively.
- E. Paint: Comply with requirements in Section 09 90 00 - Painting.
- F. Dust-Control Adhesive-Surface Walk-off Mats: Provide mats minimum 36 by 60 inches.

### 2.2 TEMPORARY FACILITIES

- A. Field Offices, General: 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 construction personnel. 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 not less than 1 receptacle on each wall. Furnish room with conference table, chairs, and 4-foot-square tack board.
  3. Drinking water and private toilet.
  4. Coffee machine and supplies.
  5. Heating and cooling equipment necessary to maintain a uniform indoor temperature of 68 to 72 deg F.
  6. Lighting fixtures capable of maintaining average illumination of 20 fc at desk height.

7. Appropriate restroom facilities.

C. Storage and Fabrication Sheds: Provide sheds within the work space, sized, furnished, and equipped to accommodate materials and equipment for construction operations.

1. Store combustible materials apart from building in area designated by Owner's Representative.

## 2.3 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 Units: Listed and labeled for type of fuel being consumed, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

3. Permanent HVAC System: If Owner's Representative authorizes use of permanent HVAC system for temporary use during construction, provide filter with MERV of 8 at each return air grille in system and remove at end of construction.

## PART 3 EXECUTION

### 3.1 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.

### 3.2 TEMPORARY UTILITY INSTALLATION

A. General: Install temporary service.

1. Arrange with utility company and Owner for time when service can be interrupted, if necessary, to make connections for temporary services.

B. Water Service: Install water service and distribution piping in sizes and pressures adequate for construction.

C. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.

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- D. 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. **Use of gasoline-burning space heaters, open flame, or salamander heating units is prohibited.**
  - E. Isolation of Work Areas in Occupied Facilities: Prevent dust, fumes, and odors from entering occupied areas.
    - 1. Prior to commencing work, isolate the HVAC system in area where work is to be performed.
      - a. Disconnect supply and return ductwork in work area from HVAC systems servicing occupied areas.
      - b. **Maintain negative air pressure within work area using HEPA-equipped air-filtration units, starting with commencement of temporary partition construction, and continuing until removal of temporary partitions is complete.**
    - 2. Maintain dust partitions during the Work. Use vacuum collection attachments on dust-producing equipment. Isolate limited work within occupied areas using portable dust-containment devices.
    - 3. Perform daily construction cleanup and final cleanup using approved, HEPA-filter-equipped vacuum equipment.
  - F. Ventilation and Humidity Control: Provide temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.
  - G. 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 underground, unless otherwise indicated
  - H. 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.
  - I. Communications and Internet Service: Provide communications and internet services for all personnel.

### 3.3 SUPPORT FACILITIES INSTALLATION

- A. General: Comply with the following:

1. Provide incombustible construction for offices, shops, and sheds located within construction area or within 30 feet of building lines. Comply with NFPA 241.
  2. Maintain support facilities until near Substantial Completion. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.
- B. Traffic Controls: Comply with requirements of authorities having jurisdiction.
1. Protect site improvements to remain including curbs, pavement, and utilities.
  2. Maintain access for fire-fighting equipment and access to fire hydrants.
- C. Parking: Provide temporary parking areas for construction personnel.
- D. 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 nor endanger permanent Work or temporary facilities.
  2. Remove snow and ice as required to minimize accumulations.
- E. Temporary Signs: Provide temporary signs to inform public and individuals seeking entrance to Project. Unauthorized signs are not permitted.
1. Provide temporary, directional signs for construction personnel and visitors.
  2. Maintain and touchup signs so they are legible at all times.
  3. Install owner provided signage as directed.
- F. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with progress cleaning requirements in Section 01 73 00 - Execution.
- G. Temporary Access: The Contractor shall provide and install ramps, stairs, ladders and similar temporary access elements as required to perform the work and facilitate its inspection during installation
- H. Lifts and Hoists: Provide facilities necessary for hoisting materials.
1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.
- I. Temporary Stairs: Until permanent stairs are available, provide temporary stairs where ladders are not adequate.
1. 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.

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- J. Provide all other required means of access to areas of work. Contractor shall be responsible for the design and adequacy of these items.

### 3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction in ways and by methods that comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.
- B. 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.
  - 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.
- C. 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.
- D. 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.
- E. Pollution Controls:
  - 1. Use water mist, temporary enclosures, and other suitable methods to limit the spread of dust and dirt generated by construction operations. Comply with governing environmental protection regulations.
    - a. Do not create hazardous or objectionable conditions, such as ice, flooding, and pollution, when using water.
  - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
  - 3. Clean adjacent building spaces and improvements of dust, dirt, and debris caused by construction operations.

- F. Pest Control: Engage pest-control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals so Project will be free of pests and their residues at Substantial Completion. **Obtain extended warranty for Owner as available through pest-control service and meeting additional requirements of Section 01 77 00 - Closeout Procedures.** Perform control operations lawfully, using environmentally safe materials.
- G. Site Enclosure Fence: Before construction operations begin, furnish and install site enclosure fence in a manner that will prevent people and animals from easily entering site except by entrance gates.
1. Extent of Fence: As required to enclose entire Project site or portion determined sufficient to accommodate construction operations.
  2. Maintain security by limiting number of keys and restricting distribution to authorized personnel.
  3. Fencing to be kept neat and orderly, replace damaged panels, and remove graffiti and/or damage as soon as observed.
- H. Security Enclosure and Lockup: Install substantial temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security.
1. Storage: Where materials and equipment must be stored, and are of value or attractive for theft, provide a secure lockup. Enforce discipline in connection with the installation and release of material to minimize the opportunity for theft and vandalism.
- I. Construction Site Security: Secure all construction equipment, machinery and vehicles, park and store only within fenced area, and render inoperable during non-work hours. Contractor is responsible to insure that no construction materials, tools, equipment, machinery or vehicles can be used for unauthorized entry or other damage or interference to activities and security of facilities adjacent to and in the vicinity of construction site. Construction site security is the sole responsibility of the Contractors until such time as the owner has taken full possession of the site for beneficial use.
- J. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.
- K. Covered Walkway: When required during the course of the Work, erect structurally adequate, protective, covered walkways for passage of individuals. Coordinate with entrance gates, other facilities, and obstructions. Comply with regulations of authorities having jurisdiction.
- L. Provide adequate 24/7 lighting for all overhead protected areas.
- 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 not complete, insulate temporary enclosures.

- N. Temporary Partitions: Provide floor-to-ceiling dustproof partitions to limit dust and dirt migration and to separate completed areas.
  - 1. Construct dustproof partitions with gypsum wallboard with joints taped on occupied side, and fire-retardant plywood on construction operations side.
  - 2. Insulate partitions to provide noise protection to occupied areas.
  - 3. Seal joints and perimeter. Equip partitions with dustproof doors and security locks.
  - 4. Protect air-handling equipment.
  - 5. 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.
  - 1. Prohibit smoking in all areas of project site.
  - 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 fire-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.
- P. Temporary Restroom Facilities:
  - 1. Provide adequate number of temporary restroom facilities for the total number of workers on the construction site at all times.
  - 2. Restrooms are to be cleaned sufficiently often per week so as to provide a safe and satisfactory condition for workers.
  - 3. Permanent facilities and/or locations are not to be used for temporary unless authorized by the owner at any point in construction. Provide deterrents for permanent facilities to discourage their use during construction.

### 3.5 MOISTURE AND MOLD CONTROL

- A. Contractor's Moisture-Protection Plan: Avoid trapping water in finished work. Plan is to be presented to Ownership for review and comment prior to commencement of any work subject to moisture and mold concerns. Document visible signs of mold that may appear during construction.
- B. Exposed Construction Phase: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect as follows:

1. Protect porous materials from water damage.
  2. Protect stored and installed material from flowing or standing water.
  3. Keep porous and organic materials from coming into prolonged contact with concrete.
  4. Remove standing water from decks.
  5. Keep deck openings covered or dammed.
- C. Partially Enclosed Construction Phase: After installation of weather barriers but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:
1. Do not load or install drywall or other porous materials or components, or items with high organic content, into partially enclosed building.
  2. Keep interior spaces reasonably clean and protected from water damage.
  3. Periodically collect and remove waste containing cellulose or other organic matter.
  4. Discard or replace water-damaged material.
  5. Do not install material that is wet.
  6. Discard, replace, or clean stored or installed material that begins to grow mold.
  7. Perform work in a sequence that allows any wet materials adequate time to dry before enclosing the material in drywall or other interior finishes.
- D. Controlled Construction Phase of Construction: After completing and sealing of the building enclosure but prior to the full operation of permanent HVAC systems, maintain as follows:
1. Control moisture and humidity inside building by maintaining effective dry-in conditions.
  2. Use permanent HVAC system to control humidity.
  3. Comply with manufacturer's written instructions for temperature, relative humidity, and exposure to water limits.
    - a. Hygroscopic materials that may support mold growth, including wood and gypsum-based products, that become wet during the course of construction and remain wet for 48 hours are considered defective.
    - b. Measure moisture content of materials that have been exposed to moisture during construction operations or after installation. Record readings beginning at time of exposure and continuing daily for 48 hours. Identify materials containing moisture levels higher than allowed. Report findings in writing to Architect.

- c. Remove materials that cannot be completely restored to their manufactured moisture level within 48 hours.

### 3.6 OPERATION, TERMINATION, AND REMOVAL

- A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.
- B. Maintenance: Maintain facilities in good operating condition until removal.
  - 1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.
- C. 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, clean and renovate permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 01 77 00 - Closeout Procedures.

END OF SECTION

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## SECTION 01 60 00 - PRODUCT REQUIREMENTS

### PART 1 GENERAL

#### 1.1 SUMMARY

- A. This 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; product substitutions; and comparable products.
  - 1. Compatibility of options between products proposed and specified.
  - 2. Reliability of date calculations by Date Sensitive Equipment.
  - 3. Selection of products for use in Project.
  - 4. Product delivery, storage, and handling.
  - 5. Manufacturers' standard warranties on products.
  - 6. Special warranties.
  - 7. Product substitutions.
  - 8. Comparable products.

#### 1.2 DEFINITIONS

- A. Products: Items purchased 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, except that products consisting of recycled-content materials are allowed, unless explicitly stated otherwise. Products salvaged or recycled from other projects are not considered new products.
  - 3. Comparable Product: Product that is demonstrated and approved through submittal process, as a product substitution, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.
- B. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.

- C. Basis-of-Design Product Specification: Where a specific manufacturer's product is named and accompanied by the words "basis of design," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of other named manufacturers.

### 1.3 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures for requirements.
- B. Product List: Submit a list, in tabular form, showing specified products. Include generic names of products required. Include manufacturer's name and proprietary product names for each product.
  1. Coordinate product list with Contractor's Construction Schedule and the Submittals Schedule.
  2. Form: Tabulate information for each product under the following column headings:
    - a. Specification Section number and title.
    - b. Generic name used in the Contract Documents.
    - c. Proprietary name, model number, and similar designations.
    - d. Manufacturer's name and address.
    - e. Supplier's name and address.
    - f. Installer's name and address.
    - g. Projected delivery date or time span of delivery period.
    - h. Identification of items that require early submittal approval for scheduled delivery date.
  3. Completed List: Within 15 days after date of commencement of the Work, submit 3 copies of completed product list. Include a written explanation for omissions of data and for variations from Contract requirements.
  4. Architect's Action: Architect will respond in writing to Contractor within 7 days of receipt of completed product list. Architect's response will include a list of unacceptable product selections and a brief explanation of reasons for this action. Architect's response, or lack of response, does not constitute a waiver of requirement to comply with the Contract Documents.
- C. Substitution Requests: For all products, materials, fabrications, or installation methods proposed to be changed from the Contract Documents, submit a Substitution Request as outlined in Section 01 25 00 - Substitution Procedures.
- D. Comparable Product Requests: For all products, materials, fabrications, or installation methods proposed as comparable to those indicated in the Contract Documents, submit a Substitution Request as outlined in Section 01 25 00 - Substitution Procedures.

#### 1.4 QUALITY ASSURANCE

- A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, product selected shall be compatible with products previously selected, even if previously selected products were also options.
  - 1. Each contractor is responsible for providing products and construction methods compatible with products and construction methods of other contractors.
  - 2. If a dispute arises between contractors over concurrently selectable but incompatible products, Architect will determine which products shall be used.

#### 1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft. Comply with manufacturer's written instructions.
- B. Delivery and Handling:
  - 1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
  - 2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
  - 3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
  - 4. Inspect products on delivery to ensure compliance with the Contract Documents and to ensure that products are undamaged and properly protected.
- C. Storage:
  - 1. Store products to allow for inspection and measurement of quantity or counting of units.
  - 2. Store materials in a manner that will not endanger Project structure.
  - 3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
  - 4. Store cementitious products and materials on elevated platforms.
  - 5. Store foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
  - 6. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
  - 7. Protect stored products from damage and liquids from freezing.

8. Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner's Representative.

## 1.6 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: Preprinted written warranty published by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
  2. Special Warranty: Written warranty required by or incorporated into the Contract Documents, either to extend time limit provided by manufacturer's warranty or to provide more rights for Owner.
- B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution. Submit a draft for approval before final execution.
  1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
  2. Specified Form: When specified forms are included with the Specifications, prepare a written document using appropriate form properly executed.
  3. Refer to Divisions 02 through 33 Sections for specific content requirements and particular requirements for submitting special warranties.
- C. Submittal Time: Comply with requirements in Section 01 77 00 - Closeout Procedures.
- D. Warranty Requirements:
  1. All warranties must include correct ownership entity, project name and start date. All warranties must tie to the substantial completion of the project, signed off by the architect
  2. All warranties must be assignable.
  3. All warranties are subject to overburden. This includes all removal, reinstallation or restoration of all existing material and finishes as required to access their work.
  4. Warranties do not supersede the contract documents.

## PART 2 PRODUCTS

### 2.1 PRODUCT SELECTION PROCEDURES

- A. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged and, unless otherwise indicated, that 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 not in conflict with requirements of the Contract Documents.
4. Where products are accompanied by the term "as selected," Architect will make selection.
5. Where products are accompanied by the term "match sample," sample to be matched is Architect's.
6. Descriptive, performance, and reference standard requirements in the Specifications establish "salient characteristics" of products.
7. Or Equal: Where products are specified by name and accompanied by the term "or equal" or "or approved equal" or "or approved," comply with provisions in "Comparable Products" Article to obtain approval for use of an unnamed product.
8. It is understood that the Contract Drawings delineate the general intent of the work and that each Subcontractor / Supplier shall provide whatever incidental material and labor necessary to translate the intent of the documents into a finished and usable product, notwithstanding the same may have been inferred and / or omitted from the plans and specifications.

B. Product Selection Procedures:

1. Product: Where Specifications name a single product and manufacturer, provide the named product that complies with requirements.
2. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements.
3. Products: Where Specifications include a list of names of both products and manufacturers, provide one of the products listed that complies with requirements.
4. Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements.
5. Available Products: Where Specifications include a list of names of both products and manufacturers, provide one of the products listed, or an unnamed product, that complies with requirements. Comply with provisions in Part 2 "Comparable Products" Article for consideration of an unnamed product.
6. Available Manufacturers: Where Specifications include a list of manufacturers, provide a product by one of the manufacturers listed, or an unnamed manufacturer, that complies with requirements. Comply with provisions in Part 2 "Comparable Products" Article for consideration of an unnamed product.

7. Product Options: Where Specifications indicate that sizes, profiles, and dimensional requirements on Drawings are based on a specific product or system, provide the specified product or system. Comply with provisions in Part 2 "Product Substitutions" Article for consideration of an unnamed product or system.
8. Basis-of-Design Product: Where Specifications name a product and include a list of manufacturers, provide the specified product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named.
  - a. Where other manufacturers are listed without a specific product it is an aid to the Contractor in seeking other providers of the Basis of Design. There is no guaranty that the other manufacturers listed can provide an equal product used as the Basis of Design. The product selected for the Basis of Design is based on performance and aesthetics and the Architect's experience with the Basis of design product. Products by other manufacturers listed or other proposed manufacturers may be rejected by the Architect. The Contractor shall assume the Basis of Design product is required and shall be prepared to provide the Basis of Design product in the event the Contractor's proposal is rejected.
  - b. Where other manufacturers are listed with a selected product the Contractor can assume the listed other product is acceptable for use.
9. Visual Matching Specification: Where Specifications require matching an established Sample, select a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.
  - a. If no product available within specified category matches and complies with other specified requirements, comply with provisions in Part 2 "Product Substitutions" Article for proposal of product.
10. Visual Selection Specification: Where Specifications include the phrase "as selected from manufacturer's colors, patterns, textures" or a similar phrase, select a product that complies with other specified requirements.
  - a. Standard Range: Where Specifications include the phrase "standard range of colors, patterns, textures" or similar phrase, Architect will select color, pattern, density, or texture from manufacturer's product line that does not include premium items.
  - b. Full Range: Where Specifications include the phrase "full range of colors, patterns, textures" or similar phrase, Architect will select color, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

## 2.2 PRODUCT SUBSTITUTIONS AND COMPARABLE PRODUCTS

- A. Timing: Architect will only consider requests for substitution received after the Notice to Proceed when using either the specified product or substitution will not affect the project schedule. Requests received after that time may be considered or rejected at discretion of Architect.

- B. Conditions: Architect may 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:
1. Comply with the requirements of Section 01 25 00 - Substitution Procedures and submit the Substitution Form provided or equivalent form provided by the Owner.
  2. 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.
  3. Requested substitution does not require extensive revisions to the Contract Documents.
  4. Requested substitution is consistent with the Contract Documents and will produce indicated results.
  5. Substitution request is fully documented and properly submitted.
  6. Requested substitution will not adversely affect Contractor's Construction Schedule.
  7. Requested substitution has received necessary approvals of authorities having jurisdiction.
  8. Requested substitution is compatible with other portions of the Work.
  9. Requested substitution has been coordinated with other portions of the Work.
  10. Requested substitution provides specified warranty.
  11. 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.
  12. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
  13. Evidence that proposed product provides specified warranty.
  14. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
  15. Samples, if requested.

### PART 3 EXECUTION (NOT USED)

END OF SECTION

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## SECTION 01 61 16 - VOLATILE ORGANIC COMPOUND (VOC) CONTENT RESTRICTIONS

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Requirements for Indoor-Emissions-Restricted products.
- B. Requirements for VOC-Content-Restricted products.
- C. Requirement for installer certification that they did not use any non-compliant products.

#### 1.2 RELATED REQUIREMENTS

- A. Section 01 30 00 - Administrative Requirements: Submittal procedures.
- B. Section 01 33 29.02 - Sustainable Design Reporting - LEED v4: Procedures for reporting emissions and VOC content data.
- C. Section 01 40 00 - Quality Requirements: Procedures for testing and certifications.
- D. Section 01 60 00 - Product Requirements: Fundamental product requirements, substitutions and product options, delivery, storage, and handling.
- E. Section 07 92 00 - Joint Sealants: Emissions-compliant sealants.
- F. Section 01 81 13 - Sustainable Design Requirements: Procedures for reporting emissions and VOC content data.

#### 1.3 DEFINITIONS

- A. Indoor-Emissions-Restricted Products: All products in the following product categories, whether specified or not:
  - 1. Interior paints and coatings applied on site.
  - 2. Interior adhesives and sealants applied on site, including flooring adhesives.
  - 3. Thermal and acoustical insulation.
  - 4. Other products when specifically stated in the specifications.
- B. VOC-Content-Restricted Products: All products in the following product categories, whether specified or not:
  - 1. Interior paints and coatings applied on site.
  - 2. Interior adhesives and sealants applied on site, including flooring adhesives.
  - 3. Wet-applied roofing and waterproofing.

- C. Interior of Building: Anywhere inside the exterior weather barrier.
- D. Adhesives: All gunnable, trowelable, liquid-applied, and aerosol adhesives, whether specified or not; including flooring adhesives, resilient base adhesives, and pipe jointing adhesives.
- E. Sealants: All gunnable, trowelable, and liquid-applied joint sealants and sealant primers, whether specified or not; including firestopping sealants and duct joint sealers.
- F. Inherently Non-Emitting Materials: Products composed wholly of minerals or metals, unless they include organic-based surface coatings, binders, or sealants; and specifically the following:
  - 1. Concrete.
  - 2. Clay brick.
  - 3. Metals that are plated, anodized, or powder-coated.
  - 4. Glass.
  - 5. Ceramics.
  - 6. Solid wood flooring that is unfinished and untreated.

#### 1.4 REFERENCE STANDARDS

- A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency current edition.
- B. ASTM D3960 - Standard Practice for Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings 2005 (Reapproved 2018).
- C. CARB (SCM) - Suggested Control Measure for Architectural Coatings; California Air Resources Board 2007.
- D. SCAQMD 1113 - Architectural Coatings 1977 (Amended 2016).
- E. SCAQMD 1168 - Adhesive and Sealant Applications 1989 (Amended 2017).

#### 1.5 SUBMITTALS

- A. See Section 01 33 00 for general submittal procedures.
- B. Product Data: For each VOC-restricted product used in the project, submit evidence of compliance.
- C. Sustainable Design Reporting: Submit evidence of compliance.
  - 1. Refer to Section 01 83 13 - Sustainable Design Requirements

- D. Installer Certifications Regarding Prohibited Content: Require each installer of any type of product (not just the products for which VOC restrictions are specified) to certify that either 1) no adhesives, joint sealants, paints, coatings, or composite wood or agrifiber products have been used in the installation of installer's products, or 2) that such products used comply with these requirements.

## 1.6 QUALITY ASSURANCE

- A. VOC Content Test Method: 40 CFR 59, Subpart D (EPA Method 24), or ASTM D3960, unless otherwise indicated.
1. Evidence of Compliance: Acceptable types of evidence are:
    - a. Report of laboratory testing performed in accordance with requirements.
    - b. Published product data showing compliance with requirements.
    - c. Certification by manufacturer that product complies with requirements.
- B. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of the type specified in this section.

## PART 2 PRODUCTS

### 2.1 MATERIALS

- A. All Products: Comply with the most stringent of federal, State, and local requirements, or these specifications.
- B. VOC-Content-Restricted Products: VOC content not greater than required by the following:
1. Adhesives, Including Flooring Adhesives: SCAQMD 1168 Rule.
  2. Joint Sealants: SCAQMD 1168 Rule.
  3. Paints and Coatings: Each color; most stringent of the following:
    - a. 40 CFR 59, Subpart D.
    - b. SCAQMD 1113 Rule.
    - c. CARB (SCM).
  4. Wet-Applied Roofing and Waterproofing: Comply with requirements for paints and coatings.

## PART 3 EXECUTION

### 3.1 FIELD QUALITY CONTROL

- A. Owner reserves the right to reject non-compliant products, whether installed or not, and require their removal and replacement with compliant products at no extra cost to Owner.

- B. Additional costs to restore indoor air quality due to installation of non-compliant products will be borne by Contractor.

END OF SECTION

## SECTION 01 73 00 - EXECUTION

### PART 1 GENERAL

#### 1.1 SUMMARY

- A. This Section includes general procedural requirements governing execution of the Work including, but not limited to, the following:
1. Construction layout.
  2. Field engineering and surveying.
  3. General installation of products.
  4. Coordination of Owner-installed products.
  5. Progress cleaning.
  6. Starting and adjusting.
  7. Protection of installed construction.
  8. Correction of the Work.

#### 1.2 SUBMITTALS

- A. Refer to Section 01 33 00 for general submittal procedures.
- B. Qualification Data: For land surveyor.
- C. Certificates: Submit certificate signed by land surveyor certifying that location and elevation of improvements comply with requirements.
- D. Certified Surveys: Submit two copies signed by land surveyor.
- E. Final Property Survey: Submit 10 copies showing the Work performed and record survey data.

#### 1.3 QUALITY ASSURANCE

- A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.

## PART 2 PRODUCTS (NOT USED)

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Acceptance of Conditions: Examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
1. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:
  - a. Description of the Work.
  - b. List of detrimental conditions, including substrates.
  - c. List of unacceptable installation tolerances.
  - d. Recommended corrections.
2. Verify compatibility with and suitability of substrates, including compatibility with finishes or primers.
3. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
4. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
5. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.
6. Should the Drawings disagree with one another, or with the Specifications, the better quality or greater quantity of Work or materials shall be performed or furnished.

### 3.2 PREPARATION

- A. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- B. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- C. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Architect. Include a detailed description of problem encountered, together with recommendations for changing the Contract Documents. Submit requests on "Request for Interpretation," form as outlined in Specification Section 1.

### 3.3 CONSTRUCTION LAYOUT

- A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Architect promptly.
- B. General: Engage a land surveyor to lay out the Work using accepted surveying practices.
  - 1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
  - 2. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
  - 3. Inform installers of lines and levels to which they must comply.
  - 4. Check the location, level and plumb, of every major element as the Work progresses.
  - 5. Notify Architect when deviations from required lines and levels exceed allowable tolerances.
  - 6. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.
- C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and invert elevations.
- D. Building Lines and Levels: Locate and lay out control lines and levels for site work, structures, foundations, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.
- E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect and Owner.

### 3.4 FIELD ENGINEERING

- A. Identification: Owner's Representative will identify existing benchmarks, control points, and property corners.
- B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.
  - 1. Do not change or relocate existing benchmarks or control points without prior written approval of Architect. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Architect before proceeding.

2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.
- C. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.
  1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
  2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
  3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.
- D. Certified Survey: On completion of foundation walls, major site improvements, and other work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and sitework.
- E. Final Property Survey: Prepare a final property survey showing significant features (real property) for Project. Include on the survey a certification, signed by land surveyor, that principal metes, bounds, lines, and levels of Project are accurately positioned as shown on the survey.
  1. Show boundary lines, monuments, streets, site improvements and utilities, existing improvements and significant vegetation, adjoining properties, acreage, grade contours, and the distance and bearing from a site corner to a legal point.
  2. Recording: At Substantial Completion, have the final property survey recorded by or with authorities having jurisdiction as the official "property survey."

### 3.5 INSTALLATION

- A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
  1. Make vertical work plumb and make horizontal work level.
  2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
  3. Conceal pipes, ducts, and wiring in finished areas, unless otherwise indicated.
  4. Maintain minimum headroom clearances as indicated on plans and of 12 feet in spaces without a suspended ceiling, unless noted otherwise. Coordinate all overhead items to maximize available clear space.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.

- C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.
- E. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.
- F. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
- G. Anchors and Fasteners: Provide anchors and fasteners as required to anchor each component securely in place, accurately located and aligned with other portions of the Work.
  - 1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect and as required by applicable codes and standards.
  - 2. Allow for building movement, including thermal expansion and contraction and live and dead load deflection.
  - 3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- H. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints. Jointing and seaming in exposed products should be approved via mockup by Architect/Ownership prior to proceeding in earnest.
- I. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

### 3.6 OWNER-INSTALLED PRODUCTS

- A. Site Access: Provide access to Project site for Owner's construction forces.
- B. Coordination: Coordinate construction and operations of the Work with work performed by Owner's construction forces.
  - 1. Construction Schedule: Inform Architect and Owner's Representative of Contractor's preferred construction schedule for Owner's portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify Architect and Owner's Representative if changes to schedule are required due to differences in actual construction progress. Provide timely notification to Ownership of all schedule dates where Owner Furnished items and contractors are required. Delays due to the contractors failure to notify ownership of necessary timelines will be rejected.

2. Preinstallation Conferences: Include Owner's Representative at preinstallation conferences covering portions of the Work that are to receive Owner's work.

### 3.7 PROGRESS CLEANING

- A. General: Clean Project site and work areas daily, including common areas. Coordinate progress cleaning for joint-use areas where more than one installer has worked. Enforce requirements strictly. Dispose of materials lawfully. Contractor shall be responsible for cleaning up after themselves and for protecting the work of others.
  1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
  2. Do not hold materials more than 7 days during normal weather or 3 days if the temperature is expected to rise above 80 deg F.
  3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
- B. Site: Maintain Project site free of waste materials and debris. Provide sufficient labor staff on site to manage daily cleanup.
- C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.
  1. Remove liquid spills promptly.
  2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
  3. Protect workers and installed materials from dust using appropriate HEPA filtration and other dust mitigation strategies.
- D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
- E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
- F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- G. Waste Disposal: Burying or burning waste materials on-site will not be permitted. Washing waste materials down sewers or into waterways will not be permitted.
- H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

- I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
- J. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

### 3.8 STARTING AND ADJUSTING

- A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- B. Adjust operating components for proper operation without binding. Adjust equipment for proper operation.
- C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Manufacturer's Field Service: If a factory-authorized service representative is required to inspect field-assembled components and equipment installation, comply with qualification requirements in Division 1 Section "Quality Requirements."
- E. Coordinate with Owners commissioning agent as required for all starting, testing, balancing and adjusting. Provide reports as required.

### 3.9 PROTECTION OF INSTALLED CONSTRUCTION

- A. Provide adequate temporary and final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion and acceptance by Ownership. Provide protection as required throughout all phases of construction for all finished materials subject to damage by others.
- B. Comply with manufacturer's written instructions for temperature and relative humidity for all installed components throughout all phases of construction.

### 3.10 CORRECTION OF THE WORK

- A. Repair or remove and replace defective construction. Restore damaged substrates and finishes. Comply with requirements in Section 01 73 20 - Cutting and Patching.
  - 1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment to bring all damaged or defective work back to an "as new" condition.
- B. Restore permanent facilities used during construction to their specified condition.
- C. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.

- D. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.
- E. Remove and replace chipped, scratched, and broken glass or reflective surfaces.
- F. All repaired or replaced defective or damaged work is subject to approval prior to final acceptance by the architect and ownership.

END OF SECTION

## SECTION 01 73 20 - CUTTING AND PATCHING

### PART 1 GENERAL

#### 1.1 SUMMARY

- A. Work Included: The Work of this Section includes, but is not limited to, procedural requirements for cutting and patching of items which are part of new Work required to complete the Work or to accomplish the following:
  - 1. Make connecting or adjoining parts fit together properly.
  - 2. Uncover portions of the Work to provide for installation of ill-timed work.
  - 3. Remove and replace defective work.
  - 4. Remove and replace work not conforming to requirements of Contract Documents.
  - 5. Remove samples of installed work as specified for testing.
  - 6. Provide routine penetrations of nonstructural surfaces for installation of piping and electrical conduit.
- B. Document in Project Record File circumstances relating to cutting and patching, including reasons for problem and solutions to problems.

#### 1.2 DEFINITIONS

- A. Cutting: Removal of in-place construction necessary to permit installation or performance of other Work.
- B. Patching: Fitting and repair work required to restore surfaces to original conditions after installation of other Work.

#### 1.3 SUBMITTALS

- A. Refer to Section 01 33 00 for general submittal procedures.
- B. Cutting and Patching Proposal: Where approval of procedures for cutting and patching is required before proceeding, submit a proposal describing procedures at least 10 days before the time cutting and patching will be performed, requesting approval to proceed. Include the following information:
  - 1. Extent: Describe cutting and patching, show how they will be performed, and indicate why they cannot be avoided.
  - 2. Changes to In-Place Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building's appearance and other significant visual elements.
  - 3. Products: List products to be used and firms or entities that will perform the Work.

4. Dates: Indicate when cutting and patching will be performed.
5. Utility Services and Mechanical/Electrical Systems: List services/systems that cutting and patching procedures will disturb or affect. List services/systems that will be relocated and those that will be temporarily out of service. Indicate how long services/systems will be disrupted.
6. Structural Elements: Where cutting and patching involve adding reinforcement to structural elements, submit details and engineering calculations showing integration of reinforcement with original structure.
7. Architect's Approval: Obtain approval of cutting and patching proposal before cutting and patching. Approval does not waive right to later require removal and replacement of unsatisfactory work.

#### 1.4 QUALITY ASSURANCE

- A. Structural Elements: Do not cut and patch structural elements without first contacting the Architect for approval.
  1. Obtain approval of the cutting and patching proposal before cutting and patching, including core drilling the following structural elements:
    - a. Structural concrete.
    - b. Structural steel.
    - c. Lintels.
    - d. Miscellaneous structural metals.
    - e. Exterior curtain wall construction.
    - f. Equipment supports.
    - g. Piping, ductwork, vessels, and equipment.
- B. Operational and Safety Elements: Do not cut and patch operating elements and safety related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety. Operating elements include the following:
  1. Primary operational systems and equipment.
  2. Air or smoke barriers.
  3. Fire-suppression systems.
  4. Mechanical systems piping and ducts.
  5. Control systems.
  6. Communication systems.

7. Electrical wiring systems.
- C. Miscellaneous Elements: Do not cut and patch miscellaneous elements or related components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety. Miscellaneous elements include the following:
  1. Water, moisture, or vapor barriers.
  2. Membranes and flashings.
  3. Equipment supports.
  4. Piping, ductwork, vessels, and equipment.
  5. Noise- and vibration-control elements and systems.
- D. Visual Requirements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch construction exposed on the exterior or in occupied spaces in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.
- E. Cutting and Patching Conference: Before proceeding, meet at Project site with parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

## 1.5 WARRANTY

- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during cutting and patching operations, by methods and with materials so as not to void existing warranties.

## PART 2 PRODUCTS

### 2.1 MATERIALS

- A. General: Comply with requirements specified in other Sections.
- B. In-Place Materials: Use materials identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
  1. If identical materials are unavailable or cannot be used, use materials that, when installed, will match the visual and functional performance of in-place materials.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Examine surfaces to be cut and patched and conditions under which cutting and patching are to be performed.

1. Compatibility: Before patching, verify compatibility with and suitability of substrates, including compatibility with in-place finishes or primers.
2. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Temporary Support: Provide temporary support of Work to be cut.
- B. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- C. Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.
- D. Utility Services and Mechanical/Electrical Systems: Where services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to prevent interruption to occupied areas.

### 3.3 PERFORMANCE

- A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
  1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
- B. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
  1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
  2. Finished Surfaces: Cut or drill from the exposed or finished side toward the concealed surfaces.
  3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
  4. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
  5. Proceed with patching after construction operations requiring cutting are complete.

- C. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections.
  - 1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation. Document replacement of concealed work as required with owners third party inspectors.
  - 2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
    - a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
    - b. Restore damaged pipe covering to its original condition.
  - 3. Where services are required to be removed, relocated, or abandoned, by-pass utility services, such as pipe or conduit, before cutting. Cut-off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal the remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after by-passing and cutting.
  - 4. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, as necessary to achieve uniform color and appearance.
    - a. Where patching occurs in a painted surface, apply primer and intermediate paint coats over the patch and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.
  - 5. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
  - 6. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and matches existing construction.
- D. Cleaning: Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, and similar materials.

END OF SECTION

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## SECTION 01 74 19 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

### PART 1 GENERAL

#### 1.1 WASTE MANAGEMENT REQUIREMENTS

- A. Owner requires that this project generate the least amount of trash and waste possible.
- B. Employ processes that ensure the generation of as little waste as possible due to error, poor planning, breakage, mishandling, contamination, or other factors.
- C. Minimize trash/waste disposal in landfills; reuse, salvage, or recycle as much waste as economically feasible.
- D. Contractor shall submit periodic Waste Disposal Reports; all landfill disposal, incineration, recycling, salvage, and reuse must be reported regardless of to whom the cost or savings accrues; use the same units of measure on all reports.
- E. Contractor shall develop and follow a Waste Management Plan designed to implement these requirements.
- F. The following sources may be useful in developing the Waste Management Plan:
- G. Methods of trash/waste disposal that are not acceptable are:
  - 1. Burning on the project site.
  - 2. Burying on the project site.
  - 3. Dumping or burying on other property, public or private.
  - 4. Other illegal dumping or burying.
- H. Regulatory Requirements: Contractor is responsible for knowing and complying with regulatory requirements, including but not limited to Federal, state and local requirements, pertaining to legal disposal of all construction and demolition waste materials.

#### 1.2 DEFINITIONS

- A. Clean: Untreated and unpainted; not contaminated with oils, solvents, caulk, or the like.
- B. Construction and Demolition Waste: Solid wastes typically including building materials, packaging, trash, debris, and rubble resulting from construction, remodeling, repair and demolition operations.
- C. Hazardous: Exhibiting the characteristics of hazardous substances, i.e., ignitability, corrosivity, toxicity or reactivity.
- D. Nonhazardous: Exhibiting none of the characteristics of hazardous substances, i.e., ignitability, corrosivity, toxicity, or reactivity.

- E. Nontoxic: Neither immediately poisonous to humans nor poisonous after a long period of exposure.
- F. Recyclable: The ability of a product or material to be recovered at the end of its life cycle and remanufactured into a new product for reuse by others.
- G. Recycle: To remove a waste material from the project site to another site for remanufacture into a new product for reuse by others.
- H. Recycling: The process of sorting, cleansing, treating and reconstituting solid waste and other discarded materials for the purpose of using the altered form. Recycling does not include burning, incinerating, or thermally destroying waste.
- I. Return: To give back reusable items or unused products to vendors for credit.
- J. Reuse: To reuse a construction waste material in some manner on the project site.
- K. Salvage: To remove a waste material from the project site to another site for resale or reuse by others.
- L. Sediment: Soil and other debris that has been eroded and transported by storm or well production run-off water.
- M. Source Separation: The act of keeping different types of waste materials separate beginning from the first time they become waste.
- N. Toxic: Poisonous to humans either immediately or after a long period of exposure.
- O. Trash: Any product or material unable to be reused, returned, recycled, or salvaged.
- P. Waste: Extra material or material that has reached the end of its useful life in its intended use. Waste includes salvageable, returnable, recyclable, and reusable material.

### 1.3 SUBMITTALS

- A. See Section 01 33 00 for general submittal procedures.
- B. Submit Waste Management Plan within 10 calendar days after receipt of Notice of Award of Bid, or prior to any trash or waste removal, whichever occurs sooner; submit projection of all trash and waste that will require disposal and alternatives to landfilling.
- C. Waste Management Plan: Include the following information:
  1. Analysis of the trash and waste projected to be generated during the entire project construction cycle, including types and quantities.
  2. Landfill Options: The name, address, and telephone number of the landfill(s) where trash/waste will be disposed of, the applicable landfill tipping fee(s), and the projected cost of disposing of all project trash/waste in the landfill(s).
  3. Landfill Alternatives: List all waste materials that will be diverted from landfills by reuse, salvage, or recycling.

4. Meetings: Describe regular meetings to be held to address waste prevention, reduction, recycling, salvage, reuse, and disposal.
  5. Materials Handling Procedures: Describe the means by which materials to be diverted from landfills will be protected from contamination and prepared for acceptance by designated facilities; include separation procedures for recyclables, storage, and packaging.
  6. Transportation: Identify the destination and means of transportation of materials to be recycled; i.e. whether materials will be site-separated and self-hauled to designated centers, or whether mixed materials will be collected by a waste hauler.
- D. Waste Disposal Reports: Submit at specified intervals, with details of quantities of trash and waste, means of disposal or reuse, and costs; show both totals to date and since last report.
1. Submit updated Report with each Application for Progress Payment; failure to submit Report will delay payment.
  2. Submit Report on a form acceptable to Owner.
  3. Landfill Disposal: Include the following information:
    - a. Identification of material.
    - b. Amount, in tons or cubic yards, of trash/waste material from the project disposed of in landfills.
    - c. State the identity of landfills, total amount of tipping fees paid to landfill, and total disposal cost.
    - d. Include manifests, weight tickets, receipts, and invoices as evidence of quantity and cost.
  4. Incinerator Disposal: Include the following information:
    - a. Identification of material.
    - b. Amount, in tons or cubic yards, of trash/waste material from the project delivered to incinerators.
    - c. State the identity of incinerators, total amount of fees paid to incinerator, and total disposal cost.
    - d. Include manifests, weight tickets, receipts, and invoices as evidence of quantity and cost.
  5. Recycled and Salvaged Materials: Include the following information for each:
    - a. Identification of material, including those retrieved by installer for use on other projects.
    - b. Amount, in tons or cubic yards, date removed from the project site, and receiving party.
    - c. Transportation cost, amount paid or received for the material, and the net total cost or savings of salvage or recycling each material.

- d. Include manifests, weight tickets, receipts, and invoices as evidence of quantity and cost.
  - e. Certification by receiving party that materials will not be disposed of in landfills or by incineration.
6. Material Reused on Project: Include the following information for each:
- a. Identification of material and how it was used in the project.
  - b. Amount, in tons or cubic yards.
  - c. Include weight tickets as evidence of quantity.
7. Other Disposal Methods: Include information similar to that described above, as appropriate to disposal method.

## PART 2 PRODUCTS

### 2.1 PRODUCT SUBSTITUTIONS

- A. Refer to Section 01 25 00 - Substitution Procedures for submittal and acceptance requirements for substitutions.
- B. For each proposed product substitution, submit the following information in addition to requirements specified in Section 01 25 00:
  - 1. Relative amount of waste produced, compared to specified product.
  - 2. Cost savings on waste disposal, compared to specified product, to be deducted from the Contract Sum.
  - 3. Proposed disposal method for waste product.
  - 4. Markets for recycled waste product.

## PART 3 EXECUTION

### 3.1 WASTE MANAGEMENT PROCEDURES

- A. See Section 01 30 00 for additional requirements for project meetings, reports, submittal procedures, and project documentation.
- B. See Section 01 50 00 for additional requirements related to trash/waste collection and removal facilities and services.
- C. See Section 01 60 00 for waste prevention requirements related to delivery, storage, and handling.
- D. See Section 01 73 20 for trash/waste prevention procedures related to demolition, cutting and patching, installation, protection, and cleaning.

### 3.2 WASTE MANAGEMENT PLAN IMPLEMENTATION

- A. Manager: Designate an on-site person or persons responsible for instructing workers and overseeing and documenting results of the Waste Management Plan.
- B. Communication: Distribute copies of the Waste Management Plan to job site foreman, each subcontractor, Owner, and Architect.
- C. Instruction: Provide on-site instruction of appropriate separation, handling, and recycling, salvage, reuse, and return methods to be used by all parties at the appropriate stages of the project.
- D. Meetings: Discuss trash/waste management goals and issues at project meetings.
  - 1. Prebid meeting.
  - 2. Preconstruction meeting.
  - 3. Regular job-site meetings.
  - 4. Job safety meetings.
- E. Facilities: Provide specific facilities for separation and storage of materials for recycling, salvage, reuse, return, and trash disposal, for use by all contractors and installers.
  - 1. Provide containers as required.
  - 2. Provide materials for barriers and enclosures that are nonhazardous, recyclable, or reusable to the maximum extent possible; reuse project construction waste materials if possible.
  - 3. Locate enclosures out of the way of construction traffic.
  - 4. Provide adequate space for pick-up and delivery and convenience to subcontractors.
  - 5. Keep recycling and trash/waste bin areas neat and clean and clearly marked in order to avoid contamination of materials.
- F. Hazardous Wastes: Separate, store, and dispose of hazardous wastes according to applicable regulations.
- G. Recycling: Separate, store, protect, and handle at the site identified recyclable waste products in order to prevent contamination of materials and to maximize recyclability of identified materials. Arrange for timely pickups from the site or deliveries to recycling facility in order to prevent contamination of recyclable materials.
- H. Reuse of Materials On-Site: Set aside, sort, and protect separated products in preparation for reuse.
- I. Salvage: Set aside, sort, and protect products to be salvaged for reuse off-site.

END OF SECTION

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## SECTION 01 77 00 - CLOSEOUT PROCEDURES

### PART 1 GENERAL

#### 1.1 SUMMARY

- A. This Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
1. Inspection procedures.
  2. Warranties.
  3. Final cleaning.

#### 1.2 SUBSTANTIAL COMPLETION

- A. Preliminary Procedures: Before requesting inspection for determining date of Substantial Completion, complete the following. List items below that are incomplete in request.
1. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.
  2. Advise Owner of pending insurance changeover requirements.
  3. Submit specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
  4. Obtain and submit releases permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
  5. Prepare and submit Project Record Documents, operation and maintenance manuals, Final Completion construction photographs, damage or settlement surveys, property surveys, and similar final record information.
  6. Deliver tools, spare parts, keys, extra materials, and similar items to location designated by Owner. Label with manufacturer's name and model number where applicable.
  7. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
  8. Complete startup testing of systems.
  9. Submit test/adjust/balance records.
  10. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
  11. Complete final cleaning requirements, including touchup painting.

12. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.
  13. Advise Owner of changeover in heat and other utilities.
  14. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
  15. Obtain all inspections and approvals by the authorities having jurisdiction to facilitate the issuance of the Certificate of Occupancy.
- B. Inspection: Submit a written request for inspection for Substantial Completion. 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.
- C. **The Owner, Architect, and applicable Engineers will inspect all Work at Substantial Completion.**
1. **For inspections in excess of the one (1), the Contractor shall reimburse the Owner, for additional services required of the Architect, the Architect's consultant for these additional inspections.**
  2. **The Architect will repeat inspection when requested and assured that the Work has been substantially completed.**
  3. **Results of the completed inspection will form the basis of requirements for final acceptance.**

### 1.3 FINAL COMPLETION

- A. Preliminary Procedures: Before requesting final inspection for determining date of Final Completion, complete the following:
1. Submit a final Application for Payment according to Division 01 Section "Payment Procedures."
  2. Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
  3. Submit evidence of final, continuing insurance coverage complying with insurance requirements.
  4. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems.
- B. Inspection: Submit a written request for final inspection for acceptance. 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. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

#### 1.4 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

- A. Preparation: **Submit PDF files.** 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. Use CSI Form 14.1A or other approved form.
1. Organize list of spaces in sequential order, proceeding from lowest floor to highest floor.
  2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
  3. Include the following information at the top of each page:
    - a. Project name.
    - b. Name of Architect.
    - c. Name of Contractor.
    - d. Page number.

#### 1.5 WARRANTIES

- A. Submittal Time: Submit written warranties on request of Architect for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated.
- B. Partial Occupancy: Submit properly executed warranties within 15 days of completion of designated portions of the Work that are completed and occupied or used by Owner during construction period by separate agreement with Contractor.
- C. **Organize warranty documents into an orderly sequence based on the table of contents of the Project Manual.**
1. **Bind warranties and bonds in heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.**
  2. **Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.**
  3. **Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.**
- D. 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.

## PART 3 EXECUTION

### 3.1 FINAL CLEANING

- A. General: Provide 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 portion of Project:
    - a. Clean Project site in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
    - b. Remove tools, construction equipment, machinery, and surplus material from Project site.
    - c. Clean exposed 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.
    - d. Clean all surfaces and other work in accordance with recommendations of the manufacturer.
    - e. Remove spots, mortar, plaster, soil, and paint from ceramic tile, stone, and other finish materials.
    - f. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
    - g. Sweep concrete floors broom clean in unoccupied spaces.
    - h. Vacuum carpet and similar soft surfaces, removing debris and excess nap; shampoo if visible soil or stains remain.
    - i. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.
    - j. Remove labels that are not permanent.

- k. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.
    - 1) Do not paint over "UL" and similar labels, including mechanical and electrical nameplates.
  - l. Wipe surfaces of mechanical and electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
  - m. Replace parts subject to unusual operating conditions.
  - n. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
  - o. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
  - p. Clean ducts, blowers, and coils if units were operated without filters during construction.
  - q. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs, and those noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.
  - r. Leave Project clean and ready for occupancy.
- C. Comply with safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on Owner's property. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove waste materials from Project site and dispose of lawfully.

END OF SECTION

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## SECTION 01 78 20 - OPERATION AND MAINTENANCE DATA

### PART 1 GENERAL

#### 1.1 SUMMARY

- A. This Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
  - 1. Project directory.
  - 2. Operation and maintenance documentation directory.
  - 3. Emergency manuals.
  - 4. Operation manuals for systems, subsystems, and equipment.
  - 5. Maintenance manuals for the care and maintenance of products, materials, and finishes, systems and equipment.

#### 1.2 DEFINITIONS

- A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.
- B. Subsystem: A portion of a system with characteristics similar to a system.

#### 1.3 SUBMITTALS

- A. Refer to Section 01 33 00 for general submittal procedures.
- B. Schedule: 120 days prior to Initial Submittal review all specification sections and provide a comprehensive schedule of Operation and Maintenance Data that will be provided prior to Substantial Completion for approval.
- C. Initial Submittal: Submit 2 draft copies of each manual at least 30 days before requesting inspection for Substantial Completion. Include a complete operation and maintenance directory. Architect will return one copy of draft and mark whether general scope and content of manual are acceptable.
- D. Final Submittal: Submit one copy of each manual in final form at least 15 days before final inspection. Architect will return copy with comments within 15 days after final inspection.
  - 1. Correct or modify each manual to comply with Architect's comments. Submit 3 copies of each corrected manual within 15 days of receipt of Architect's comments.

#### 1.4 COORDINATION

- A. Where operation and maintenance documentation include information on installations by more than one factory-authorized service representative, assemble and coordinate information furnished by representatives and prepare manuals.

## PART 2 PRODUCTS

### 2.1 PROJECT DIRECTORY

1. Indicate contractors at all tiers
2. Identify components and location of work
3. Contact information for both normal and emergency response.

### 2.2 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY

- A. Organization: Include a section in the directory for each of the following:
  1. List of documents.
  2. List of systems.
  3. List of equipment.
  4. Table of contents.
  5. Identification.
  6. Manufacturer's contact information.
  7. Reference to Drawing Number or Specification Section
  8. Utility Shut Off Locations
  9. Filter and Valve Schedules
- B. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.
- C. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.
- D. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.
- E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."
- F. Manufacturer's Contact Information: Include a table with both normal and emergency contact information for all manufacturer's.
- G. Reference to Drawing Number or Specification Section: Include a table indicating the Drawing Number or Specification Section associated with each piece of Equipment, System, or Subsystem.

H. Utility Shut Off Locations: Include a table with all utility shut off locations associated with equipment (Electric Panels, Control Panels, Valve Numbers, Disconnect Locations, etc.)

I. Filter and Valve Schedules: Provide a table and plan with all filter and valve locations located and identified.

## 2.3 MANUALS, GENERAL

A. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:

1. Title page.

2. Table of contents.

3. Manual contents.

B. Title Page: Enclose title page in transparent plastic sleeve. Include the following information:

1. Subject matter included in manual.

2. Name and address of Project.

3. Name and address of Owner.

4. Date of submittal.

5. Name, address, and telephone number of Contractor at all tiers.

6. Name and address of Architect.

7. Cross-reference to related systems in other operation and maintenance manuals.

C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.

1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.

D. Manual Contents, General: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.

### E. Manuals, Paper Copy:

1. Binders: Heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.

- a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.
  - b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents. Indicate volume number for multiple-volume sets.
2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software diskettes for computerized electronic equipment.
4. Supplementary Text: Prepared on 8-1/2-by-11-inch white bond paper.
5. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
  - a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
  - b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.
- F. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.
1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
  2. File Names and Bookmarks: Enable bookmarking of individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.

## 2.4 EMERGENCY MANUALS

- A. Content: Organize manual into a separate section for each of the following:
1. Type of emergency.
  2. Emergency instructions.

3. Emergency procedures.
- B. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:
  1. Flood.
  2. Gas leak.
  3. Water leak.
  4. Power failure.
  5. Water outage.
  6. System, subsystem, or equipment failure.
  7. Chemical release or spill.
- C. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.
- D. Emergency Procedures: Include the following, as applicable:
  1. Instructions on stopping.
  2. Shutdown instructions for each type of emergency.
  3. Operating instructions for conditions outside normal operating limits.
  4. Required sequences for electric or electronic systems.
  5. Special operating instructions and procedures.

## 2.5 OPERATION MANUALS

- A. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:
  1. System, subsystem, and equipment descriptions.
  2. Performance and design criteria if Contractor is delegated design responsibility.
  3. Operating standards.
  4. Operating procedures.
  5. Operating logs.
  6. Wiring diagrams.

7. Control diagrams.
  8. Piped system diagrams.
  9. Precautions against improper use.
  10. License requirements including inspection and renewal dates.
- B. Descriptions: Include the following:
1. Product name and model number.
  2. Manufacturer's name.
  3. Equipment identification with serial number of each component.
  4. Equipment function.
  5. Operating characteristics.
  6. Limiting conditions.
  7. Performance curves.
  8. Engineering data and tests.
  9. Complete nomenclature and number of replacement parts.
- C. Operating Procedures: Include the following, as applicable:
1. Startup procedures.
  2. Equipment or system break-in procedures.
  3. Routine and normal operating instructions.
  4. Regulation and control procedures.
  5. Instructions on stopping.
  6. Normal shutdown instructions.
  7. Seasonal and weekend operating instructions.
  8. Required sequences for electric or electronic systems.
  9. Special operating instructions and procedures.
- D. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.
- E. Piped Systems: Diagram piping as installed and identify color-coding where required for identification.

## 2.6 PRODUCT MAINTENANCE MANUAL

- A. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.
- B. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.
- C. Product Information: Include the following, as applicable:
  - 1. Product name and model number.
  - 2. Manufacturer's name.
  - 3. Color, pattern, and texture.
  - 4. Material and chemical composition.
  - 5. Reordering information for specially manufactured products.
- D. Maintenance Procedures: Include manufacturer's written recommendations and the following:
  - 1. Inspection procedures.
  - 2. Types of cleaning agents to be used and methods of cleaning.
  - 3. List of cleaning agents and methods of cleaning detrimental to product.
  - 4. Schedule for routine cleaning and maintenance.
  - 5. Repair instructions.
- E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
- F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
  - 1. Include procedures to follow and required notifications for warranty claims.

## 2.7 SYSTEMS AND EQUIPMENT MAINTENANCE MANUAL

- A. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.

- B. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.
- C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:
  - 1. Standard printed maintenance instructions and bulletins.
  - 2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
  - 3. Identification and nomenclature of parts and components.
  - 4. List of items recommended to be stocked as spare parts.
- D. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
  - 1. Test and inspection instructions.
  - 2. Troubleshooting guide.
  - 3. Precautions against improper maintenance.
  - 4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
  - 5. Aligning, adjusting, and checking instructions.
  - 6. Demonstration and training videotape, if available.
- E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
  - 1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
  - 2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.
- F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
- G. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
- H. Warranties: Include copies of warranties and lists of circumstances and conditions that would affect validity of warranties or bonds.

1. Include procedures to follow and required notifications for warranty claims.

## PART 3 EXECUTION

### 3.1 MANUAL PREPARATION AND ASSEMBLY, GENERAL

- A. Project Directory: Prepare a separate manual that provides a project directory for contractors at all tiers of the project.
- B. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals.
- C. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.
- D. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
- E. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.
  1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
  2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.
- F. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
  1. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.
- G. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in Record Drawings to ensure correct illustration of completed installation.
  1. Do not use original Project Record Documents as part of operation and maintenance manuals.
  2. Comply with requirements of newly prepared Record Drawings in Section 01 78 39 - Project Record Documents.

- H. Comply with Section 01 77 00 - Closeout Procedures for schedule for submitting operation and maintenance documentation.

END OF SECTION

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## SECTION 01 78 39 - PROJECT RECORD DOCUMENTS

### PART 1 GENERAL

#### 1.1 SUMMARY

- A. This Section includes administrative and procedural requirements for Project Record Documents, including the following:
1. Record Drawings.
  2. Record Specifications.
  3. Record Product Data.

#### 1.2 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:** Submit one set of plots from corrected Record ELECTRONIC Drawings and one set of marked-up Record Prints. Architect will initial and date each plot and mark whether general scope of changes, additional information recorded, and quality of drafting are acceptable. Architect will return plots and prints for organizing into sets, printing, binding, and final submittal.
  - b. **Final Submittal:** Submit three set(s) of marked-up Record Prints, one set(s) of Record Electronic Drawing files, one set(s) of Record electronic Drawing plots, and three copies printed from record plots. Plot and print each Drawing, whether or not changes and additional information were recorded.
    - 1) **Electronic Media:** PDF.

- B. Record Specifications: Submit one copy of Project's Specifications, including addenda and contract modifications.

- C. Record Product Data: Submit one copy of each Product Data submittal.

1. Where Record Product Data is required as part of operation and maintenance manuals, submit marked-up Product Data as an insert in manual instead of submittal as Record Product Data.

- D. Miscellaneous Record Submittals: See other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit one paper copy and annotated PDF electronic files and directories of each submittal.

- E. Reports: Submit written report weekly indicating items incorporated into project record documents concurrent with progress of the Work, including revisions, concealed conditions, field changes, product selections, and other notations incorporated

## PART 2 PRODUCTS

### 2.1 RECORD DRAWINGS

- A. Record Prints: The General Contractor shall maintain one set of black-line white prints of the Contract Drawings and Shop Drawings.
1. Preparation: Mark Record Prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to prepare the 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 understandable drawing technique.
    - c. Record data as soon as possible after obtaining it. Record and check the markup before enclosing concealed installations.
    - 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 below first floor.
    - d. Locations and depths of underground utilities.
    - e. Revisions to routing of piping and conduits.
    - f. Revisions to electrical circuitry.
    - g. Actual equipment locations.
    - h. Duct size and routing.
    - i. Locations of concealed internal utilities.
    - j. Changes made by Change Order or Construction Change Directive.
    - k. Changes made following Architect's written orders.

1. 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 or Shop Drawings, whichever is most capable of showing actual physical conditions, completely and accurately. If Shop Drawings are marked, show cross-reference on the Contract Drawings.
  4. Mark record sets 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 Electronic Drawings: Immediately before inspection for Certificate of Substantial Completion, review marked-up Record Prints with Architect. When authorized, the General Contractor shall prepare a full set of corrected Electronic Drawings of the Contract Drawings and Shop Drawings, as follows:
1. Format: DWG (current version) and PDF.
  2. Deleted
  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 one set of Electronic Drawings of the Contract Drawings for use in recording information.
    - a. Architect makes no representations as to the accuracy or completeness of Electronic Drawings as they relate to the Contract Drawings.
- C. Newly Prepared Record Drawings: The General Contractor shall prepare new Drawings instead of preparing Record Drawings where Architect determines that neither the original Contract Drawings nor Shop Drawings are suitable to show actual installation.
1. New Drawings may be required when a Change Order is issued as a result of accepting an alternate, substitution, or other modification.
  2. Consult Architect for proper scale and scope of detailing and notations required to record the actual physical installation and its relation to other construction. Integrate newly prepared Record Drawings into Record Drawing sets; comply with procedures for formatting, organizing, copying, binding, and submitting.

- D. Format: Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
1. Record Prints: Organize Record Prints and newly prepared Record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
  2. Record Transparencies: Organize into unbound sets matching Record Prints. Place transparencies in durable tube-type drawing containers with end caps. Mark end cap of each container with identification. If container does not include a complete set, identify Drawings included.
  3. Record Electronic Drawings: Organize electronic 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 electronic file.
  4. Identification: As follows:
    - a. Project name.
    - b. Designation "PROJECT RECORD DRAWINGS."
    - c. Name of Architect.
    - d. Name of Contractor.

## 2.2 RECORD SPECIFICATIONS

- A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.
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.

## 2.3 RECORD PRODUCT DATA

- A. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.
1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.

2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
3. Note related Change Orders, Record Specifications and Record Drawings where applicable.

## 2.4 MISCELLANEOUS RECORD SUBMITTALS

- A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.

## PART 3 EXECUTION

### 3.1 RECORDING AND MAINTENANCE

- A. Recording: Maintain one copy of each submittal during the construction period for Project Record Document purposes. Post changes and modifications to Project Record Documents as they occur; do not wait until the end of Project.
- B. Maintenance of Record Documents and Samples: Store Record Documents and Samples in the field office apart from the Contract Documents used for construction. Do not use Project Record Documents for construction 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.

END OF SECTION 01 78 39

END OF SECTION

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## SECTION 01 79 00 - DEMONSTRATION AND TRAINING

### PART 1 GENERAL

#### 1.1 SUMMARY

- A. This Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:
  - 1. Demonstration of operation of systems, subsystems, and equipment.
  - 2. Training in operation and maintenance of systems, subsystems, and equipment.

#### 1.2 SUBMITTALS

- A. Refer to Section 01 33 00 for general submittal procedures.
- B. Instruction Program: Submit electronically an outline of instructional program for demonstration and training, including 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. At completion of training, submit one complete training manual(s) for Owner's use.

#### 1.3 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 01 40 00 - Quality Requirements, experienced in operation and maintenance procedures and training.
- C. Pre-Construction Conference: Conduct conference at Project site to comply with requirements in Section 01 31 00 - Project Management and Coordination. Review methods and procedures related to demonstration and training including, but not limited to, the following:
  - 1. Inspect and discuss locations and other facilities required for instruction.
  - 2. Review and finalize instruction schedule and verify availability of educational materials, instructors' personnel, audiovisual equipment, and facilities needed to avoid delays.
  - 3. Review required content of instruction.
  - 4. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.

#### 1.4 COORDINATION

- A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations.
- B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.
- C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by Architect.

### PART 2 PRODUCTS

#### 2.1 INSTRUCTION PROGRAM

- A. Program Structure: Develop an instruction program that includes individual training modules for each system and equipment not part of a system, as required by individual Specification Sections, and as follows:
  - 1. Equipment.
  - 2. Fire-protection systems.
  - 3. Heat generation.
  - 4. Refrigeration systems.
  - 5. HVAC systems.
  - 6. HVAC instrumentation and controls.
  - 7. Electrical service and distribution.
  - 8. Lighting equipment and controls.
  - 9. Communication systems.
- 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:
  - 1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
    - a. System, subsystem, and equipment descriptions.
    - b. Performance and design criteria if Contractor is delegated design responsibility.
    - c. Operating standards.
    - d. Regulatory requirements.

- e. Equipment function.
  - f. Operating characteristics.
  - g. Limiting conditions.
  - h. Performance curves.
2. Documentation: Review the following items in detail:
- a. Emergency manuals.
  - b. Operations manuals.
  - c. Maintenance manuals.
  - d. Project Record Documents.
  - e. Identification systems.
  - f. Warranties and bonds.
  - g. Maintenance service agreements and similar continuing commitments.
3. Emergencies: Include the following, as applicable:
- a. Instructions on meaning of warnings, trouble indications, and error messages.
  - b. Instructions on stopping.
  - c. Shutdown instructions for each type of emergency.
  - d. Operating instructions for conditions outside of normal operating limits.
  - e. Sequences for electric or electronic systems.
  - f. Special operating instructions and procedures.
4. Operations: Include the following, as applicable:
- a. Startup procedures.
  - b. Equipment or system break-in procedures.
  - c. Routine and normal operating instructions.
  - d. Regulation and control procedures.
  - e. Control sequences.
  - f. Safety procedures.

- g. Instructions on stopping.
  - h. Normal shutdown instructions.
  - i. Operating procedures for emergencies.
  - j. Operating procedures for system, subsystem, or equipment failure.
  - k. Seasonal and weekend operating instructions.
  - l. Required sequences for electric or electronic systems.
  - m. Special operating instructions and procedures.
5. Adjustments: Include the following:
- a. Alignments.
  - b. Checking adjustments.
  - c. Noise and vibration adjustments.
  - d. Economy and efficiency adjustments.
6. Troubleshooting: Include the following:
- a. Diagnostic instructions.
  - b. Test and inspection procedures.
7. Maintenance: Include the following:
- a. Inspection procedures.
  - b. Types of cleaning agents to be used and methods of cleaning.
  - c. List of cleaning agents and methods of cleaning detrimental to product.
  - d. Procedures for routine cleaning
  - e. Procedures for preventive maintenance.
  - f. Procedures for routine maintenance.
  - g. Instruction on use of special tools.
8. Repairs: Include the following:
- a. Diagnosis instructions.
  - b. Repair instructions.

- c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
- d. Instructions for identifying parts and components.
- e. Review of spare parts needed for operation and maintenance.

## PART 3 EXECUTION

### 3.1 PREPARATION

- A. Assemble educational materials necessary for instruction, including documentation and training module.  
Assemble training modules into a combined training manual.
- B. Set up instructional equipment at instruction location.

### 3.2 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.
  - 1. Owner's Representative will furnish Contractor with names and positions of participants.
- 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, through Architect, with at least seven days' advance notice.
- D. Records of Training: All trainings for all sections of work must be video recorded and submitted under appropriate submittal number.
- 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 give to Owner. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

END OF SECTION

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## SECTION 01 81 13 - LEED FOR HOMES MID-RISE

### PART 1 GENERAL

#### 1.1 SUMMARY

A. **Section includes general requirements and procedures for compliance with certain USGBC LEED prerequisites and credits needed for Project to obtain LEED v4 Homes and Multifamily Midrise criteria for Silver Certification- pending confirmation for GOLD . Specific project goals that may impact this area of work include but are not limited to the following:**

1. Using recycled content, locally extracted, or rapidly renewable materials;
2. Limiting construction waste sent to landfill or incinerators;
3. Implementing a construction pollution prevention plan (erosion controls);
4. Creating and documenting compliance with a Quality Assurance Plan;
5. Utilizing best practices for managing exterior and interior moisture, as documented in the Water Management Systems Builder Checklist;
6. Ensuring that energy goals are met through product selection and quality installation;
7. Passing performance tests for unit tightness (blower door), heating/cooling duct tightness (duct blaster), and exhaust and ventilation fan flow rates, as tested by the LEED Green Rater (USEcoLogic).

#### 1.2 RELATED REQUIREMENTS

- A. Divisions 01 through 33 Sections for LEED requirements specific to the work of each of these Sections. Requirements may or may not include reference to LEED.
- B. **The LEED project checklist, along with other documents will be included as part of this spec document as an added addendum and made part of the executed contract for all construction work. The LEED for Homes Reference Guide is a contract Reference Document.**
- C. **The builder shall designate a qualified team member to track credit requirements and documentation as indicated on the LEED checklist and project specific.**

#### 1.3 DEFINITIONS:

- A. Regional Materials: Materials that have been extracted, harvested, or recovered, as well as manufactured, within 100 miles (160 km) of Project site. If only a fraction of a product or material is extracted, harvested, or recovered and manufactured locally, then only that percentage (by weight) shall contribute to the regional value.
- B. Recycled Content: The recycled content shall be determined by weight.

1. "Postconsumer" material is defined as waste material that is generated by end users of the product and that can no longer be used for its intended purpose.
  2. "Preconsumer" material is defined as material diverted from the waste stream during the manufacturing process. Excluded is reutilization of materials such as scrap generated in a process that is reclaimed in the same process that generated it.
- C. Environmental Product Declaration (EPD): An independently verified report based on life-cycle assessment studies that have been conducted according to a set of common rules for each product category and peer-reviewed
1. Product Specific Declaration: A product with a publicly available, critically reviewed life-cycle assessment conforming to ISO 14044 that has at least a cradle to gate scope.
  2. Industry-Wide (Generic) EPD: Provide products with third-party certification (Type III), including external verification, in which the program operator explicitly recognizes the manufacturer as a participant. EPD must conform to ISO 14025, 14040, 14044, and EN 15804 or ISO 21930 and have at least a cradle to gate scope.
  3. Product-Specific Type III EPD: A product with a third-party certification, including external verification, in which the program operator explicitly recognizes the manufacturer. EPD must conform to ISO 14025, 14040, 14044, and EN 15804 or ISO 21930 and have at least a cradle to gate scope.
  4. USGBC approved program: Products that comply with other USGBC approved environmental product declaration frameworks.
- D. Health Product Declaration Open Standard (HPD): A standard format for reporting product content and associated health information for building products and materials.
- E. Manufacturer Inventory: A complete inventory for a product including a publicly available inventory of all ingredients identified by name and Chemical Abstract Service Registration Number (CASRN). For any materials defined as trade secret or intellectual property, the name and/or CASRN may be withheld, but the role, amount and GreenScreen benchmark must be disclosed as defined in GreenScreen v1.2.

#### 1.4 SUBMITTALS:

- A. Refer to Section 01 33 00 for general submittal procedures.
- B. **LEED Action Plan**
  1. Submit the following within 30 days of date established for commencement of the Work.
    - a. List of proposed regional materials
    - b. List of proposed materials with recycled content
    - c. List of proposed materials with extended producer responsibility

C. Materials

1. Product Data for all aggregate contained in concrete identifying location of extraction and manufacturing.
2. Product Data for all paints and coatings stating VOC content.
3. Product data for all floor covering identifying participation in extended producer responsibility program, and/or recycled content as well as confirmation that product has been tested and meets requirements of CA Section 1350.
4. Product data for all insulation identifying participation in extended producer responsibility program, and/or recycled content as well as confirmation that product has been tested and meets requirements of CA Section 1350.
5. If tropical wood is used, obtain chain-of-custody certificates for certified wood products. Include statement of cost for each product.
6. Product data for all roofing material verifying Energy Star certification, SRI value, and warranty requirements.
7. Product data for all plumbing fixtures, dishwashers, clothes washers listing flow rate (water factor for clothes washers).
8. Manufacturer documentation for permanently installed building products that comply with the laboratory testing standards defined above in Definitions – ‘Environmental Product Declaration.’
9. Manufacturer documentation for products that comply with the following certifications:
  - a. Manufacturer Inventory
  - b. Health Product Declaration
  - c. Cradle to Cradle
  - d. Declare
  - e. Cradle to Cradle Material Health Certificate
  - f. Product Lens Certification
  - g. USGBS approved program. Other USGBC approved programs meeting material ingredient reporting criteria.

D. Waste Management:

1. Provide proof that contractor has explored recycling options for the project, such as e-mail correspondence and letters.

2. Provide documentation through waste management logs and hauling tickets demonstrating total construction waste and total recycled construction waste.
- E. Durability Management: The building must confirm with a signature that all items included on the ENERGY STAR for Homes version 3 Water Management System Checklist have been installed.
- F. Thermal Enclosure Inspection Checklist: The builder must confirm with a signature that all items included on the LEED for Homes Multi-Family Mid-Rise Thermal Enclosure Inspection Checklist have been installed. The checklist is based off of the ENERGY STAR Qualified Homes, Version 3 (Rev. 03) list.
- G. Trades Training: Submit documentation with dates, trainers, trades, and duration of training. Include information related to the topics discussed.
- H. Operations and Maintenance Manual: The builder must confirm with a signature that the following items have been met and provided to the home's occupants:
  1. A completed checklist of LEED for Homes features
  2. A copy of each signed Accountability Form
  3. A copy of the durability inspection checklist
  4. The product manufacturers' manuals for all installed equipment, fixtures, and appliances
  5. General information on efficient use of energy, water, and natural resources
  6. Operations and maintenance guidance for any LEED for Homes – related equipment installed in the home (i.e. space heating and cooling equipment, mechanical ventilation, etc.)
  7. Guidance on occupant activities and choices (i.e. cleaning materials, cleaning methods, lighting selection, etc.)
  8. Educational information on “green power”

## PART 2 PRODUCTS

### 2.1 MATERIALS

- A. Provide products and procedures necessary to meet requirements of this Section. Although other Sections may specify similar requirements, the Contractor shall determine additional materials and procedures necessary to comply with this Section.
- B. **Regional Materials:** Where possible, not less than 50% of the following building products shall be regional:
  1. Aggregate for concrete and foundation

- C. Certified Wood: Wood-based materials produced from forests that fall between the Tropics of Cancer and the Tropics of Capricorn shall be certified as “FSC” according to FSC STD-01-001, “FSC Principles and Criteria for Forest Stewardship”, and to FSC STD 04-004, “FSC Standard for Chain of Custody Certification.”
- D. Roofing: Roof materials shall be Energy Star certified with a minimum initial SRI of 65 for low slope roof. Roof materials shall carry a warranty that is equal in all material respects to the product warranty for comparable non-reflective roof products within the same company or industry standard.
- E. Plumbing Fixtures: Plumbing fixture flow rates should not exceed the following:
  - 1. Toilets: 1.28 gpf
  - 2. Lavatory Faucet: 1.5 gpm
  - 3. Shower: 2.0 gpm
  - 4. Kitchen Sink: 2.0 gpm
  - 5. Dishwashers: 3.5 GPC and ENERGY STAR
  - 6. Clothes Washers: 3.2 water factor and ENERGY STAR
- F. Environmental Product Declarations (EPD): Provide at least 20 permanently installed products (sourced from at least 5 different manufacturers) which meet one of the disclosure criteria:
  - 1. Product-Specific Declaration: Valued as one quarter (1/4) of a product.
  - 2. Industry-Wide (Generic) EPD: Valued as one half (1/2) of a product.
  - 3. Product Specific Type III EPD: Valued as one (1) whole product.
- G. Material Ingredient Reporting: Use at least 20 different 20 different permanently installed products from at least five different manufacturers that use any of the following programs to demonstrate the chemical inventory of the product to at least 0.1% (1000 ppm), which meet one of the following disclosure criteria:
  - 1. Manufacturer Inventory
  - 2. Materials defined as trade secret or intellectual property may withhold the name and/or CASRN/EC Number but must disclose role, amount and hazard screen using either:
    - a. CASRN
      - 1) GreeScreen Benchmark – GreenScreen v1.2
      - 2) GHS rev.6 (2015)
    - b. Health Product Declarations (HPDs)
    - c. Cradle to Cradle (C2C) certifications (v2 Basic level or v3 Bronze level)

- d. Declare product labels
- e. Cradle to Cradle Material Health Certificate
- f. Product Lens Certification
- g. Other USGBC approved program meeting the material ingredient reporting criteria.

## 2.2 LOW-EMITTING MATERIALS

- A. At least 90% of each of the following items shall comply with the California Department of Public Health Standard Method V1.1-2010, using CA Section 01350, Appendix B, New Single-Family Residence Scenario:
  - 1. Paints & Coatings
  - 2. Flooring
  - 3. Insulation
- B. Inherently non-emitting sources: Products that are inherently non-emitting sources of VOCs (stone, ceramic, powder-coated metals, plated or anodized metal, glass, concrete, clay brick, and unfinished or untreated solid wood flooring) are considered fully compliant without any VOC emissions testing if they do not include integral organic based surface coatings, binders, or sealants.
- C. General Emissions Requirements: Products must demonstrate they have been tested and determined compliant in accordance with California Department of Public Health, (CDPH), Standard Method v1.1-2010, using the applicable exposure scenario. Manufacturer's or third party documentation demonstrating compliance must state the exposure scenario used to determine compliance, and the range of total VOCs (tVOC) after 14 days measured as specified in the CDPH Standard Method v1.1 as follows:
  - 1. mg/m<sup>3</sup> or less
  - 2. Between 0.5 and 5.0 mg/m<sup>3</sup>
  - 3. mg/m<sup>3</sup> or more

## PART 3 EXECUTION

### 3.1 TRAINING

- 1. Trades Training
  - a. Prior to construction but after all trades are hired, hold 8 hours of trades training in field/classroom for subcontractors. Training must occur for a total of 8 hours over any number of days.
    - 1) The builder's site supervisor must be present for all 8 hours.

- 2) Each trade is not required to be in training for all 8 hours.
- b. Training shall review and discuss the green or other unusual aspects of the project including LEED for Homes prerequisites and expectations during certification. Special focus should be given to those areas trades have traditionally struggled in the past.
- c. At a minimum, the mechanical, plumbing, insulating, framing, and air sealing subcontractors must attend.

### 3.2 INSPECTIONS, TESTING, AND COMMISSIONING

- A. Contractor shall assign representatives with expertise and authority to act on its behalf and shall schedule them to participate in testing and verification activities including.
  - B. Inspections
    1. The builder must visually confirm that all items included on the Water Management System Checklist and LEED for Homes Multi-Family Mid-Rise Thermal Enclosure Inspection Checklist have been installed.
  - C. Testing
    1. Duct Leakage
      - a. Duct leakage testing must be performed with all mechanical components installed prior to installation of drywall and after installation of drywall.
      - b. The final (post-drywall installation) tested duct leakage rate must be less than or equal to 4 CFM 25 Pascals per 100 sq ft of conditioned floor area served by each system (6 CFM 25 Pascals per 100 sf ft of conditioned floor area is acceptable for units less than 1,200 sf). Total duct leakage in-units must not exceed 8 CFM 25 Pascals per 100 sf ft of conditioned floor area. Only a duct leakage rate less than or equal to 4 CFM 25 Pascals per 100 sq ft of conditioned floor area and total duct leakage less than 8 CFM 25 Pascals per 100 sf ft of conditioned floor area will be considered a passing test.
    2. Blower Door Testing
      - a. Air leakage rate must be less than or equal to 0.30 CFM50 per square foot of enclosure with blower door test. Subcontractors will be required to correct all issues to ensure a passing test. Only an air leakage rate less than or equal to 0.30 CFM50 per square foot of enclosure will be considered a passing test.
    3. Contractor will be required to remedy all issues to achieve a passing test.
  - D. Commissioning
    1. Fundamental commissioning for all central commercial heating, cooling, water heating, and ventilation systems will be performed.

## 2. Commissioning Team

- a. Members Appointed by Contractor(s): Individuals, each having the authority to act on behalf of the entity he or she represents, explicitly organized to implement the commissioning process through coordinated action. The commissioning team shall consist of, but not be limited to, representatives of [each] Contractor, including Project superintendent and subcontractors, installers, suppliers, and specialists deemed appropriate by the CxA.
- b. Members Appointed by Owner:
  - 1) CxA: The designated person, company, or entity that plans, schedules, and coordinates the commissioning team to implement the commissioning process. Owner will engage the CxA under a separate contract.
  - 2) Representatives of the facility user and operation and maintenance personnel.
  - 3) Architect and engineering design professionals.

## 3. Owner's Responsibilities

- a. Provide the OPR documentation to the CxA and Contractor for information and use.
- b. Assign operation and maintenance personnel and schedule them to participate in commissioning team activities.
- c. Provide the BoD documentation, prepared by Architect and approved by Owner, to the CxA and Contractor for use in developing the commissioning plan, systems manual, and operation and maintenance training plan.
  - 1) Contractor's Responsibilities
- d. Contractor shall assign representatives with expertise and authority to act on its behalf and shall schedule them to participate in and perform commissioning process activities including, but not limited to, the following:
  - 1) Evaluate performance deficiencies identified in test reports and, in collaboration with entity responsible for system and equipment installation, recommend corrective action.
  - 2) Cooperate with the CxA for resolution of issues recorded in the Issues Log.
  - 3) Attend commissioning team meetings held on as needed basis.
  - 4) Integrate and coordinate commissioning process activities with construction schedule.
  - 5) Review and accept construction checklists provided by the CxA.
  - 6) Complete paper or electronic construction checklists as Work is completed and provide to the Commissioning Authority on a weekly basis.
  - 7) Review and accept commissioning process test procedures provided by the Commissioning Authority.

- 8) Complete commissioning process test procedures.

#### CXA'S RESPONSIBILITIES

- a. Include CxA responsibilities in this article that have an impact on Contractor's activities and responsibilities.
- b. Organize and lead the commissioning team.
- c. Provide commissioning plan.
- d. Convene commissioning team meetings.
- e. Provide Project-specific construction checklists and commissioning process test procedures.
- f. 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, construction 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.
- g. Prepare and maintain the Issues Log.
- h. Prepare and maintain completed construction checklist log.
- i. Witness systems, assemblies, equipment, and component startup.
- j. Compile test data, inspection reports, and certificates; include them in the systems manual and commissioning process report.

#### 4.2 CONSTRUCTION ACTIVITY POLLUTION PREVENTION

- A. Implement all measures identified in the erosion and sediment control plans for the project.
- B. Inspect all erosion and sediment control measures frequently. Immediately remediate any issues identified, including those identified by third parties.

#### 4.3 PEST CONTROL

- A. Seal external cracks, joints, penetrations, edges, and entry points with caulking. Where caulking is not possible, install pest-proof screens. Install moisture-resistant pest-proof coverings for exposed foundation insulation.

#### 4.4 INDOOR ENVIRONMENTAL QUALITY

- A. Seal ducts and vents immediately after they are installed. Do not remove seals until construction is complete.
  1. Do not use permanent heating, cooling, and ventilating systems during construction period.

2. If permanent heating, cooling, and ventilating system are used during construction, install MERV 8 filters.

END OF SECTION

## SECTION 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS

### PART 1 GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Owner's Project Requirements and Basis-of-Design documentation are included by reference for information only.

#### 1.2 SUMMARY

- A. Section Includes:

1. General requirements for coordinating and scheduling commissioning.
2. Commissioning meetings.
3. Commissioning reports.
4. Use of test equipment, instrumentation, and tools for commissioning.
5. Construction checklists, including, but not limited to, installation checks, startup, performance tests, and performance test demonstration.
6. Commissioning tests and commissioning test demonstration.
7. Adjusting, verifying, and documenting identified systems and assemblies.

- B. Related Requirements:

1. Section 01 3300 "Submittal Procedures" for submittal procedures requirements for commissioning.
2. Section 01 7700 "Closeout Procedures" for certificate of Construction Phase Commissioning Completion submittal requirements.
3. Section 01 7820 "Operation and Maintenance Data" for preliminary operation and maintenance data submittal.

#### 1.3 DEFINITIONS

- A. Acceptance Criteria: Threshold of acceptable work quality or performance specified for a commissioning activity, including, but not limited to, construction checklists, performance tests, performance test demonstrations, commissioning tests and commissioning test demonstrations.
- B. Basis-of-Design Document: A document prepared by Owner, Architect, 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: An entity engaged by Owner, and identified in Section 01 1000 "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: 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. The scope of commissioning is defined in Section 01 1000 "Summary."
- 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 01 7700 "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 01 7900 "Demonstration and Training."
    - d. Completion and acceptance of submittals and reports.
- G. Owner's Project Requirements: A document written by Owner, Architect, or Commissioning Authority 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.
- H. 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.
- I. "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.
- J. Test: Performance tests, performance test demonstrations, commissioning tests, and commissioning test demonstrations.
- K. Sampling Procedures and Tables for Inspection by Attributes: As defined in ASQ Z1.4.

#### 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 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, plus consultants that Commissioning Authority may deem appropriate for a particular portion of the commissioning.
  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.
  3. Architect, plus employees and consultants that Architect may deem appropriate for a particular portion of the commissioning.

## 1.6 INFORMATIONAL SUBMITTALS

- A. Comply with requirements in Section 01 3300 "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 01 3200 "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. Commissioning Coordinator Letter of Authority:
1. Within 10 days after approval of Commissioning Coordinator qualifications, submit a letter of authority for Commissioning Coordinator, signed by a principal of Contractor's firm. Letter shall authorize Commissioning Coordinator to do the following:
  2. Make inspections required for commissioning.
  3. Coordinate, schedule, and manage commissioning of Contractor, subcontractors, and suppliers.
  4. Obtain documentation required for commissioning from Contractor, subcontractors, and suppliers.
  5. Report issues, delayed resolution of issues, schedule conflicts, and lack of cooperation or expertise on the part of members of the commissioning team.
- F. Commissioning Coordinator Qualification Data: For entity coordinating Contractor's commissioning activities to demonstrate their capabilities and experience.
1. Experienced: When used with an entity or individual, "experienced" 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.
- G. List test instrumentation, equipment, and monitoring devices. Include the following information:
1. Make, model, serial number, and application for each instrument, equipment, and monitoring device.
- H. Brief description of intended use.
1. Calibration record showing the following:
    - a. Calibration agency, including name and contact information.
    - b. Last date of calibration.
    - c. Range of values for which calibration is valid.
  2. Certification of accuracy.
    - a. N.I.S.T. traceability certification for calibration equipment.
    - b. Due date of the next calibration.

I. Test Reports:

1. Pre-Startup Report: Prior to start up of equipment or a system, submit signed, completed construction 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.
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.

J. Construction Checklists:

1. Material checks.
2. Installation checks.
3. Startup procedures, where required.
4. Test Scripts

## 1.7 CLOSEOUT SUBMITTALS

A. Commissioning Report:

1. At Construction Phase Commissioning Completion, include the following:
  - a. Pre-startup reports.
  - b. Approved test procedures
  - c. Test data forms, completed and signed.
  - d. Progress reports.
  - e. Commissioning issues report log.
  - f. Commissioning issues reports showing resolution of issues.
  - g. Correspondence or other documents related to resolution of issues.
  - h. Other reports required by commissioning.

- i. List unresolved issues and reasons they remain unresolved and should be exempted from the requirements for Construction Phase Commissioning Completion.
  - j. 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 QUALITY ASSURANCE

A. Commissioning Coordinator Qualifications:

- 1. Documented experience commissioning systems of similar complexity to those contained in these documents on at least Three projects of similar scope and complexity.
- 2. Certification of commissioning process expertise. The following certifications are acceptable. Owner reserves the right to accept or reject certifications as evidence of qualification.
  - a. Certified Commissioning Professional, by Building Commissioning Association.
  - b. Commissioning Process Management Professional, by American Society of Heating, Refrigerating and Air-Conditioning Engineers.
  - c. Accredited Commissioning Process Authority Professional, by University of Wisconsin.
  - d. Accredited Commissioning Process Manager, by University of Wisconsin.
  - e. Accredited Green Commissioning Process Provider, by University of Wisconsin.

B. Calibration Agency Qualifications: Certified by The American Association of Laboratory Accreditation that the calibration agency complies with minimum requirements of ISO/IEC 17025.

## 1.9 COMMISSIONING AUTHORITY'S RESPONSIBILITIES

A. Commissioning Authority Responsibilities: Comply with requirements in Section 01 10 00 "Summary."

## 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.
- B. Test equipment and instrumentation required to perform commissioning shall comply with the following criteria:

1. Be manufactured for the purpose of testing and measuring tests for which they are being used and have an accuracy to test and measure system performance within the tolerances required to determine acceptable performance.
2. Calibrated and certified.
  - a. Calibration performed and documented by a qualified calibration agency according to national standards applicable to the tools and instrumentation being calibrated. Calibration shall be current according to national standards or within test equipment and instrumentation manufacturer's recommended intervals, whichever is more frequent, but not less than within six months of initial use on Project. Calibration tags permanently affixed.
  - b. Repair and recalibrate test equipment and instrumentation if dismantled, dropped, or damaged since last calibrated.
3. Maintain test equipment and instrumentation.
4. Use test equipment and instrumentation only for testing or monitoring Work for which they are designed.

## 2.2 PROPRIETARY TEST EQUIPMENT, INSTRUMENTATION, AND TOOLS

- A. Proprietary test equipment, instrumentation, and tools are those manufactured or prescribed by tested equipment manufacturer and required for work on its equipment as a condition of equipment warranty, or as otherwise required to service, repair, adjust, calibrate or perform work on its equipment.
  1. Identify proprietary test equipment, instrumentation, and tools required in the test equipment identification list submittal.
  2. Proprietary test equipment, instrumentation, and tools shall become the property of Owner at Substantial Completion.

## 2.3 REPORT FORMAT AND ORGANIZATION

- A. General Format and Organization:
- B. Bind report in three-ring binders.
- C. Label the front cover and spine of each binder with the report title, volume number, project name, Contractor's name, and date of report.
- D. Record report on compact disk.
- E. 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.
- F. Commissioning Report:
  1. Include a table of contents and an index to each test.

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. Approved test procedures.
  - d. Test data forms, completed and signed.
  - e. 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 construction checklists and preliminary test procedures and data forms.

### 3.2 CONSTRUCTION CHECKLISTS

- A. Construction checklists cannot modify or conflict with the Contract Documents.
- B. Create construction checklists based on actual systems and equipment to be included in Project.
- C. Material Checks: Compare specified characteristics and approved submittals with materials as received. Include factory tests and other evaluations, adjustments, and tests performed prior to shipment, if applicable.
  1. Services connection requirements, including configuration, size, location, and other pertinent characteristics.
  2. Included optional features.
  3. Delivery Receipt Check: Inspect and record physical condition of materials and equipment on delivery to Project site, including agreement with approved submittals, cleanliness and lack of damage.
  4. Installation Checks:
    - a. Location according to Drawings and approved Shop Drawings.
    - b. Configuration.
    - c. Compliance with manufacturers' written installation instructions.

- d. Attachment to structure.
  - e. Access clearance to allow for maintenance, service, repair, removal, and replacement without the need to disassemble or remove other equipment or building elements. Access coordinated with other building elements and equipment, including, but not limited to, ceiling and wall access panels, in a manner consistent with OSHA fall-protection regulations and safe work practices.
  - f. Utility connections are of the correct characteristics, as applicable.
  - g. Correct labeling and identification.
  - h. Startup Checks: Verify readiness of equipment to be energized. Include manufacturer's standard startup procedures and forms.
- D. Startup: Perform and document initial operation of equipment to prove that it is installed properly and operates as intended according to manufacturer's standard startup procedures, minimum.
- E. Performance Tests:
- 1. Static Tests: As specified elsewhere, including, but not limited to, duct and pipe leakage tests, insulation-resistance tests, and water-penetration tests.
  - 2. Component Performance Tests: Tests evaluate the performance of an input or output of components under a full range of operating conditions.
  - 3. Equipment and Assembly Performance Tests: Test and evaluate performance of equipment and assemblies under a full range of operating conditions and loads.
  - 4. System Performance Tests: Test and evaluate performance of systems under a full range of operating conditions and loads.
  - 5. Intersystem Performance Tests: Test and evaluate the interface of different systems under a full range of operating conditions and loads.
- F. Deferred Construction Checklists: Obtain Owner approval of proposed deferral of construction checklists, including proposed schedule of completion of each deferred construction checklist, before submitting request for Certificate of Construction Phase Commissioning Completion. When approved, deferred construction checklists may be completed after date of Construction Phase Commissioning Completion. Include the following in request for Certificate of Construction Phase Commissioning Completion:
- 1. Identify deferred construction checklists by number and title.
  - 2. Provide a target schedule for completion of deferred construction checklists.
  - 3. Written approval of proposed deferred construction checklists, including approved schedule of completion of each deferred construction checklist.

- G. Delayed Construction Checklists: Obtain Owner approval of proposed delayed construction checklists, including proposed schedule of completion of each delayed construction checklist, before submitting request for Certificate of Construction Phase Commissioning Completion. When approved, delayed construction checklists may be completed after date of Construction Phase Commissioning Completion. Include the following in request for Certificate of Construction Phase Commissioning Completion:
1. Identify delayed construction checklist by construction checklist number and title.
  2. Provide a target schedule for completion of delayed construction checklists.
  3. Written approval of proposed delayed construction checklists, including approved schedule of completion of each delayed construction checklist.

### 3.3 GENERAL EXECUTION REQUIREMENTS

- A. Schedule and coordinate commissioning with the construction schedule.
- B. Perform activities identified in construction checklists, including tests, and document results of actions as construction proceeds.
- C. Perform test demonstrations for Owner's witness. Unless otherwise indicated, demonstrate tests for 100 percent of work to which the test applies. In some instances, demonstration of a random sample of other than 100 percent of the results of a test is specified.
  1. Where sampling is specified, the sampling plan and procedure for the test demonstration shall be determined using ASQ Z1.4.
    - a. General Inspection: Level III
    - b. Special Inspection: Level S-4 .
    - c. Acceptance Quality Limit (AQL) of 1.5
  2. The "lot size" in ASQ Z1.4 is the sum of the number of items to which the test demonstration applies, as described in the scope subparagraph of each test.
  3. On determination of the sample size, the samples shall be selected randomly by Owner's witness at the time of the test demonstration.
  4. Include in the Commissioning Plan a detailed list of the test demonstrations with lot and sample quantities for each test.
- D. Report test data and commissioning issue resolutions.
- E. Schedule personnel to participate in and perform Commissioning-Process Work.
- F. Installing contractors' commissioning responsibilities include, but are not limited to, the following:
  1. Operating the equipment and systems they install during tests.

2. In addition, installing contractors may be required to assist in tests of equipment and systems with which their work interfaces.

### 3.4 COMMISSIONING COORDINATOR RESPONSIBILITIES

- A. Management and Coordination: Manage, schedule, and coordinate commissioning, including, but not limited to, the following:
  1. Coordinate with subcontractors on their commissioning responsibilities and activities.
  2. Obtain, assemble, and submit commissioning documentation.
  3. Conduct periodic on-site commissioning meetings. Comply with requirements in Section 01 3100 "Project Management and Coordination."
  4. Develop and maintain the commissioning schedule. Integrate commissioning schedule into the construction schedule. Update schedule at specified intervals.
  5. Review and comment on preliminary test procedures and data forms.
  6. Report inconsistencies and issues in system operations.
  7. Verify that tests have been completed and results comply with acceptance criteria, and that equipment and systems are ready before scheduling test demonstrations.
  8. Direct and coordinate test demonstrations.
  9. Coordinate witnessing of test demonstrations by Owner's witness.
  10. Coordinate and manage training. Be present during training sessions to direct video recording, present training and direct the training presentations of others. Comply with requirements in Section 01 7900 "Demonstration and Training."
  11. Prepare and submit specified commissioning reports.
  12. Track commissioning issues until resolution and retesting is successfully completed.
  13. Retain original records of Commissioning-Process Work, organized as required for the commissioning report. Provide Owner's representative access to these records on request.
  14. Assemble and submit commissioning report.

### 3.5 COMMISSIONING TESTING

- A. Quality Control: Construction checklists, including tests, are quality-control tools designed to improve the functional quality of Project. Test demonstrations evaluate the effectiveness of Contractor's quality-control process.

- B. Owner's witness will be present to witness commissioning work requiring the signature of an owner's witness, including, but not limited to, test demonstrations. Owner's project manager will coordinate attendance by Owner's witness with Contractor's published commissioning schedule. Owner's witness will provide no labor or materials in the commissioning work. The only function of Owner's witness will be to observe and comment on the progress and results of commissioning.
- C. Construction Checklists:
  - 1. Complete construction checklists as Work is completed.
  - 2. Distribute construction checklists to installing contractors before they start work.
  - 3. Installers:
    - a. Verify installation using approved construction checklists as Work proceeds.
    - b. Complete and sign construction checklists weekly for work performed during the preceding week.
  - 4. Provide Commissioning Authority access to construction checklists.
- D. Installation Compliance Issues: Record as an installation compliance issue Work found to be incomplete, inaccessible, at variance with the Contract Documents, nonfunctional, or that does not comply with construction checklists. Record installation compliance issues on the construction checklist at the time they are identified. Record corrective action and how future Work should be modified before signing off the construction checklist.
- E. Pre-Startup Audit: Prior to executing startup procedures, review completed installation checks to determine readiness for startup and operation. Report conditions, which, if left uncorrected, adversely impact the ability of systems or equipment to operate satisfactorily or to comply with acceptance criteria. Prepare pre-startup report for each system.
- F. Test Procedures and Test Data Forms:
  - 1. Test procedures shall define the step-by-step procedures to be used to execute tests and test demonstrations.
  - 2. Test procedures shall be specific to the make, model, and application of the equipment and systems being tested.
  - 3. Completed test data forms are the official records of the results of tests.
  - 4. Commissioning Authority will provide to Contractor preliminary test procedures and test data forms for performance tests and commissioning tests after approval of Product Data, Shop Drawings, and preliminary operation and maintenance manual.
  - 5. Review preliminary test procedures and test data forms and provide comments within 14 days of receipt from Commissioning Authority. Review shall address the following:

- a. Equipment protection and warranty issues, including, but not limited to, manufacturers' installation and startup recommendations, and operation and maintenance instructions.
- b. Applicability of the procedure to the specific software, equipment, and systems approved for installation.
6. After Contractor has reviewed and commented on the preliminary test procedures and test data forms, Commissioning Authority will revise and reissue the approved revised test procedures and test data forms marked "Approved for Testing."
7. Use only approved test procedures and test data forms marked "Approved for Testing" to perform and document tests and test demonstrations.

G. Performance of Tests:

1. The sampling rate for tests is 100 percent. The sampling rate for test demonstrations is 100 percent unless otherwise indicated.
2. Perform and complete each step of the approved test procedures in the order listed.
3. Record data observed during performance of tests on approved data forms at the time of test performance and when the results are observed.
4. Record test results that are not within the range of acceptable results on commissioning issue report forms in addition to recording the results on approved test procedures and data forms according to the "Commissioning Compliance Issues" Paragraph in this Article.
5. On completion of a test, sign the completed test procedure and data form. Tests for which test procedures and data forms are incomplete, not signed, or which indicate performance that does not comply with acceptance criteria will be rejected. Tests for which test procedures and data forms are rejected shall be repeated and results resubmitted.

H. Performance of Test Demonstration:

1. Perform test demonstrations on a sample of tests after test data submittals are approved. The sampling rate for test demonstrations shall be 100 percent unless otherwise indicated in the individual test specification.
2. Notify Owner's witness at least three days in advance of each test demonstration.
3. Perform and complete each step of the approved test procedures in the order listed.
4. Record data observed during performance of test demonstrations on approved data forms at the time of demonstration and when the results are observed.
5. Provide full access to Owner's witness to directly observe the performance of all aspects of system response during the test demonstration. On completion of a test demonstration, sign the completed data form and obtain signature of Owner's witness at the time of the test to authenticate the reported results.

6. Test demonstration data forms not signed by Contractor and Owner's witness at the time of the completion of the procedure will be rejected. Test demonstrations for which data forms are rejected shall be repeated and results shall be resubmitted.
  - a. Exception for Failure of Owner's Witness to Attend: Failure of Owner's witness to be present for agreed-on schedule of test demonstration shall not delay Contractor. If Owner's witness fails to attend a scheduled test, Contractor shall proceed with the scheduled test. On completion, Contractor shall sign the data form for Contractor and for Owner's witness, and shall note the absence of Owner's witness at the scheduled time and place.
7. False load test requirements are specified in related sections.
  - a. Where false load testing is specified, provide temporary equipment, power, controls, wiring, piping, valves, and other necessary equipment and connections required to apply the specified load to the system. False load system shall be capable of steady-state operation and modulation at the level of load specified. Equipment and systems permanently installed in this work shall not be used to create the false load without Architect's written approval.

I. Deferred Tests:

1. Deferred Tests List: Identify, in the request for Certificate of Construction Phase Commissioning Completion, proposed deferred tests or other tests approved for deferral until specified seasonal or other conditions are available. When approved, deferred tests may be completed after the date of Construction Phase Commissioning Completion. Identify proposed deferred tests in the request for Certificate of Construction Phase Commissioning Completion as follows:
  - a. Identify deferred tests by number and title.
  - b. Provide a target schedule for completion of deferred tests.
2. Schedule and coordinate deferred tests. Schedule deferred tests when specified conditions are available. Notify Architect and Commissioning Authority at least three working days (minimum) in advance of tests.
3. Where deferred tests are specified, coordinate participation of necessary personnel and of Architect, Commissioning Authority, and Owner's witness. Schedule deferred tests to minimize occupant and facility impact. Obtain Architect's approval of the proposed schedule.

J. Delayed Tests:

1. Delayed Tests List: Identify, in the request for Certificate of Construction Phase Commissioning Completion, proposed delayed tests. Obtain Owner approval of proposed delayed tests, including proposed schedule of completion of each delayed test, before submitting request for Certificate of Construction Phase Commissioning Completion. Include the following in the request for Certificate of Construction Phase Commissioning Completion:
  - a. Identify delayed tests by test number and title.

- b. Written approval of proposed delayed tests, including approved schedule of completion of delayed tests.
2. Schedule and coordinate delayed tests. Schedule delayed tests when conditions that caused the delay have been rectified. Notify Architect and Commissioning Authority at least three working days (minimum) in advance of tests.
3. Where delayed tests are approved, coordinate participation of necessary personnel and of Architect, Commissioning Authority, and Owner's witness. Schedule delayed tests to minimize occupant and facility impact. Obtain Architect's approval of the proposed schedule.

K. Commissioning Compliance Issues:

1. Test results that are not within the range of acceptable results are commissioning compliance issues.
2. Track and report commissioning compliance issues until resolution and retesting are successfully completed.
3. If a test demonstration fails, determine the cause of failure. Direct timely resolution of issue and then repeat the demonstration. If a test demonstration must be repeated due to failure caused by Contractor work or materials, reimburse Owner for billed costs for the participation in the repeated demonstration.
4. Test Results: If a test demonstration fails to meet the acceptance criteria, perform the following:
  - a. Complete a commissioning compliance issue report form promptly on discovery of test results that do not comply with acceptance criteria.
  - b. Submit commissioning compliance issue report form within 24 hours] of the test.
  - c. Determine the cause of the failure.
  - d. Establish responsibility for corrective action if the failure is due to conditions found to be Contractor's responsibility.
5. Commissioning Compliance Issue Report: Provide a commissioning compliance issue report for each issue. Do not report multiple issues on the same commissioning compliance issue report.
  - a. Exception: If an entire class of devices is determined to exhibit the identical issue, they may be reported on a single commissioning compliance issue report. (For example, if all return-air damper actuators that are specified to fail to the open position are found to fail to the closed position, they may be reported on a single commissioning issue report. If a single commissioning issue report is used for multiple commissioning compliance issues, each device shall be identified in the report, and the total number of devices at issue shall be identified.)
  - b. Complete and submit Part 1 of the commissioning compliance issue report immediately when the condition is observed.

- c. Record the commissioning compliance issue report number and describe the deficient condition on the data form.
  - d. Resolve commissioning compliance issues promptly. Complete and submit Part 2 of the commissioning compliance issue report when issues are resolved.
6. Diagnose and correct failed test demonstrations as follows:
- a. Perform diagnostic tests and activities required to determine the fundamental cause of issues observed.
  - b. Record each step of the diagnostic procedure prior to performing the procedure. Update written procedure as changes become necessary.
  - c. Record the results of each step of the diagnostic procedure.
  - d. Record the conclusion of the diagnostic procedure on the fundamental cause of the issue.
  - e. Determine and record corrective measures.
  - f. Include diagnosis of fundamental cause of issues in commissioning compliance issue report.
7. Retest:
- a. Schedule and repeat the complete test procedure for each test demonstration for which acceptable results are not achieved. Obtain signature of Owner's witness on retest data forms. Repeat test demonstration until acceptable results are achieved. Except for issues that are determined to result from design errors or omissions, or other conditions beyond Contractor's responsibility, compensate Owner for direct costs incurred as the result of repeated test demonstrations to achieve acceptable results.
  - b. For each repeated test demonstration, submit a new test data form, marked "Retest."
8. Do not correct commissioning compliance issues during test demonstrations.
- a. Exceptions will be allowed if the cause of the issue is obvious and resolution can be completed in less than five minutes. If corrections are made under this exception, note the deficient conditions on the test data form and issue a commissioning compliance issue report. A new test data form, marked "Retest," shall be initiated after the resolution has been completed.

### 3.6 COMMISSIONING MEETINGS

- A. Schedule and conduct commissioning meetings. Comply with requirements in Section 01 3100 "Project Management and Coordination."

### 3.7 SEQUENCING

- A. Sequencing of Commissioning Verification Activities: For a particular material, item of equipment, assembly, or system, perform the following in the order listed unless otherwise indicated:

1. Construction Checklists:
  - a. Material checks.
  - b. Installation checks.
  - c. Start up, as appropriate. Some startup may depend on component performance. Such startup may follow component performance tests on which the startup depends.
  - d. Performance Tests:
    - 1) Static tests, as appropriate.
    - 2) Component performance tests. Some component performance tests may depend on completion of startup. Such component performance tests may follow startup.
    - 3) Equipment and assembly performance tests.
    - 4) System performance tests.
    - 5) Intersystem performance tests.
    - 6) Commissioning tests.
- B. Before performing commissioning tests, verify that materials, equipment, assemblies, and systems are delivered, installed, started, and adjusted to perform according to construction checklists.
- C. Verify readiness of materials, equipment, assemblies, and systems by performing tests prior to performing test demonstrations. Notify Architect if acceptable results cannot be achieved due to conditions beyond Contractor's control or responsibility.
- D. Commence tests as soon as installation checks for materials, equipment, assemblies, or systems are satisfactorily completed. Tests of a particular system may proceed prior to completion of other systems, provided the incomplete work does not interfere with successful execution of test.

### 3.8 SCHEDULING

- A. Commence commissioning as early in the construction period as possible.
- B. Commissioning Schedule: Integrate commissioning into Contractor's construction schedule. See Section 01 3200 "Construction Progress Documentation."
  1. Include detailed commissioning activities in monthly updated Contractor's construction schedule and short interval schedule submittals.
  2. Schedule the start date and duration for the following commissioning activities:
    - a. Submittals.
    - b. Preliminary operation and maintenance manual submittals.

- c. Installation checks.
  - d. Startup, where required.
  - e. Performance tests.
  - f. Performance test demonstrations.
  - g. Commissioning tests.
  - h. Commissioning test demonstrations.
- 3. Schedule shall include a line item for each installation check, startup, and test activity specific to the equipment or systems involved.
  - 4. Determine milestones and prerequisites for commissioning. Show commissioning milestones, prerequisites, and dependencies in monthly updated critical-path-method construction schedule and short interval schedule submittals.

C. Two-Week Look-Ahead Commissioning Schedule:

- 1. Two weeks prior to the beginning of tests, submit a detailed two-week look-ahead schedule. Thereafter, submit updated two-week look-ahead schedules weekly for the duration of commissioning.
- 2. Two-week look-ahead schedules shall identify the date, time, beginning location, Contractor personnel required, and anticipated duration for each startup or test activity.
- 3. Use two-week look-ahead schedules to notify and coordinate participation of Owner's witnesses.

D. Owner's Witness Coordination:

- 1. Coordinate Owner's witness participation via Architect.
- 2. Notify Architect of commissioning schedule changes at least two work days in advance for activities requiring the participation of Owner's witness.

### 3.9 COMMISSIONING REPORTS

A. Test Reports:

- 1. Pre-startup reports include observations of the conditions of installation, organized into the following sections:
  - a. Equipment Model Verification: Compare contract requirements, approved submittals, and provided equipment. Note inconsistencies.
  - b. Preinstallation Physical Condition Checks: Observe physical condition of equipment prior to installation. Note conditions including, but not limited to, physical damage, corrosion, water damage, or other contamination or dirt.

- c. Preinstallation Component Verification Checks: Verify components supplied with the equipment, preinstalled or field installed, are correctly installed and functional. Verify external components required for proper operation of equipment correctly installed and functional. Note missing, improperly configured, improperly installed, or nonfunctional components.
  - d. Summary of Installation Compliance Issues and Corrective Actions: Identify installation compliance issues and the corrective actions for each. Verify that issues noted have been corrected.
  - e. Evaluation of System Readiness for Startup: For each item of equipment for each system for which startup is anticipated, document in summary form acceptable to Owner completion of equipment model verification, preinstallation physical condition checks, preinstallation component verification checks, and completion of corrective actions for installation compliance issues.
2. Test data reports include the following:
- a. "As-tested" system configuration. Complete record of conditions under which the test was performed, including, but not limited to, the status of equipment, systems, and assemblies; temporary adjustments and settings; and ambient conditions.
  - b. Data and observations, including, but not limited to, data trend logs, recorded during the tests.
  - c. Signatures of individuals performing and witnessing tests.
  - d. Data trend logs accumulated overnight from the previous day of testing.
3. Commissioning Compliance Issues Reports: Report as commissioning compliance issues results of tests and test demonstrations that do not comply with acceptance criteria. Report only one issue per commissioning compliance issue report. Use sequentially numbered facsimiles of commissioning compliance issue report form included in this Section, or other form approved by Owner. Distribute commissioning compliance issue reports to parties responsible for taking corrective action. Identify the following:
- a. Commissioning compliance issue report number. Assign unique, sequential numbers to individual commissioning compliance issue reports when they are created, to be used for tracking.
  - b. Action distribution list.
  - c. Report date.
  - d. Test number and description.
  - e. Equipment identification and location.
  - f. Briefly describe observations about the performance associated with failure to achieve acceptable results. Identify the cause of failure if apparent.

- g. Diagnostic procedure or plan to determine the cause (include in initial submittal)
  - h. Diagnosis of fundamental cause of issues as specified below (include in resubmittal).
  - i. Fundamental cause of unacceptable performance as determined by diagnostic tests and activities.
  - j. When issues have been resolved, update and resubmit the commissioning issue report forms by completing Part 2. Identify resolution taken and the dates and initials of the persons making the entries.
  - k. Schedule for retesting.
4. Weekly progress reports include information for tests conducted since the preceding report and the following:
    - a. Completed data forms.
    - b. Equipment or system tested, including test number, system or equipment tag number and location, and notation about the apparent acceptability of results.
    - c. Activities scheduled but not conducted per schedule.
    - d. Commissioning compliance issue report log.
    - e. Schedule changes for remaining Commissioning-Process Work, if any.
  5. Data trend logs shall be initiated and running prior to the time scheduled for the test demonstration.
    - a. Trend log data format shall be multiple data series graphs. Where multiple data series are trend logged concurrently, present the data on a common horizontal time axis. Individual data series may be presented on a segmented vertical axis to avoid interference of one data series with another, and to accommodate different axis scale values. Graphs shall be sufficiently clear to interpret data within the accuracy required by the acceptance criteria.
    - b. Attach to the data form printed trend log data collected during the test or test demonstration.
    - c. Record, print out, and attach to the data form operator activity during the time the trend log is running. During the time the trend log is running, operator intervention not directed by the test procedure invalidates the test results.
  6. System Alarm Logs: Record and print out a log of alarms that occurred since the last log was printed. Evaluate alarms to determine if the previous day's work resulted in any conditions that are not considered "normal operation."

- a. Conditions that are not considered "normal operation" shall be reported on a commissioning issue report attached to the alarm log. Resolve as necessary. The intent of this requirement is to discover control system points or sequences left in manual or disabled conditions, equipment left disconnected, set points left with abnormal values, or similar conditions that may have resulted from failure to fully restore systems to normal, automatic control after test completion.

### 3.10 CERTIFICATE OF CONSTRUCTION PHASE COMMISSIONING COMPLETION

- A. When Contractor considers that construction phase commissioning, or a portion thereof which Owner agrees to accept separately, is complete, Contractor shall prepare and submit to Owner and Commissioning Authority through Architect a comprehensive list of items to be completed or corrected. Failure to include an item on such list does not alter Contractor's responsibility to compete commissioning.
- B. On receipt of Contractor's list, Commissioning Authority will make an inspection to determine whether the construction phase commissioning or designated portion thereof is complete. If Commissioning Authority's inspection discloses items, whether included on Contractor's list, which is not sufficiently complete as defined in "Construction Phase Commissioning Completion" Paragraph in the "Definitions" Article, Contractor shall, before issuance of the Certificate of Construction Phase Completion, complete or correct such items on notification by Commissioning Authority. In such case, Contractor shall then submit a request for another inspection by Commissioning Authority to determine construction phase commissioning completion.
- C. Contractor shall promptly correct deficient conditions and issues discovered during commissioning. Costs of correcting such deficient conditions and issues, including additional testing and inspections, the cost of uncovering and replacement, and compensation for Architect's and Commissioning Authority's services and expenses made necessary thereby, shall be at Contractor's expense.
- D. When construction phase commissioning or designated portion is complete, Commissioning Authority will prepare a Certificate of Construction Phase Commissioning that shall establish the date of completion of construction phase commissioning. Certificate of Construction Phase Commissioning Completion shall be submitted prior to requesting inspection for determining date of Substantial Completion.

END OF SECTION

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## SECTION 01 91 14 - COMMISSIONING AUTHORITY RESPONSIBILITIES

### PART 1 GENERAL

#### 1.1 SUMMARY

- A. Commissioning is intended to achieve the following specific objectives; this section covers the Commissioning Authority's responsibilities for commissioning:
  - 1. Verify that the work is installed in accordance with Contract Documents and the manufacturer's recommendations and instructions, and that it receives adequate operational checkout prior to startup: Startup reports and Prefunctional Checklists are utilized to achieve this.
  - 2. Verify and document that functional performance is in accordance with Contract Documents: Functional Tests performed by Contractor and witnessed by the Commissioning Authority are utilized to achieve this.
  - 3. Verify that operation and maintenance manuals submitted to Owner are complete: Detailed O&M data submittals are specified.
  - 4. Verify that the Owner's operating personnel are adequately trained: Formal training conducted by Contractor is specified.
- B. Commissioning, including Functional Tests, O&M documentation review, and training, is to occur after startup and initial checkout and be completed before Substantial Completion.
- C. Coordinate and direct all the commissioning activities in a logical, sequential and efficient manner using consistent protocols and forms, centralized documentation, clear and regular communications and consultations with all necessary parties, frequently updated timelines and schedules and technical expertise.

#### 1.2 SCOPE OF COMMISSIONING

- A. The following are to be commissioned:
- B. Other equipment and systems explicitly identified elsewhere in Contract Documents as requiring commissioning.

#### 1.3 REFERENCE STANDARDS

- A. ASHRAE Guideline 1.1 - The HVAC&R Technical Requirements for the Commissioning Process 2007, with Errata (2012).

#### 1.4 SUBMITTALS

- A. Commissioning Plan:
  - 1. Submit preliminary draft for review by Owner and Architect within 30 days after commencement of Commissioning Authority contract.

2. Submit revised draft to be included in the construction Contract Documents, not less than 4 weeks prior to bid date.
  3. Submit final plan not more than 90 days after commencement of construction, for issuance to all parties.
- B. List of Prefunctional Checklists to be developed:
1. Submit preliminary list at start of construction documents phase or within 30 days after commencement of contract, whichever is later.
  2. Submit revised list not less than 6 weeks prior to bid date, for inclusion in the construction Contract Documents.
  3. Submit final list not more than 60 days after start of construction.
- C. Prefunctional Checklists:
1. Submit preliminary draft at start of construction documents phase or within 30 days after commencement of contract, whichever is later.
  2. Submit revised draft for review by Owner and Architect not less than 6 weeks prior to bid date, for inclusion in the construction Contract Documents.
  3. Submit final draft to Contractor not less than 4 weeks prior to startup of particular items to be commissioned.
- D. List of Functional Test procedures to be developed:
1. Submit preliminary list at start of construction documents phase or within 30 days after commencement of contract, whichever is later.
  2. Submit revised list not less than 6 weeks prior to bid date, for inclusion in Contract Documents; this is intended to be a list of titles, not full description of the tests.
  3. Submit final list not more than 60 days after start of construction.
- E. Functional Test Procedures:
1. Submit preliminary draft at start of construction documents phase or within 30 days after commencement of contract, whichever is later.
  2. Submit revised draft for review by Owner and Architect not less than 6 weeks prior to bid date, for inclusion in the construction Contract Documents.
  3. Submit final draft to Contractor not less than 4 weeks prior to startup of particular items to be commissioned.
- F. Training Plan.

- G. Recommissioning Manual: Submit within 60 days after receipt of Owner's instructions to proceed with preparation.
- H. Commissioning Process Record: Submit to Contractor for inclusion with O&M manuals. Include, at a minimum the following:
- I. Final Commissioning Report: Submit to Owner. Include the following:

## PART 3 EXECUTION

### 2.1 COMMISSIONING PLAN

- A. Prepare and implement the Commissioning Plan, covering commissioning schedule, Prefunctional Checklist and Functional Test procedures, coordination requirements, and forms to be used, for all parties in the commissioning process.
  - 1. Call and chair meetings of the Commissioning team when appropriate.
  - 2. Give Contractor sufficient notice for scheduling commissioning activities.
  - 3. Develop a comprehensive start-up and initial systems checkout plan with cooperation of Contractor and subcontractors.
  - 4. ASHRAE Guideline 1.1 may be used as a guide for the Commissioning Plan.
  - 5. Avoid replication of information included in the construction Contract Documents to the greatest extent possible.
- B. Review the construction Contract Documents for Contractor submittals of draft checklists, draft test procedures, manufacturer startup procedures, and other information intended for the use of the Commissioning Authority in preparing the Commissioning Plan.
- C. Commissioning Schedule:
  - 1. Coordinate with Contractor anticipated dates of startup of each item of equipment and system.
  - 2. Contractor's scheduling responsibilities are specified in the construction Contract Documents.
  - 3. Revise and re-issue schedule monthly.
  - 4. Prefunctional Checklists and Functional Tests are to be performed in sequence from components, to subsystems, to systems.
  - 5. Deliver relevant Prefunctional Checklists and Functional Test Procedures to Contractor in time to avoid delay.

### 2.2 CONSTRUCTION CONTRACT DOCUMENTS

- A. General Commissioning Specifications: Architect has prepared general commissioning specifications for inclusion in the construction Contract Documents; review and submit comments to Owner.

1. These specifications include:
    - a. Procedures applicable to all types of items to be commissioned.
  2. Prepare specifications for any of the following that would be recommended, for incorporation into the construction Contract Documents by Architect:
    - a. Additional Contractor submittals needed for purposes of commissioning, such as startup procedures, draft test procedures, draft training plans, etc.
    - b. Additional Owner personnel training.
    - c. Additional operation or maintenance data that should be submitted.
- B. Prefunctional Checklists: Develop detailed Checklists for each item to be commissioned.
1. List of Checklists to be Developed: Prepare and maintain a detailed list of titles, not full text.
  2. The Checklist forms are intended to be part of the Contractor's Contract Documents.
- C. Functional Testing: Develop detailed procedures for each item to be commissioned; submit for review by Owner and Architect.
1. List of Test Procedures to be Developed: Prepare and maintain a detailed list of titles, not full text.
  2. The forms the Commissioning Authority will use to report Functional Test results are not intended to be part of Contractor's Contract Documents, but the Functional Test Procedures that must be executed by the Contractor must be made part of the Contract Documents, by modification if necessary.
- D. Develop any other reporting forms Contractor will be required to use; if they are likely to require a substantially different amount of work than the Contractor can reasonably anticipate, they must be included in the construction Contract Documents.
- E. If any part of the documents described above have not been developed by the bid date, coordinate with Architect the issuance of modifications to the construction Contract Documents

### 2.3 PREFUNCTIONAL CHECKLISTS

- A. Prefunctional Checklists - Content: Prepare forms for Contractor's use, in sufficient detail to document that the work has been installed in accordance with Contract Documents and the manufacturer's recommendations and instructions, and that it receives adequate operational checkout prior to startup.
1. Prepare separate Checklists for each type of equipment, system, or other assembly, customized to the item.
  2. Identify each Checklist by using Contract Documents identification number or name, if any; if none, create unique identifiers for each Checklist; do not rely on Contractor to number checklists.

3. Multiple identical or near-identical items may appear on a single Checklist provided there is space to record all required data for each separately; label each set of data uniquely.
4. Include space to record manufacturer name, model number, serial number, capacity and other relevant characteristics, and accessories and other features as applicable; include space to record "as specified", "as submitted", and "as installed" data.
5. Include space to record whether or not the required submittals have been received; list each separate type of submittal.
6. Include line items for each physical inspection to be performed.
7. Include line items for each operational inspection to be performed, such as checking switch operation, fan rotation, valve and damper stroke, and measuring actual electrical loads.
8. Include separate section for sensors and actuators, with space for documenting actual physical location and calibration measurements; provide a separate generic calibration checklist identified wherever referenced.
9. Include spaces to record that related Checklists for related work upon which this work depends have been completed.

B. Prefunctional Checklists - Format:

1. Provide a cover sheet showing name of equipment item or system, documentation identification number (see Documentation Identification Scheme), names of accessory components involved, and identification of related checklists.
2. Include on cover sheet space for Contractor's use in attesting to completeness; provide spaces for the signatures of the general contractor and each subcontractor or other entity responsible, customized to the project and the type of item.
3. Include on the cover sheet, above the signature block, the following statement: "The work referenced in this Checklist and other work integral to or dependent on this work is complete and ready for functional testing. The checklist items are complete and have been checked off only by parties having direct knowledge of the event." Include two checkboxes:
  - a. "This Checklist is submitted for approval with no exceptions."
  - b. "This Checklist is submitted for approval, subject to the attached list of outstanding items, none of which preclude the performance of safe and reliable functional tests. A statement of completion will be submitted upon completion of the outstanding items."
4. Use a consistent, tabular format for all Checklists, with one line per checklist activity.
5. For each line item, provide space for initials and date, and identification of the subcontractor or other entity responsible.

## 2.4 FUNCTIONAL TEST PROCEDURES

- A. Develop test procedures in sufficient detail to demonstrate that functional performance is in accordance with Contract Documents, including proper operation through specified modes of operation where there is a different system response, including seasonal, unoccupied, warm-up, cool-down, part- and full-load regimes.
  - 1. Obtain assistance and review by installing subcontractors.
  - 2. Itemize each test sequence in step-by-step order, with acceptance criteria for each step and for the test as a whole.
  - 3. Include test setup instructions, description of tools and apparatus, special cautions, and.
  - 4. Avoid procedures that would void or otherwise limit warranties; review with Contractor prior to execution.
  - 5. For HVAC systems, procedures may include energy management control system trending, stand-alone datalogger monitoring, or manual functional testing.
  - 6. Obtain explicit approval of Contractor in regard to feasibility and safety prior to execution.
- B. Functional Test Forms: Prepare and distribute forms in advance of testing. Use a consistent format to the greatest degree practicable. For each form, include the following:
  - 1. Signature Block: Signature of the designated commissioning lead and the system and equipment installer attesting that the recorded test results are accurate.

## 2.5 CONSTRUCTION PHASE

- A. Coordinate the commissioning work with Contractor and Construction Manager; ensure that commissioning activities are being incorporated into the master schedule.
- B. Perform site visits, as necessary, to observe component and system installations. Attend planning and job-site meetings to obtain information on construction progress. Review Contractor's meeting minutes for issues relating to the commissioning process. Assist in resolving discrepancies.
- C. Commissioning Kick-Off Meeting: Plan and conduct a meeting early in the construction phase to review proposed commissioning schedule, activities, and responsibilities with parties involved. Require attendance by every member of the Commissioning Team.
- D. Conduct periodic meetings as necessary to coordinate, resolve planning issues, and aid in resolution of deficiencies, minimizing the time spent by Contractor and Owner personnel; hold meetings at least monthly.
- E. Submit periodic progress reports to Owner and Contractor.
- F. Review Contractor shop drawing submittals applicable to systems being commissioned for compliance with commissioning needs; verify that Owner's responsibilities are clearly defined in warranties.

- G. Review and approve submittals directly related to commissioning.
- H. Deliver Prefunctional Checklists and Functional Test procedures to Contractor.
- I. Verify satisfactory completion of Prefunctional Checklists by Contractor by reviewing checklists and by site observation and spot checking; provide formal approval when satisfactory.
- J. Verify startup of all systems by reviewing start-up reports and by site observation; provide formal approval when satisfactory.
- K. Coordinate, witness and approve Functional Tests performed by Contractor. Coordinate retesting until satisfactory performance is achieved.
- L. HVAC Commissioning:
  - 1. Gather and review the control sequences and interlocks and work with Contractor and design engineers until sufficient clarity has been obtained, in writing, to be able to prepare detailed Functional Test procedures.
  - 2. Witness all or part of HVAC piping test and flushing procedures, sufficient to be confident that proper procedures were followed; document testing and include documentation in O&M manuals.
  - 3. Witness all or part of duct testing and cleaning procedures, sufficient to be confident that proper procedures were followed; document testing and include documentation in O&M manuals.
  - 4. Review TAB Plan prepared by Contractor.
  - 5. Before TAB is executed, witness sufficient Functional Testing of the control system to approve it to be used for TAB.
  - 6. Verify air and water systems balancing by spot testing, by reviewing completed reports, and by site observation; provide formal approval when satisfactory.
  - 7. Analyze trend logs and monitoring data to verify performance.
- M. Witness and document testing of systems and components over which the Commissioning Authority does not have direct control, such as smoke control systems, tests contracted directly by Owner, and tests by manufacturer's personnel; include documentation in O&M manuals.
- N. When Functional Testing for specific systems or equipment is specified to be performed by the Commissioning Authority rather than the Contractor, perform such testing without assistance of Contractor.
- O. Maintain a master deficiency and resolution log and a separate testing record. Provide written progress and test reports with recommended actions.
- P. Operation and Maintenance Data: Review submitted operation and maintenance data for completeness; provide formal approval if satisfactory.

Q. Notify Contractor and Owner of deficiencies in procedures or results; suggest solutions.

## 2.6 TRAINING

- A. Training Plan: Prepare a comprehensive Training Plan, incorporating draft training plans submitted by Contractor.
  1. Include a [ ] hour session by the HVAC design engineer covering the overall HVAC system and equipment design concepts, with one-line schematic drawings.
  2. Include a [ ] hour session by the Commissioning Authority on the use of the blank Prefunctional Checklists and Functional Test forms for re-commissioning purposes.
  3. Establish criteria for determining satisfactory completion of training.
- B. Verify that training was satisfactorily completed; provide formal approval if satisfactory.

## 2.7 CLOSEOUT

- A. Commissioning Record: Use the same format and organization as specified for the O&M manuals.
  1. Include the Final Commissioning Plan and Final Report.
  2. For each product or system and equipment item, include the following organized as indicated, with separator tabs:
    - a. Design intent documentation, furnished by Architect or others.
    - b. Detailed operational sequences.
    - c. Startup plan and approved startup reports.
    - d. Filled out Prefunctional Checklists.
    - e. Filled out Functional Test reports; trend logs and monitoring reports and analysis; other verification documentation.
    - f. Training plan and training records.
    - g. Recommissioning recommendations, including time schedule and procedures; include blank copies of all Prefunctional Checklists and Functional Test report forms.
- B. Final Commissioning Report: Include:
  1. Executive summary.
  2. List of participants and roles.
  3. Brief facility description.
  4. Overview of commissioning scope and general description of testing and verification methods.

5. For each item commissioned, an evaluation of adequacy of:
    - a. The product itself; i.e. compliance with Contract Documents.
    - b. Installation.
    - c. Functional performance; include a brief description of the verification method used and observations and conclusions from the testing.
    - d. O&M documentation, including design intent.
    - e. Operator training.
  6. List of all outstanding non-compliance items, referenced to the specific functional test, inspection, trend log, etc., where the deficiency is documented.
  7. List of unresolved issues, seasonal or deferred testing, and other concerns that could affect facility operation.
  8. Recommendations for improvement to equipment or operations, future actions, commissioning process changes, etc. (about four to six pages).
  9. Attach appendices containing all commissioning documentation, including logs, minutes, reports, deficiency lists, communications, findings, etc., except that specified to be part of the Commissioning Record.
- C. Recommissioning Manual: Revise the Commissioning Plan documents, checklists, and Functional Test forms as necessary based on accepted recommendations of the final Commissioning Report. Provide step-by-step instructions for recommissioning, blank forms, and cross-references to O&M data needed during recommissioning.

## 2.8 POST-OCCUPANCY PHASE

- A. Coordinate deferred and seasonal Functional Tests; verify correction of deficiencies.
- B. On-Site Review: 10 months after Substantial Completion conduct on-site review with Owner's staff.
  1. Review the current facility operation and condition of outstanding issues related to the original and seasonal commissioning.
  2. Interview staff to identify problems or concerns they have operating the facility as originally intended.
  3. Make suggestions for improvements and for recording these changes in the O&M manuals.
  4. Identify areas of concern that are still under warranty or are the responsibility of the original construction contractor.

5. Assist facility staff in developing reports, documents and requests for services to remedy outstanding problems.

END OF SECTION

## SECTION 02 41 00 - DEMOLITION

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Abandonment and removal of existing utilities and utility structures.

#### 1.2 RELATED REQUIREMENTS

- A. Section 01 10 00 - Summary: Description of items to be removed by Owner.
- B. Section 01 10 00 - Summary: Description of items to be salvaged or removed for re-use by Contractor.
- C. Section 01 50 00 - Temporary Facilities and Controls: Site fences, security, protective barriers, and waste removal.
- D. Section 01 60 00 - Product Requirements: Handling and storage of items removed for salvage and relocation.
- E. Section 01 70 00 - Execution and Closeout Requirements: Project conditions; protection of bench marks, survey control points, and existing construction to remain; reinstallation of removed products; temporary bracing and shoring.
- F. Section 01 74 19 - Construction Waste Management and Disposal: Limitations on disposal of removed materials; requirements for recycling.
- G. Section 31 23 23 - Fill: Fill material for filling holes, pits, and excavations generated as a result of removal operations.

#### 1.3 REFERENCE STANDARDS

#### 1.4 SUBMITTALS

- A. See Section 01 33 00 for general submittal procedures.
- B. Site Plan: Showing:
  - 1. Areas for temporary construction and field offices.
  - 2. Areas for temporary and permanent placement of removed materials.
- C. Demolition Plan: Submit demolition plan as specified by OSHA and local authorities.
  - 1. Indicate coordination with separate contract for multi-block demo/development project.
  - 2. Indicate extent of demolition, removal sequence, bracing and shoring, and location and construction of barricades and fences.
  - 3. Identify demolition firm and submit qualifications.

- D. Project Record Documents: Accurately record actual locations of capped and active utilities and subsurface construction.

## PART 2 PRODUCTS

### 2.1 MATERIALS

- A. Fill Material: As specified in Section 31 23 23 - Fill.

## PART 3 EXECUTION

### 3.1 SCOPE

- A. Preparation of existing utilities within the limits of construction for abandonment in place.
- B. Remove other items indicated, for salvage, relocation, and recycling.
- C. Fill excavations, open pits, and holes in ground areas generated as result of removals, using specified fill; compact fill as specified in Section 31 22 00.

### 3.2 GENERAL PROCEDURES AND PROJECT CONDITIONS

- A. Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.
  1. Obtain required permits.
  2. Comply with applicable requirements of NFPA 241.
  3. Use of explosives is not permitted.
  4. Take precautions to prevent catastrophic or uncontrolled collapse of structures to be removed; do not allow worker or public access within range of potential collapse of unstable structures.
  5. Provide, erect, and maintain temporary barriers and security devices.
  6. Use physical barriers to prevent access to areas that could be hazardous to workers or the public.
  7. Conduct operations to minimize effects on and interference with adjacent structures and occupants.
  8. Do not close or obstruct roadways or sidewalks without permit.
  9. Conduct operations to minimize obstruction of public and private entrances and exits; do not obstruct required exits at any time; protect persons using entrances and exits from removal operations.
  10. Obtain written permission from owners of adjacent properties when demolition equipment will traverse, infringe upon or limit access to their property.
- B. Do not begin removal until receipt of notification to proceed from Owner.

- C. Protect existing structures and other elements that are not to be removed.
  - 1. Provide bracing and shoring.
  - 2. Prevent movement or settlement of adjacent structures.
  - 3. Stop work immediately if adjacent structures appear to be in danger.
- D. Minimize production of dust due to demolition operations; do not use water if that will result in ice, flooding, sedimentation of public waterways or storm sewers, or other pollution.
- E. Perform demolition in a manner that maximizes salvage and recycling of materials.
  - 1. Comply with requirements of Section 01 74 19 - Waste Management.
  - 2. Dismantle existing construction and separate materials.
  - 3. Set aside reusable, recyclable, and salvageable materials; store and deliver to collection point or point of reuse.

### 3.3 EXISTING UTILITIES

- A. Coordinate work with utility companies; notify before starting work and comply with their requirements; obtain required permits.
- B. Protect existing utilities to remain in service from damage.
- C. Do not disrupt public utilities without permit from authority having jurisdiction.
- D. Do not close, shut off, or disrupt existing life safety systems that are in use without at least 7 days prior written notification to Owner.
- E. Do not close, shut off, or disrupt existing utility branches or take-offs that are in use without at least 3 days prior written notification to Owner.
- F. Locate and mark utilities to remain in service or to be abandoned; mark using highly visible tags or flags, with identification of utility type; protect from damage due to subsequent construction, using substantial barricades if necessary.
- G. Remove exposed piping, valves, meters, equipment, supports, and foundations of disconnected and abandoned utilities.

### 3.4 DEBRIS AND WASTE REMOVAL

- A. Remove from site all materials not to be reused on site; comply with requirements of Section 01 74 19 - Waste Management.
- B. Leave site in clean condition, ready for subsequent work.

C. Clean up spillage and wind-blown debris from public and private lands.

END OF SECTION

## SECTION 03 30 00 - CAST-IN-PLACE CONCRETE

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

#### 1.2 SUMMARY

- A. Provide labor, materials, equipment and services necessary for and reasonably incidental to the completion of all cast-in-place concrete work shown or herein specified. The work includes all concrete poured in placed with the required reinforcement called for on the drawings, concrete forms and forming, concrete over metal decking, pads under mechanical and electrical equipment and special pads as shown and noted on drawings. Coordinate concrete work with other trades and ensure the insertion of all cast-in-place items at the proper time.

#### 1.3 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume.

#### 1.4 QUALITY ASSURANCE

- A. Contractor Qualifications: A company who specializes in the placement of formwork, reinforcing steel, and concrete with a minimum of 3 years experience on projects of a similar size and scope.
- B. Specialty Engineer Qualifications: Professional Engineer registered in the State of the proposed project whose specialty includes the structural design of concrete formwork.
  - 1. The Specialty Engineer will be required to perform periodic site observations to confirm the formwork construction meets the requirements of the formwork drawings.
  - 2. The Specialty Engineer shall carry professional liability insurance coverage in the aggregate amount of \$1,000,000.00 to protect the Engineer from claims, which may arise in the performance of engineering services
- C. Codes and Standards: Comply with provisions of following codes, specifications and standards, except where more stringent requirements are shown or specified. ACI 301 'Specifications for Structural Concrete for Buildings'; ACI 117 'Specifications for Tolerance for Concrete Construction and Materials, and CRSI Concrete Reinforcing Steel Institute, 'Manual of Standard Practice'.
- D. Workmanship: The Contractor is responsible for correction of concrete work which does not conform to the specified requirements, including strength, tolerances and finishes. Correct deficient concrete as directed by Architect.

- E. Formwork Shop Drawings: Prepared by or under the supervision of a qualified professional engineer detailing fabrication, assembly, and support of formwork. Design and engineering of formwork are Contractor's responsibility.
  - 1. Shoring and Reshoring: Indicate proposed schedule and sequence of stripping formwork, shoring removal, and installing and removing reshoring.
- F. Pre-Construction Conference: Conduct conference at Project site to comply with requirements of Division 1 Section "Project Meetings" and the following.
  - 1. At least 10 days prior to submittal of design mixes, conduct a meeting to review detailed requirements for preparing concrete design mixes and to determine procedures for satisfactory concrete operations. Review requirements for submittals, status of coordinating work, and availability of materials. Establish preliminary work progress schedule and procedures for materials inspection, testing, and certifications. Request that representatives of each entity directly concerned with cast-in-place concrete attend conference, including, but not limited to, the following:

Contractor's superintendent and project manager; Laboratory responsible for field quality control; Ready-mix concrete producer; Concrete subcontractor; Primary admixture manufacturers; Architect or Owner's representative; Structural engineer.
- G. Materials and Installed work may require testing and retesting, as directed by Architect, at any time during progress of work. Allow free access to material stockpiles and facilities. Tests, not specifically indicated to be done at Owner's expense, including retesting of rejected materials and installed work, shall be done at Contractor's expense.
- H. Protection of Footings Against Freezing: Cover completed work at footing level with sufficient temporary or permanent cover as required to protect footings and adjacent subgrade against possibility of freezing; maintain cover for time period as necessary.
- I. Protect adjacent finish materials against spatter during concrete placement.

## 1.5 SUBMITTALS

- A. Shop Drawings - Reinforcement: Submit shop drawings for fabrication, bending, and placement of concrete reinforcement. Comply with ACI 315 "Manual of Standard Practice for Detailing Reinforced Concrete Structures" showing bar schedules, stirrup spacing, diagrams of bent bars, and arrangement of concrete reinforcement. Include special reinforcement required at openings through concrete structures and construction joints. Show wall reinforcing in elevations, in addition to section.
  - 1. Structural design drawings shall not be reproduced or used as base sheets for shop drawings.
- B. Shop Drawings - Formwork: Submit shop drawings signed and sealed by a Specialty Engineer as indicated. Show general construction of forms including jointing, special form joint or reveals, sequence of stripping formwork, shoring removal, and installing and removing re-shores. Provide calculations on required levels of shoring included reshoring placement and required supporting floor concrete strengths.

1. The formwork Specialty Engineer shall submit written field observation reports to the Architect/Engineer within 7 days of each visit.
  2. The formwork Specialty Engineer shall submit to the Architect/Engineer certification verifying liability insurance coverage with the first submission of formwork shop drawings.
  3. Review is for general architectural applications and features only. Design of formwork for structural stability and efficiency is Contractor's responsibility.
- C. Samples: Upon request, submit samples of chairs, spacers, waterstops, joint materials, and other materials as requested by Architect, including names, sources and descriptions.
- D. Mix Design: Submit mix designs for all classes of concrete including aggregate gradation and actual properties.
- E. Mill Test: Upon request, submit certified mill test reports for specified cement, reinforcement and welded wire fabric.
- F. Pour Sequence Plan: Submit plan showing approximate locations of concrete pour construction joints. Generally place construction joints in supported concrete construction at 1/3 points of the beam and slab spans.
- G. Certification for Admixture: Provide material certification, signed by manufacturer and contractor, certifying that each admixture complies with, or exceeds, specified requirements. Chloride ion content must be included.
- H. Certificate of Conformance: Provide certificate of conformance for epoxy coating on reinforcing bars and for epoxy coating repair material.
- I. Related Materials: Upon request, submit cut sheets and product information on curing compounds, patching and bonding materials, sealers, minutes of preconstruction conference, and other items.
- J. LEED - Product Data for MR Credit, Building Product Disclosure and Optimization, Sourcing of Raw Materials: For products having recycled content, provide documentation indicating percentages by weight of post-consumer and pre-consumer recycled content. Include statement indicating cost for each product having recycled content.
- K. LEED – Regional Materials for MR Credit, Building Product Disclosure and Optimization, Sourcing of Raw Materials: Provide material extraction and manufacturing locations.
- L. LEED – Design Mixtures for Innovation Credit: For each concrete mixture containing fly ash as a replacement for Portland cement or other potential replacements and for equivalent concrete mixtures that do not contain Portland cement replacements.

## PART 2 - PRODUCTS

### 2.1 FORM MATERIALS

- A. Forms for Exposed Finish Concrete: Unless otherwise indicated, construct formwork for exposed concrete surfaces with plywood, metal, metal-framed plywood faced or other acceptable panel-type materials, to provide continuous, straight, smooth, exposed surfaces. Furnish in largest practicable sizes

to minimize number of joints and to conform to joint system shown on drawings. Provide form material with sufficient thickness to withstand pressure of newly-placed concrete without bow or deflection.

- B. Forms for Unexposed Finish Concrete: Form concrete surfaces which will be unexposed in finished structure with plywood, lumber, metal or other acceptable material. Provide lumber dressed on at least 2 edges and one side for tight fit.
- C. Form Coatings: Provide commercial formulation form-coating compounds that will not bond with, stain nor adversely affect concrete surfaces, and will be compatible with and not impair subsequent treatments of concrete surfaces, such as sealants or dampproofing.
- D. Form Ties: Steel wire snap ties with positive breakbacks which will leave no metal closer than 1" from formed surface of concrete, leaving a cone-shaped recess.
- E. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch minimum.
- F. Forms for Cylindrical Columns, Pedestals and Supports; Metal, glass-fiber-reinforced plastic, paper or fiber tubes that will produce surfaces with gradual or abrupt irregularities, not exceeding specified formwork surface class. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.

## 2.2 REINFORCING MATERIALS

- A. Reinforcing Bars: ASTM A615 615M, Grade 60 (Grade 420) deformed.
- B. Epoxy Coated Reinforcing Bars: ASTM A775/A 775M, Grade 60 deformed steel.
- C. Welded Wire Fabric: ASTM A185, welded steel wire fabric.
- D. **LEED - Recycled Content:** Recycled content shall be a minimum of 75% post-consumer content.

## 2.3 REINFORCING ACCESSORIES

- A. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete or fiber-reinforced concrete of greater compressive strength than concrete, and as follows:
  1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected or CRSI Class 2 stainless-steel bar supports.
  2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.
- B. Joint Dowel Bars: Plain-steel bars, ASTM A 615/A 615M, Grade 60 (Grade 420). Saw (do not shear) bars true to length with ends square and free of burrs.
- C. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating; compatible with epoxy coating on reinforcement and complying with ASTM A 775/A 755M.

## 2.4 CONCRETE MATERIALS

- A. Portland Cement: ASTM C150, Type I. Use one brand of cement throughout project.
- B. Blended Hydraulic Cement: ASTM C595M, Type 1S or 1P.
- C. Fly Ash: ASTM C618, Class C or F.
- D. Granulated Blast Furnace Slag: ASTM C989 Grade 120
- E. Normal Weight Aggregates: ASTM C33, and as herein specified. Maximum aggregate size 1" for all concrete.
  - 1. Local aggregates not complying with ASTM C 33 but which have shown by special test or actual service to produce concrete adequate strength and durability may be used when acceptable to the Architect.
- F. Lightweight Aggregate: ASTM C330
  - 1. Nominal Maximum aggregate size: 1 inch.
- G. Water: Potable and complying with ASTM C 94.

## 2.5 ADMIXTURES

- A. General: Admixtures certified by manufacturer to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material and to be compatible with other admixtures and cementitious materials. Do not use admixtures containing calcium chloride.
- B. Corrosion Inhibitor: ASTM C 494, Type C. Add a corrosion inhibiting admixture to the mix where indicated on the drawings to add "DCI" and at the rates as indicated on the drawings. The admixture shall be DCI as manufactured by Grace Construction Products.
- C. Air-Entraining Admixture: ASTM C 260.
- D. Water-Reducing Admixture: ASTM C 494, Type A.
- E. High-Range, Water-Reducing Admixture: ASTM C 494, Type F.
- F. Water-Reducing and Accelerating Admixture: ASTM C 494, Type E.
- G. Water-Reducing and Retarding Admixture: ASTM C 494, Type D.
- H. Calcium Chloride: Calcium chloride, thiocyanates or admixtures containing more than 0.10% water soluble chloride ions by weight of total cementitious materials are not permitted. The use of calcium chloride in concrete is prohibited.

## 2.6 RELATED MATERIALS

- A. Fiber Reinforcement for concrete shall comply with a blend of cold drawn steel wire fiber and 100 percent virgin homopolymer polypropylene graded multifilament fiber containing no reprocessed olefin materials. Engineered and manufactured in an ISO 9001:2000 certified facility for use as concrete reinforcement at a minimum addition rate of one 24 lbs/cubic yard. UL classified. Comply with National Building Codes, ASTM C 116/C 1116/M, Type I and Type III fiber reinforcement concrete and ASTM A 820.

1. Polypropylene Component Properties

- a. Absorption: Nil
- b. Specific Gravity: 091
- c. Fiber Length: Multi-Design Gradation
- d. Electrical Conductivity: Low
- e. Melt Point: 324 degrees Fahrenheit

2. Steel Wire Component Properties

- a. Tensile Strength: 140-180 KSI
- b. Fiber Length: 1.5
- c. Aspect Ratio: 34
- d. Deformation: Continuously deformed circular segment

- B. Vapor Retarder: Provide moisture barrier cover over prepared base material. Use only materials which are resistant to decay when tested in accordance with ASTM E 154. Polyethylene sheet not less than 10 mils thick.
- C. Non-Shrink Grout: The grout shall conform to CRD-C 621-83, "Corps of Engineers Specification for Non-Shrink Grout". **Acceptable products** "Masterflow 713"; Master Builders, "Euco-NS Grout"; Euclid Chemical Company, "Five Star Grout"; US Grout Corporation.
- D. Membrane-Forming Curing and Sealing Compound: ASTM C309. The compound shall be an acrylic emulsion blend, high solids (15% solids content minimum), low VOC (700 g/ maximum) type curing and sealing compound. (Sodium Silicate Compounds are prohibited.) **Acceptable products or approved equal**. "Super Aqua-Cure VOX"; Euclid Chemical Company, "Cure and Seal 309 WB"; Symons Corporation, "Kure-N-Seal WB"; Sonneborn Building Products.
- E. Dissipating Resin Curing Compound: ASTM 209. The compound shall be a liquid membrane forming curing compound formulated from hydrocarbon resins that breaks down quickly to allow the subsequent application of floor coverings. **Acceptable products or approved equal**. "Kurez DR VOX"; Euclid Chemical Company,
- F. Penetrating Hardener and Floor Sealer: Non-film forming penetrating liquid in solution, based on sodium silicate or sodium silicate compounds, compatible with curing system and with subsequent coatings and toppings:
1. **Acceptable Products and Manufacturers:**
    - a. S-102, Sinak Corporation, San Diego, CA.
    - b. Sealhard, L&M Construction Chemicals, Omaha, NE.
    - c. Surehard, Kaufman Products, Baltimore, MD.
    - d. Liqui-Hard, WR Meadows, Cleveland OH.
    - e. Ashford Formula, Curecrete Chemical Co., Springville, UT.

- G. Waterproof Sheet Curing Material: The compound shall conform to ASTM C-171.
- H. Bonding Compound: Polyvinyl acetate or acrylic base, rewettable type, for use only in areas not subject to moisture. Acceptable products or approved equal "Eucoweld"; Euclid Chemical Company. "Weldcrete"; By the Lamson Company.
- I. Epoxy Adhesive: ASTM C881, two component material suitable for use on dry or damp surfaces. Acceptable products or approved equal; "Sikadur Hi-Mod"; Sika Chemical Corp., "Euco Epoxy #452 or #620"; Euclid Chemical Company.
- J. Patching Mortar: Free-flowing, polymer-modified cementitious coating. Acceptable products, or approved equal, "Euco Thin Coat"; Euclid Chemical Company, "Sika Top 121"; Sika Chemical Corp.
- K. Reglets: Where resilient or elastomeric sheet flashing or bituminous membranes are terminated in reglets, provide reglets of not less than 0.0217 inch thick (26-gage) galvanized sheet steel. Fill reglet or cover face opening to prevent intrusion of concrete or debris.
- L. Joint Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber, or ASTM D 1752, cork or self-expanding cork.
- M. Epoxy Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Shore A hardness of 80 per ASTM D 2240.
- N. Waterstop: CE CRD-C 572 polyvinylchloride plastic dumb-bell or ribbed type extruded water stop for all construction joints in concrete foundation walls and wherever noted on plans to prevent passage of fluid through joint. Factory fabricate corners, intersections and directional changes.
- O. Self-Expanding Strip Waterstop: Bentonite waterproofing compound specifically formulated to be used as self-healing rectangular strip joint water system.
- P. Dovetail Anchor Slots: Hot-dip galvanized sheet steel, not less than 0.0336 inch thick (22 gage) with bent tab anchors. Fill slot with temporary filler or cover face opening to prevent intrusion of concrete or debris.
- Q. Shelf Angle Wedge Inserts: Malleable iron insert with  $\frac{3}{4}$  inch diameter askew head bolts and standard nut with washer. Ultimate capacity of anchors shall be a minimum of 18,000 pounds and finish to be hot dip galvanized. Inserts shall be cast with a minimum of  $1\frac{1}{2}$  inch of concrete below bottom. Acceptable products or approved equals. "HW-340", Hohmann & Barnard; "No. 245 Wedge Insert", Heckmann Building Products, "250-3/4", Peerless Hardware Manufacturing Company.

## 2.7 PROPORTIONING AND DESIGN OF MIXES

- A. Mix Designs: Prepare mix designs for each type of strength of concrete. All mix designs shall be proportioned in accordance with Section 5.3, "Proportioning on the Basis of Field Experience and/or Trial Mixtures" of ACI 318.
- B. Limit use of fly ash to not exceed 25 percent of total cementitious material content by weight.
- C. Limit use of blast furnace slag to 50 percent of total cementitious material content by weight. Mixes containing blast furnace slag shall not be used for interior slabs on grade or for interior overbuild slabs.

- D. Contractor is cautioned to carefully consider the use of Blended Hydraulic Cements during cold weather due to its tendency to retard concrete curing. The Contractor and the concrete supplier are responsible for selecting the concrete design mix to prevent problems with curing and finishing during cold weather.
- E. Submit written reports to the Architect of each proposed mix for each class of concrete at least 30 days prior to start of work. Do not begin concrete production until mixes have been reviewed by the Architect. Reports shall include organic content, sieve analysis, specific gravity of aggregates; proportion of all materials; brand of cement; admixtures; slump; water/cement ratios; percentage of air, and results of 7-day and 28-day compression tests.
- F. Strength: Concrete shall have compressive strengths at 28 days as shown on structural drawings.
- G. Lightweight Structural Concrete: Lightweight aggregate and concrete shall conform to ASTM C330. Proportion mix to produce concrete with a minimum compressive strength of 3000 psi at 28 days and an air dry unit weight of 110 pcf plus or minus 3 pcf as determined by ASTM C567. Concrete slump at the point of placement shall not exceed 5 inches. Maximum slump shall be 6 inches (at truck discharge point) for pumped concrete and 5 inches elsewhere. Air entrain concrete to have an air content at point of discharge of 4% to 7%.
- H. Water/Cement Ratio: All concrete shall have a water/cement ratio not to exceed 0.58, except concrete for garages, exterior plazas, and concrete exposed to freezing and thawing shall have a water/cement ratio not exceeding 0.40.
- I. Air Content: All concrete exposed to freezing and thawing and/or required to be watertight shall have an air content of 6 +/- 1.5 percent.
- J. Synthetic Fiber (Fibrous Reinforcement): Add to mix at rate of 1.5 lb per cubic yard (0.68 kilos per cubic meter) unless otherwise recommended by manufacturer.
- K. Admixture Usage: All concrete shall contain the specified water reducing admixture and/or the specified high range water reducing admixture (superplasticizer). All concrete required to be air entrained shall contain an approved air entraining admixture. All pumped concrete, concrete for industrial slabs, architectural concrete, concrete required to be watertight and concrete with a water/cement ratio below 0.50 shall contain the specified HRWR (superplasticizer).
- L. Limit water soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.
- M. Concrete Topping Mixes: The concrete mix shall have a maximum size of coarse aggregate of 1/2". Where topping will be exposed to weather, the mix shall be air-entrained and have a maximum water/cement ratio of 0.45.
- N. Adjustment to Concrete Mixes: Mix design and adjustments may be requested by Contractor when characteristics of materials, job conditions, weather, test results, or other circumstances warrant; at no additional cost to Owner and as accepted by Architect. Laboratory test data for revised mix design and strength results must be submitted to and reviewed by the Architect prior to use.
- O. Slump Limits: All concrete shall have a maximum slump of 5 inches (4 inches +/- 1 inch), except concrete containing HRWR admixture (super plasticizer) which shall have a slump not more than 8 inches after addition of HRWR to site-verified 2-3 inch slump concrete.

## 2.8 CONCRETE MIXING

- A. Ready-Mix Concrete: Comply with the requirements of ASTM C94, and as herein specified. Furnish batch ticket information.
  - 1. During hot weather, or under conditions contributing to rapid setting of concrete, a shorter mixing time than specified in ASTM C94 may be required. When the air temperature is above 85 degrees F., reduce the mixing and delivery time from 90 to 60 minutes.
  - 2. For concrete materials arriving at site with insufficient slump, the one time limited addition of water withheld at the ready-mix plant is permitted. Add up to 10 gallons of water per 9 yard truck to increase slump to specified limits. Water/cement ratio of concrete after one-time addition of water shall not exceed the water/cement ratio of the approved mix design. Such additions shall be clearly noted on the delivery ticket.

## PART 3 - EXECUTION

### 3.1 FORMS

- A. Design, erect, support, brace and maintain formwork according to ACI 301 to support vertical and lateral loads that might be applied until such loads can be supported by concrete structure. Construct formwork so concrete members and structures are of correct size, shape, alignment, elevation and position.
- B. Design formwork to be readily removable without impact, shock or damage to cast-in-place concrete surfaces and adjacent materials.
- C. Construct forms complying with ACI 117, to sizes, shapes, lines and dimensions shown, and to obtain accurate alignment, location, grades, level and plumb work in finished structures. Provide for openings, offsets, sinkages, keyways, recesses, moldings, rustications, reglets, chamfers, blocking, screeds, bulkheads, anchorages and inserts, and other features required in work. Use selected materials to obtain required finishes. Solidly butt joints and provide backup at joints to prevent leakage of cement paste.
- D. Provide temporary openings where interior area of formwork is inaccessible for cleanout for inspection before concrete placement, and for placement of concrete.
- E. Chamfer exposed corners and edges using wood, metal, PVC or rubber chamfer strips fabricated to produce uniform smooth lines and tight edge joints.
- F. Precaution: Do not build sleeves, conduits, outlet boxes, pipes into forms for joists or beams without prior approval of the Architect.
- G. Form Ties: Install ties to prevent form deflection, and to prevent spalling concrete surfaces upon removal.
- H. Provisions for Other Trades: Provide openings in concrete formwork to accommodate work of other trades. Determine size and location of openings, recesses and chases from trades providing such items. Accurately place and securely support items built into forms.
- I. Cleaning and Tightening: Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt or other debris just before concrete is placed. Retighten forms and bracing after concrete placement if required to eliminate mortar leaks and maintain proper alignment.

- J. Coat contact surfaces of forms with a form coating compound before reinforcement is placed.

3.2 PLACING REINFORCEMENT

- A. Comply with specified codes and standards, and comply with Concrete Reinforcing Steel Institute's Manual of Standard Practice for placing reinforcements.
- B. Clean reinforcement of loose rust and mill scale, earth, ice and other materials, which reduce or destroy bond with concrete.
- C. Accurately position, support and secure reinforcement against displacement by formwork, construction, or concrete placement operations before concrete is placed. Locate and support reinforcing by metal chairs, runners, bolsters, spacers, and hangers, as required. "Wet" placement of rebar is prohibited.
- D. Place reinforcement to obtain at least minimum coverages for concrete protection. Arrange, space and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.
- E. Concrete cover: Protect reinforcing by thickness of concrete indicated on drawings. Where not otherwise shown thickness over reinforcement shall be as follows:

Provide clear distance to outermost reinforcing as follows:

Concrete Cast Against Earth..... 3 inches

Concrete Exposed to Earth or Weather:

#5 or smaller .....	1-1/2 inches
#6 or Larger.....	2 inches

Other Concrete:

Slabs & Walls .....	3/4 inches
Beams & Columns .....	1-1/2 inches
Walls cast against lagging .....	1-1/2 inches to outer face

Concrete for Parking Levels:

Slabs and Beams – Top Cover.....	2 inches
Slabs – Bottom Cover .....	1 inch
Beams – Bottom and Side Cover.....	1-1/2 inches

- F. Epoxy-Coated Reinforcement: Provide epoxy coated reinforcing at locations as indicated on the Structural Notes and Structural Drawings. Use epoxy-coated steel wire ties to fasten epoxy-coated reinforcement. Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D 3963/D 3963M.
- G. In Slabs-on-Grade: Place reinforcing in top 1/3 of depth unless otherwise noted.

- H. Install welded wire fabric in as long lengths as practicable. Lap adjoining pieces at least one full mesh and lace splices with wire. Offset end laps in adjacent widths to prevent continuous laps in either direction.
- I. At construction joints, no reinforcing steel shall terminate within 60 diameters of joint; provide additional reinforcement as shown on drawings.
- J. Splice Limitations: Make no splices in reinforcement, except as shown on drawings or authorized by Structural Engineer. Lap approved splices in continuous reinforcing minimum of 40 diameters, unless noted otherwise. In slabs, beams, and girders, do not splice reinforcement at points of maximum stress. At slabs and walls where bars lap or splice, stagger splices in adjacent bars. Lap splices in columns, piers, struts, sufficiently to transfer full stress by concrete bond.

### 3.3 JOINTS

- A. Construction Joints - Supported Concrete: Locate and install construction joints as indicated or, if not indicated, so as not to impair strength and appearance of the structure, as acceptable to Architect. Generally, construction joints shall be placed at 1/3 span for concrete slabs and beams.
- B. Construction and Control Joints - Walls and Slab on Grade: Locate and install as indicated or, if not indicated, so as not to impair the strength and appearance of the structure, as acceptable by the Architect.
- C. Contraction (Control) Joints in Slabs-on-Ground: Construct contraction joints in slabs-on-ground to form panels of patterns as shown. Use saw cuts 1/8 inch wide by 1/4 slab depth or inserts 1/4 inch wide by 1/4 of slab depth, unless otherwise indicated. Saw cutting of joints shall be made as soon as possible after slab finishing as may be safely done without dislodging aggregate.
- D. Place construction joints perpendicular to the main reinforcement. Continue reinforcement across construction joints.
- E. Provide keyways at least 1-1/2" deep in construction joints in walls, slabs and between walls and footings.

### 3.4 INSTALLATION OF EMBEDDED ITEMS

- A. General: Set and build into work anchorage devices and other embedded items required for other work that is attached to, or supported by, cast-in-place concrete. Use setting drawings, diagrams, instructions and directions provided by suppliers of items to be attached thereto.
- B. Edge Forms and Screed Strips for Slabs: Set edge forms or bulkheads and intermediate screed strips for slabs to obtain required elevations and contours in finished slab surface. Provide and secure units sufficiently strong to support types of screed strips by use of strike-off templates or accepted compacting type screeds.
- C. Dovetail Slots: Install dovetail slots vertically for anchoring masonry facing. Build dovetail slots into forms for embedment in concrete that is to be faced or abutted with another material. Space vertically at 24" for beams and walls. Install slots on vertical surfaces over 16" high to be faced. Provide vertical slot in concrete wall or column for each abutting masonry partition.

### 3.5 CONCRETE PLACEMENT

- A. Preplacement Inspection: Before placing concrete, inspect and complete the formwork installation, reinforcing steel and items to be embedded or cast-in. Notify other crafts to permit the installation of their work; cooperate with other trades in setting such work, as required. Clean all formwork of excess water and miscellaneous debris. Thoroughly wet wood form immediately before placing concrete as required where form coatings are not used.
- B. Coordinate the installation of joint materials and moisture barriers with placement of forms and reinforcing steel.
- C. General: Comply with ACI 304 and as herein specified.
- D. Deposit concrete continuously or in layers of such thickness that no concrete will be placed on concrete which has hardened sufficiently to cause the formation of seams or planes of weakness within the section. If a section cannot be placed continuously, provide construction joints as herein specified. Deposit concrete as nearly as practicable to its final location to avoid segregation due to rehandling or flowing.
- E. Placing Concrete in Forms: Deposit concrete in forms in horizontal layers not deeper than 24" and in a manner to avoid inclined construction joints. Where placement consists of several layers, place each layer while preceding layer is still plastic to avoid cold joints.
- F. Consolidate placed concrete by mechanical vibrating equipment supplemented by hand-spacing, rodding or tamping. Use equipment and procedures for consolidation of concrete in accordance with the recommended practices of ACI, to suit the type of concrete and project conditions.
- G. Do not use vibrators to transport concrete inside of forms. Insert and withdraw vibrators vertically at uniformly spaced locations not farther than the visible effectiveness of the machine. Place vibrators to rapidly penetrate the placed layer of concrete and at least 6" into the preceding layer. Do not insert vibrators into lower layers of concrete that have begun to set. At each insertion, limit the duration of vibration to the time necessary to consolidate the concrete and complete embedment of reinforcement and other embedded items without causing segregation of the mix.
- H. Placing Concrete Slabs: Deposit and consolidate concrete slabs in a continuous operation, within the limits of construction joints, until the placing of a panel or section is completed.
- I. Consolidate concrete during placing operations so that concrete is thoroughly worked around reinforcement and other embedded items and into corners.
- J. Bring slab surfaces to the correct level with a straightedge and strikeoff. Use bull floats or darbies to smooth the surface, leaving it free of humps or hollows. Do not sprinkle water on the plastic surface. Do not disturb the slab surfaces prior to beginning finishing operations.
- K. Maintain reinforcing in the proper position during concrete placement operations.
- L. Cold Weather Placing: Protect concrete work from physical damage or reduced strength which could be caused by frost, freezing actions, or low temperatures, in compliance with ACI 306 and as herein specified. When air temperature has fallen to or is expected to fall below 40 degrees F, uniformly heat all water and aggregates before mixing as required to obtain a concrete mixture temperature of not less than 50 degrees F and not more than 80 degrees F at point of placement.

- M. Hot Weather Placing: When hot weather conditions exist that would seriously impair the quality and strength of concrete, place concrete in compliance with ACI 305 and as herein specified. Cool ingredients before mixing to maintain concrete temperature at time of placement below 90 degrees F. Mixing water may be chilled, or chopped ice may be used to control the concrete temperature provided the water equivalent of the ice is calculated to the total amount of mixing water. Cover reinforcing steel with water-soaked burlap if it becomes too hot, so that the steel temperature will not exceed the ambient air temperatures immediately before embedment in concrete. Wet forms thoroughly before placing concrete. Do not use retarding admixtures unless accepted in mix designs.

### 3.6 FINISH OF FORMED SURFACES

- A. Rough Form Finish: For formed concrete surfaces not exposed- to-view in the finish work or by other construction unless otherwise indicated. This is the concrete surface having the texture imparted by the form facing material used, with tie holes and defective areas repaired and patched and fins and other projections exceeding 1/4" in height rubbed down or chipped off.
- B. Smooth Form Finish: For formed concrete surfaces exposed-to- view, or that are to be covered with a coating or covering material applied directly to the concrete, or a covering material applied directly to the concrete, such as waterproofing, damp proofing, painting or other similar system. This is the as-cast concrete surface as obtained with selected form facing material, arranged orderly and symmetrically with a minimum of seams. Repair and patch defective areas with all fins or other projections completely removed and smoothed.
- C. Related Unformed Surfaces: At top of walls, horizontal offsets and similar unformed surfaces occurring adjacent to formed surfaces, strike-off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise shown.

### 3.7 MONOLITHIC SLAB FINISHES

- A. General: Comply with recommendations in ACI 302.1R for screeding, reststraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Float Finish: Apply float finish to monolithic slab surfaces that are to receive trowel finish and other finishes as hereinafter specified and slab surfaces which are to be covered with membrane or elastic waterproofing, membrane or elastic roofing, or sand-bed terrazzo and as otherwise indicated.
1. After screeding and consolidating and leveling concrete slabs, do not work surface until ready for floating. Begin floating using float blades or float shoes only when surface water has disappeared or when concrete has stiffened sufficiently to permit operation of power driven floats, or both. Consolidate surface with power- driven floats, or by hand-floating if area is small or inaccessible to power units. Cut down high spots and fill low spots. Uniformly slope surfaces to drain, if applicable. Immediately after leveling, refloat surface to a uniform, smooth, granular texture.
- C. Trowel Finish: Apply trowel to monolithic slab surfaces to be exposed-to-view, and slab surfaces to be covered with resilient flooring, carpet, ceramic or quarry tile, paint or other thin film finish coating system.

1. After floating begin first trowel finish operation using a power-driven trowel. Begin final trowelling when surface produces a ringing sound as trowel is moved over surface. Consolidate concrete surface by final hand-troweling operation, free of trowel marks, uniform in texture and appearance.
- D. Trowel and Fine Broom Finish: Where ceramic or stone is to be installed with thin-set mortar, apply trowel finish as specified, then immediately follow with slightly scarifying surface by fine brooming.
- E. Non-Slip Broom Finish: Apply non-slip broom finish to exterior concrete platforms, steps and ramps and elsewhere as indicated. Immediately after trowel finishing, slightly roughen concrete surface by brooming with fiber bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.
- F. Scratch Finish: Level to  $F_f15/F_L13$  tolerance with minimum local tolerance of  $F_f13/F_L10$ , roughen surface with stiff brushes or rakes before final set.
  1. Locations: Slabs to receive thick set mortar beds and other similar bonded cementitious finish flooring materials over 1 inch in thickness.
- G. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- H. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates of manufacturer furnishing machines and equipment.

### 3.8 FLOOR SLAB TOLERANCE

- A. Floor Slab Tolerance: measured within 48 hours according to ASTM E 1155/E 1155M for a randomly trafficked floor surface. After final troweling operation, slabs shall have a surface flatness ( $F_f$ ) / levelness ( $F_l$ ) tolerance conforming to 25 / 20 minimum overall for composite of all measured values and 18 / 13 for any individual floor section. Unshored elevated slabs shall conform to  $F_f$  20 for any individual floor section. For post-tensioned slabs, floor flatness may be measured prior to stressing the post-tensioned reinforcing strands. Retail floors shall have a surface flatness ( $F_f$ ) conforming to 50 minimum overall for composite of all measured values.

### 3.9 CONCRETE CURING AND PROTECTION

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperature and maintain without drying at a relatively constant temperature for a period of time necessary for hydration of cement and proper hardening. Start curing as soon as free water has disappeared from concrete surface after placing and finishing. Continue curing for at least 7 days in accordance with ACI 301 procedures. Avoid rapid drying at end of curing period.
- B. Curing shall be by application of the specified membrane-forming curing and sealing compound, the specified dissipating resin curing compound or by application of waterproof sheet materials conforming to ASTM C 171-80.

- C. Liquid membrane-forming curing and sealing compounds shall be applied in accordance with the manufacturer's recommendations. Interior slabs with resilient tile, carpet or left exposed and all exterior slabs, sidewalks, curbs, etc. shall be cured with the specified membrane-forming curing and sealing compound.
- D. Any membrane-forming curing and sealing compound used in floor slabs receiving applied finish flooring shall be guaranteed by the manufacturer, in writing, not to impair bonding of adhesive.
- E. For slabs, which are to receive terrazzo, bonded cementitious materials, epoxy or urethane coatings, liquid floor hardener, or waterproofing, use a curing treatment of moisture-retaining covers or the specified dissipating resin curing compound.
- F. The curing compounds must be applied immediately after final finishing. For curing by the waterproof sheet material, the concrete must be continually moist-cured for a minimum of 7 days. The curing process must begin immediately after final finishing.
- G. Provide Moisture-Cover Curing As Follows: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width with sides and ends lapped at least 3" and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
- H. Provide Membrane Curing to Slabs As Follows: Apply membrane-forming curing and sealing compound or dissipating resin curing compound to concrete surfaces within 2 hours of final finishing operations. Apply uniformly in continuous operation by power-spray or roller in accordance with manufacturer's directions. Recoat areas which are subjected to heavy rainfall within 3 hours after initial application. Maintain continuity of coating and repair damage during curing period.
- I. Curing Formed Surfaces: Cure formed concrete surfaces, including undersides of beams, supported slabs and other similar surfaces by moist curing with forms in place for full curing period or until forms are removed. If forms are removed, continue curing by methods specified above, as applicable.
- J. Sealer and Dustproofer: Apply a second coat of specified membrane-forming curing and sealing compound only to surface indicated to receive sealer-dustproofer finish.

### 3.10 SHORES AND RESHORES

- A. Comply with reshores ACI 318, ACI 347R (ACI 318M) ACI 301 and recommendations for shoring and reshoring in multistory construction, and as herein specified.
- B. Extend shoring from ground to roof for structures 4 stories or less, unless otherwise permitted.
- C. Extend shoring at least 4 floors under floor or roof being placed for structures over 4 stories. Shore floor directly under floor or roof being placed, so that loads from construction above will transfer directly to these shores. Space shoring in stories below this level in such a manner that no floor or member will be excessively loaded or will induce tensile stress in concrete members where no reinforcing steel is provided. Extend shores beyond minimums to ensure proper distribution of loads throughout structure.
- D. Remove shores and reshore in a planned sequence to avoid damage to partially cured concrete. Locate and provide adequate reshoring to safely support work without excessive stress or deflection.

- E. Keep reshores in place a minimum of 15 days after placing upper tier, and longer if required, until concrete has attained its required 28-day strength and heavy loads due to construction operations have been removed.

### 3.11 REMOVAL OF FORMS

- A. Formwork not supporting weight of concrete, such as sides of beams, walls, columns, and similar parts of the work, may be removed after cumulatively curing at not less than 50 degrees F for 24 hours after placing concrete, provided concrete is sufficiently hard to not be damaged by form removal operations, and provide curing and protection operations are maintained.
- B. Formwork supporting weight of concrete, such as beam soffits, joists, slabs, and other structural elements may not be removed in less than 7 days and then only if reshores are employed. Reshore simultaneously with stripping to distribute construction loads safely to three or more floors below, or to ground. Perform reshoring to permit early form removal so that at no time will large areas of new construction be required to support its own weight. All reshores under cantilever slabs or beam construction to remain in place at least 28 days after concrete is poured. Determine potential compressive strength of in-place concrete by testing field-cured specimens representative of concrete location of members.

### 3.12 MISCELLANEOUS

- A. Filling-In: Fill in holes and openings left in concrete structures for passage of work by other trades, unless otherwise shown or directed, after work of other trades is in place. Mix, place and cure concrete as herein specified, to blend with in-place construction. Provide other miscellaneous concrete filling shown or required to complete work.
- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates of manufacturer furnishing machines and equipment.
- D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items. Cast-in inserts and accessories as shown on Drawings. Scree, tamp, and trowel-finish concrete surfaces.

### 3.13 CONCRETE SURFACE REPAIRS

- A. Patching Defective Areas: Repair and patch defective areas with cement mortar immediately after removal of forms, when acceptable to Architect.
- B. Cut out honeycomb, rock pockets, voids over 1/2" in any dimension, and holes left by tie rods and bolts, down to solid concrete but in no case to a depth of less than 1". Make edges of cuts perpendicular to the concrete surface. Thoroughly clean, dampen with water and brush-coat the area to be patched with specified bonding agent. Place patching mortar after bonding compound has dried.

- C. Repair of Formed Surfaces: Remove and replace concrete having defective surfaces if defect cannot be repaired to satisfaction of Architect. Surface defects as such include color and texture irregularities, cracks, spalls, air bubbles, honeycomb, rock pockets; fins and other projections on surface; and stains and other discolorations that cannot be removed by cleaning. Flush out form tie holes, fill with dry pack mortar.
- D. Repair of Unformed Surfaces: Test unformed surfaces, such as monolithic slabs, for smoothness and verify surface plane to tolerances specified for each surface and finish.
- E. Repair defective area, except random cracks and single holes not exceeding 1" diameter, by cutting out and replacing with fresh concrete. Remove defective areas to sound concrete with clean, square cuts and expose reinforcing steel with at least 3/4" clearance all around. Dampen concrete surfaces in concrete with patching concrete and apply bonding compound. Mix patching concrete of same materials to provide concrete of same type or class as original concrete. Place, compact and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
- F. Repair isolated random cracks and single holes not over 1" in diameter by dry-pack method. Groove top of cracks and cut out holes to sound concrete and clean of dust, dirt and loose particles. Dampen cleaned concrete surfaces and apply bonding compound. Mix dry-pack, consisting of one part Portland cement to 2-1/2 parts fine aggregate passing a No. 16 mesh sieve, using only enough water as required for handling and placing. Place dry pack after bonding compound has dried. Compact dry-pack mixture in place and finish to match adjacent concrete. Keep patched area continuously moist for not less than 72 hours.

## PART 4 - QUALITY CONTROL

### 4.1 TESTING DURING CONSTRUCTION

- A. The Owner will employ a testing laboratory to perform tests and to submit test results.
- B. Sampling and testing for quality control during placement of concrete shall include the following.
  - 1. Sampling Fresh Concrete: ASTM C172, except modified for slump to comply with ASTM C94.
  - 2. Slump: ASTM C143; up to one test for each concrete load at point of discharge; and one test for each set of compressive strength test specimens.
  - 3. Air Content: ASTM C173, volumetric method for lightweight or normal weight concrete; ASTM C231 pressure for normal weight concrete; one for each set of compressive strength test specimens.
  - 4. Concrete Temperature: Test hourly when air temperature is 40 degrees F and below, and when 80 degrees F and above; and each time a set of compression test specimens made.
  - 5. Compression Test Specimen: ASTM C31, one set of 6 standard 6" x 12" cylinders for each strength test, minimum. Alternately, one set of nine (9) 4" x 8" cylinders for each strength test, minimum.
  - 6. Compressive Strength Tests: ASTM C39, one set for each 75 cu. yds. or fraction thereof, of each concrete class placed in any one day or for each 5,000 sq. ft. of surface area placed; two specimens tested at 7 days, two specimens at 28 days and two specimens retained in reserve for later testing if required. If 4" x 8" cylinders are used instead of 6" x 9" cylinders, increase testing of specimens to three specimens tested at 7 days, three specimens at 28 days and three specimens retained in reserve for later testing if required. Additional cylinders shall be formed as required for early stripping by the Contractor.

- C. Test Results will be reported in writing to Architect, Structural Engineer and Contractor within three working days that tests are made. Reports of compressive strength tests shall contain the project identification, date of concrete placement, name of concrete testing service, concrete type and class, location of concrete batch in structure, design compressive strength at 28 days, concrete mix proportions and materials; compressive breaking strength and type of break for both 7-day and 28- day tests.
- D. Additional Tests: The testing service will make additional tests of in-place concrete when test results indicate specified concrete strengths and other characteristics have not been attained in the structure, as directed by Architect. Testing service may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42, or by other methods as directed. Contractor shall pay for such tests conducted, any other additional testing as may be required, and extra engineering and architectural services related to evaluating the problem and developing an acceptable solution.
- E. The contractor shall be responsible for scheduling with the testing laboratory, and shall provide free access for its personnel and labor required in helping to obtain and handle samples of concrete.

END OF SECTION 03 30 00

## SECTION 03 38 00 - POST-TENSIONED CONCRETE

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

#### 1.2 SUMMARY

- A. Provide labor, materials, equipment and services necessary for and reasonably incidental to the completion of post-tensioned concrete work.
- B. Reinforcing and related accessories for post-tensioning cast-in-place concrete.
- C. Jacks and related equipment for stressing tendons.
- D. All anchors, couplers, chairs and slab bolsters required to hold the strand in true position.
- E. Support steel and back-up bars, consisting of mild reinforcing steel, as indicated on the drawings, placed on chairs furnished by others.

#### 1.3 REFERENCES

- A. Reference Standards: At minimum, comply with the following:
  - 1. ACI 318 - "Building Code Requirements for Reinforced Concrete"
  - 2. PTI - "Specification for Unbonded Single Strand Tendons"
  - 3. PTI - "Guide Specifications for Post-Tensioning Materials"
  - 4. ACI 423.3 "Recommendations for Concrete Members Prestressed with Unbonded Tendons"

#### 1.4 SUBMITTALS

- A. Shop Drawings: Shop drawings shall be submitted for review showing complete details of post-tensioned members including construction joint layout, pour sequencing, arrangement of strand, number of strands, methods of maintaining alignment, type of post-tensioning enclosures, detailing of anchorage devices, calculations of friction and anchorage devices, calculations of friction and anchorage stresses, calculated elongation records, jacking forces and associated gauge pressure, size of jacking pockets and other incidental features.
  - 1. No fabrication shall proceed until the shop drawings are approved. Approval of shop drawings will be for size and arrangement only, and shall in no way remove responsibility of the post-tensioning supplier from his design, detailing and fabrication requirements.

- B. Calculations: The post-tensioned strand supplier shall submit calculations and shop drawings certified by a professional engineer registered in the state of the project for all members or elements provided by the supplier.
- C. Tests
  - 1. Mill tests for post-tensioning strand along with the location used shall be submitted to the Contractor at the time of shipment.
  - 2. A certified calibration curve shall accompany each stressing jack. If inconsistencies between the measured elongation and gauge reading occur in excess of 5 percent the jack gauges shall be recalibrated by the supplier.
  - 3. Provide an ICBO approval or data from an independent testing firm showing the post-tensioning system anchorages meet the static and dynamic tests required in ACI 423.
  - 4. Proof of plant certification for tendons shall accompany each tendon shipment to the jobsite.
- D. Construction Sequence: Construction joints and stressing sequence procedures shall be provided by the strand supplier for approval by the Contractor.

## 1.5 QUALITY ASSURANCE

- A. Post-tensioning Systems: Systems shall be provided by manufacturers certified by the Post-Tensioning Institute only.
- B. Technical Assistance: Furnish all necessary technical assistance to ensure the placement and stressing of the strands is in accordance with manufacturer's recommendations.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Sheathing
  - 1. All post-tensioning strands shall be greased and wrapped with an approved slippage sheathing designed for an ungrouted system. The sheathing shall consist of a flexible tube of plastic wrapping impervious to cement paste. The plastic shall be of suitable strength and durability to prevent rupture due to temperature changes and normal handling.
  - 2. Polyethylene adhesive tape, split sheathing and grease shall be provided for field use to protect the exposed tendons at anchors and to repair damaged sheathing.
  - 3. Minimum thickness of the sheathing shall not be less than 0.040 inches for medium or high density polyethylene on polypropylene.
  - 4. The sheathing shall have an inside diameter at least 0.010 inches greater than maximum strand diameter.
  - 5. The sheathing shall be connected to all stressing, intermediate and fixed anchorages in a watertight fashion. All fixed ends shall be fully connected prior to delivery to the jobsite.
- B. Anchorages and Couplings:

1. Anchoring hardware shall meet the requirements set forth in the recommendations of the Post-Tensioning Institute, "Guide Specifications for Post-Tensioning Materials" and ACI 318. Anchors shall be designed at transfer to provide a maximum concrete bearing stress of 2,500 psi under the anchor plate.
2. Size of bearing plates shall be in accordance with ACI 318 unless certified test reports from an independent testing lab are submitted and approved by the Contractor.
3. End stressing pocket formers shall be plastic or other easily removable material and shall conform to the true edge configuration. Tapered pocket formers are required at angled slab edges. Blockouts in slabs are not allowed without prior approval of the Contractor.
4. Couplings shall be used only at locations specifically indicated on the contract documents or as approved.
5. Minimum concrete cover for anchorages shall not be less than the minimum reinforcement cover noted on the drawings.
6. Anchorages shall include design features permitting watertight connection of the sheathing to the anchorage, and watertight closing of the wedge cavity, for stressing and non-stressing anchorages. Intermediate stressing anchorages shall be designed to permit complete watertight encapsulation of the prestressing steel.

C. Post-Tensioning Strand:

1. Post-Tensioning strand size and end anchorage size shall be selected by the supplier and submitted to the Contractor for review and approval. The post-tensioning tendons shall be fabricated at and shipped from a plant that is currently certified by the Post-Tensioning Institute.
2. Strands shall conform to "Standard Specification for Steel Strand, Uncoated Seven-Wire for Prestressed Concrete", ASTM A-416, Grade 270,  $\frac{1}{2}$  diameter tendon area .153 in<sup>2</sup>.
3. All bolsters and chairs are to have unturned legs to allow for stapling to the deck.
4. Bolsters and chairs shall be plastic coated, epoxy coated or corrosion resistant, in slabs exposed to corrosive atmosphere.
5. Maximum spacing of slab strand shall be 8 times the thickness of the slab but not greater than 60" except where otherwise noted on the drawings.
6. Suitable horizontal and vertical support chairs and bolsters shall be provided to hold the strand in true position. In slabs, all supports shall be placed at 36" maximum spacing or chosen so as to properly support the strand tendon in the required profile.
7. All strands shall be coated to protect them from rust or other corrosion.
8. Stressing Jacks: Provide a minimum of three (3) hydraulic jacks, in new or like new condition, for use in stressing the strand. Each jack is to be equipped with calibrated gauges and certified calibration curves.
9. Grout for Post-tensioned End Anchors: Non-metallic, non-shrink grout which may be poured or damp-packed. Grout shall have a minimum compressive strength of 5,000 psi in seven days. Grout containing chlorides will not be permitted.

## PART 3 - EXECUTION

### 3.1 DESIGN

- A. Design shall be in accordance with the requirements set forth in the "Recommendations for Concrete Members Prestressed With Unbonded Tendons" ACI-423.3, ACI-318 and PTI "Specification for Unbonded Single Strand Tendons."

- B. Maximum stress in the strand anchorage shall not exceed 70 percent of the minimum guaranteed ultimate strength of the strand. Temporary stress shall not exceed 80 percent of the minimum guaranteed ultimate strength of the strand.
- C. The post-tensioning material supplier shall use friction coefficients of .0012 for wobble and .08 for curvature unless the supplier submits and the Contractor approves data to warrant a revision in these figures. These coefficients shall be used to determine stress loss and number of strands and submitted to the Contractor for review prior to commencing any work on the post-tensioning material.

### 3.2 STRESS LOSS

- A. The loss in stress in low relaxation post-tensioning strand due to elastic shortening, creep and shrinkage of the concrete, creep of steel and sequence stressing shall be assumed to be 15,000 psi for slabs and 20,000 for beams unless the supplier submits and the Contractor approves data to warrant a change in this figure. Other losses to be provided for shall include but not be limited to relaxation losses, friction losses, etc., and shall be based on tests of representative samples of materials. If stress relieved strand is used as an equivalent, the losses shall be assumed to be 30,000 psi for slabs and 35,000 psi for beams.
- B. Tests shall be conducted in accordance with PTI “Specification for Unbonded Single Strand Tendons,” ASTM A-416, and ASTM E-328.
- C. Forces shown are minimum effective after all losses, at any point within the tendon. In translating forces to number of tendons no rounding down in the quantity of tendons will be permitted.
- D. The maximum allowable tensile stress shall not exceed 189KSI before losses at the dead end anchor nor after seating at the stressing anchor. The strand at any intermediate location, after seating, shall not exceed 200 KSI.

### 3.3 INSTALLATION

- A. Technical Assistance: Installer shall notify post-tensioning supplier to ensure that adequate and timely technical assistance is provided to ensure placement and stressing per the manufacturer's requirements.
- B. Workmanship: The work shall be performed by workers who have successfully performed previous post-tensioning installation of a similar nature.
- C. Post-Tensioning Strand Placement:
  1. Slab bolsters shall be used to support the strand when the center of gravity of the strand is 2" or less to the bottom of the slab.
  2. Broken strands or strands showing defects shall be removed and replaced at the post-tensioning supplier's sole cost.
  3. Post-tensioning strand shall have a parabolic profile and shall conform to the control points shown on the drawings. Dimensions locating the profile apply to the center of gravity of the strand. Low points of the strand are at mid-span unless otherwise noted on the drawings.
  4. All bolsters and chairs are to be stapled securely to the formwork as required to hold strand in position to the satisfaction of the Contractor.

5. In placing the strands and anchorages care must be taken to insure the plastic sheathing is not damaged or removed from the anchors. In corrosive environments, all damaged areas to the sheathing and all exposed tendons at the anchors shall be greased and spirally wrapped with a double layer of polyethylene adhesive tape to prevent bonding of the strand to the concrete.
6. All strands must be placed uniformly, straight, without slack, and reverse curvature within the tolerance of ACI 318. Strands shall be firmly supported to prevent displacement during subsequent operations.
7. After installing the tendons and prior to concrete casting, the sheathing shall be inspected for possible damage.
8. All stressing and intermediate anchorages shall be connected to the sheathing in a watertight fashion in the field.
9. In corrosive environments corrosion protection devices shall be installed over the stressing end after cutting of tendons and installed at intermediate anchorages immediately after stressing.

D. Tensioning:

1. Stressing jacks and gauges shall be individually identified and calibrated against known standards at intervals not exceeding 6 months.
2. Tensioning should commence as soon as the concrete strength reaches the required strength noted on the drawings. If, within 96 hours after placing, this strength has not been reached, notify the Contractor.
3. The post-tensioning steel shall be stressed and anchored in accordance with the post-tensioning shop drawings.
4. Grouting End Anchors: The Contractor shall grout all exposed post-tensioned strand end anchors. All anchors shall be protected by applying an asphaltic base coat or mastic prior to grouting.
5. Storage of Materials: No material shall be stored on slabs without the Contractor's approval. Protect all material from damage.

E. Elongation Records:

1. Post-tensioning records of the actual field elongation and gauge pressures applied to each strand shall be kept. Copies of the actual field records shall be submitted to the Contractor promptly upon completion of each member or slab. These records shall be taken and submitted by an independent testing and inspection firm retained by the Contractor.
2. At the time of stressing the first member of each type, the individual strand shall be checked to establish a procedure for insuring uniform results. At any time a rechecked may be required by the Contractor, if it appears that the designed stress are not being obtained.
3. No cutting or covering of strand ends shall be permitted until elongation records have been approved by the Contractor.

#### PART 4 - QUALITY CONTROL TESTING DURING CONSTRUCTION

- A. The Owner will employ a testing laboratory to perform inspections of the post-tension system to verify the installed work conforms with the approved shop drawings and shall inspect the jacking process. The testing agency shall submit inspection reports to the Owner, General Contractor, Sub-Contractor, Architect, Structural Engineer, and County.
- B. Test Results will be reported in writing to Architect, Structural Engineer and Contractor within three working days that tests are made.

- C. The contractor shall be responsible for scheduling with the testing laboratory, and shall provide free access for its personnel and labor required in helping to obtain and handle samples of concrete.

END OF SECTION 03 38 00

## SECTION 03 45 00 - PRECAST ARCHITECTURAL CONCRETE

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Cast stone masonry for sills, parapet caps and copings.
- B. Supports, anchors, and attachments.
- C. Grouting under panels.

#### 1.2 RELATED REQUIREMENTS

- A. Section 07 21 19 - Foamed in Place Insulation
- B. Section 07 62 00 - Sheet Metal Flashing and Trim: Flashing of barrier walls at perimeters.
- C. Section 07 92 00 - Joint Sealants: Sealing perimeter and intermediate joints.

#### 1.3 REFERENCE STANDARDS

- A. ACI 301 - Specifications for Structural Concrete 2016.
- B. ACI 318 - Building Code Requirements for Structural Concrete 2019, with Errata (2021).
- C. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength 2021.
- D. ASTM A563 - Standard Specification for Carbon and Alloy Steel Nuts 2021a.
- E. ASTM A563M - Standard Specification for Carbon and Alloy Steel Nuts (Metric) 2021a.
- F. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement 2020.
- G. ASTM A775/A775M - Standard Specification for Epoxy-Coated Steel Reinforcing Bars 2019.
- H. ASTM C1602/C1602M - Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete 2012.
- I. ASTM C260/C260M - Standard Specification for Air-Entraining Admixtures for Concrete 2010a (Reapproved 2016).
- J. ASTM C642 - Standard Test Method for Density, Absorption, and Voids in Hardened Concrete 2013.
- K. ASTM C979/C979M - Standard Specification for Pigments for Integrally Colored Concrete 2016.
- L. ASTM D3963/D3963M - Standard Specification for Fabrication and Jobsite Handling of Epoxy-Coated Steel Reinforcing Bars 2021.

- M. IAS AC157 - Accreditation Criteria for Fabricator Inspection Programs for Reinforced and Precast/Prestressed Concrete 2017.
- N. PCI MNL-117 - Manual for Quality Control for Plants and Production of Architectural Precast Concrete Products 2013.
- O. PCI MNL-120 - PCI Design Handbook - Precast and Prestressed Concrete 2017.
- P. PCI MNL-122 - Architectural Precast Concrete 2007.
- Q. PCI MNL-123 - Design and Typical Details of Connections for Precast and Prestressed Concrete 1988.
- R. PCI MNL-135 - Tolerance Manual for Precast and Prestressed Concrete Construction 2000.

#### 1.4 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene one week prior to commencing work of this section.

#### 1.5 PERFORMANCE REQUIREMENTS

- A. Design Loads: Static loads, anticipated dynamic loading, including positive and negative wind loads, thermal movement loads, and erection forces as defined by applicable code.
- B. Calculate structural properties of units in accordance with ACI 318 and design load requirements provided on the structural drawings.
- C. Other Cementitious Materials: Replace as much Portland cement as possible with fly ash, ground granulated blast furnace slag, silica fume, or rice hull ash as is consistent with strength and appearance requirements.
- D. Accommodate construction tolerances, deflection of building structural members, and clearances of intended openings.

#### 1.6 SUBMITTALS

- A. See Section 01 33 00 for general submittal procedures.
- B. Product Data: Manufacturer's information on accessory products, including pigments, admixtures, inserts, plates, etc.
- C. Shop Drawings: Indicate layout, unit locations, configuration, unit identification marks, reinforcement, integral insulation, insulated panel system connectors, connection details, support items, location of lifting devices, dimensions, openings, and relationship to adjacent materials. Provide erection drawings.
  - 1. Include details of mix designs.
  - 2. Include structural design calculations.
  - 3. Indicate welded connections. Detail loose and cast-in hardware.

4. Indicate locations, details, and dimensional tolerances of anchorage devices to be embedded in or attached to the structure or other construction.
- D. Mix Design: Submit proposed concrete mix design.
1. Indicate proposed mix design complies with requirements of ACI 301, Section 4 - Concrete Mixtures.
  2. Indicate proposed mix design complies with requirements of ACI 318, Chapter 5 - Concrete Quality, Mixing and Placing.
  3. Indicate proposed mix design complies with fiber reinforcing manufacturer's written recommendations.
- E. Designer's Qualification Statement.
- F. Fabricator's Qualification Statement: Provide documentation showing precast concrete fabricator is accredited under IAS AC157.
- G. Fabrication Test Reports: Provide fabrication test reports.
- H. Maintenance Data: Indicate surface cleaning instructions.

## 1.7 QUALITY ASSURANCE

- A. Fabricator Qualifications:
1. Firm having at least 10 years of documented successful experience in production of precast concrete of the type required.
  2. Plant certified under Architectural Precast Association Plant Certification Program for production of architectural precast concrete.
  3. Fabricator Qualifications: Precast concrete fabricator accredited by IAS according to IAS AC157.
  4. Provide certification that manufacturing procedures and testing requirements, quality-control recommendations and inspection procedures, comply with PCI MNL 117 "Manual for Quality Control for Plants and Production of Architectural Precast Concrete Products."
  5. Fabricator shall engage an independent testing agency for purposes of determining suitability of materials to be used in the work and providing precast architectural concrete production quality control.

## 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Handling: Lift and support precast units only from support points.
- B. Blocking and Lateral Support During Transport and Storage: Use materials that are clean, non-staining, and non-harmful to exposed surfaces. Provide temporary lateral support to prevent bowing and warping.

- C. Protect units to prevent staining, chipping, or spalling of concrete. Do not place units directly on the bare ground.
- D. Mark units with date of production in location that will be concealed after installation.

## PART 2 PRODUCTS

1. **Preliminary Basis-of-Design: Arban & Carosi:** provided architectural precast concrete designs with anchorage systems including inserts, dowels, and other connection devices.
2. Provide designed and produced by manufacturer/fabricator meeting quality control standards, and meeting or exceeding performance and aesthetic criteria specified.

### 2.2 PRECAST UNITS, GENERAL

- A. Precast Architectural Concrete Units: Comply with PCI MNL-120, PCI MNL-122, PCI MNL-123, PCI MNL-135, and ACI 318.
  1. Concrete: Minimum 5000 psi, 28 day strength, air entrained to 5 to 7 percent; comply with ACI 301.
  2. Design Loads: Static loads, anticipated dynamic loading, including positive and negative wind loads, thermal movement loads, and erection forces as defined by applicable code.
  3. Calculate structural properties of units in accordance with ACI 318.
  4. Accommodate construction tolerances, deflection of building structural members, and clearances of intended openings.
  5. Provide connections that accommodate building movement and thermal movement and adjust to misalignment of structure without unit distortion or damage.
  6. Finish Type A: Ensure exposed-to-view finish surfaces of precast units are uniform in color and appearance.

### 2.3 ARCHITECTURAL CAST STONE

- A. Cast Stone: Architectural concrete product manufactured to simulate appearance of natural stone, complying with ASTM C1364; Cast Stone Institute Standard Specification 04720-98.
  1. Compressive Strength: As specified in ASTM C1364; calculate strength of pieces to be field cut at 80 percent of uncut piece.
  2. Freeze-Thaw Resistance: Demonstrated by field experience.
  3. Shapes: Parapet caps, copings and sill units as indicated.
  4. Surface Texture: Fine grained texture, with no bugholes, air voids, or other surface blemishes visible from distance of 20 feet.
  5. Shapes: Provide shapes indicated on drawings.

- a. Variation from Any Dimension, Including Bow, Camber, and Twist: Maximum of plus/minus 1/8 inch or length divided by 360, whichever is greater, but not more than 1/4 inch.
  6. Unless otherwise indicated on drawings, provide:
    - a. Wash or slope of 1:12 on exterior horizontal surfaces.
    - b. Drips on projecting components, wherever possible.
    - c. Raised fillets at back of sills and at ends to be built in.
  7. Provide drips on underside if overhanging units.
  8. Color: Smokehouse Arban Precast 057A1 with sealer.
  9. Remove cement film from exposed surfaces before packaging for shipment.
- B. **Basis of Design:**
1. **Parapet and Precast Sills: RockCast Custom cast stone series as manufactured by Reading Rock Inc. or approved equal. Colors as indicated on the drawings.**
- C. Cast Stone Quality: Units with deficiencies listed in Cast Stone Institute Technical Bulletin No. 36 - Inspection and Acceptance for List of Deficiencies subject to rejection.
1. Excessive Crazing: Cause for rejection. Excessive crazing is defined as that which is visible from distance of 10 feet under dry and normal daylight conditions, similar to other visual and textural irregularities.
  2. Acceptance Criteria: Includes Section 10 of ASTM C1364.
- D. Maximum Color Variations: ASTM D2244.
1. Hue: Two percent.
  2. Lightness, Chroma, and Hue Combined: 6 percent.
- E. Tolerances: Dimension as indicated on Drawings. Fabricate and furnish to following tolerances:
1. Length or Width: Plus/minus 1/8 inch.
  2. Variation in Cross-sectional Dimension: Plus/minus 1/8 inch.
  3. End Deviation for Square or Designated Skew: Length divided by 360, 1/4 inch maximum.
  4. Bowing of Members: Length divided by 360, 3/8 inch maximum.
  5. Warpage of Members: Length divided by 360, 3/8 inch maximum.

- F. Protective Sealer: Provide a factory applied water repellent / sealer to cast stone units. **Basis of design is Protectosil Chem-Trete BSM 400.** Sealer shall be a clear odorless liquid containing pure alkyltrialkoxysilanes. Apply in accordance with manufacturer's written instruction.
- G. Source Quality Control for Architectural Cast Stone
  - 1. Test compressive strength and absorption of specimens selected at random from plant production.
    - a. Test in accordance with ASTM C642.
    - b. Select specimens at rate of 3 per 500 cubic feet, with a minimum of 3 per production week.
    - c. Submit reports of tests by independent testing agency, showing compliance with requirements.

## 2.4 REINFORCEMENT

- A. Reinforcing Steel: ASTM A615/A615M, Grade 40 (40,000 psi).
  - 1. Deformed billet-steel bars.
  - 2. Epoxy coated in accordance with ASTM A775/A775M.
- B. Steel Welded Wire Reinforcement (WWR): Class A epoxy coated, deformed type, ASTM A884/A884M.
  - 1. Form: Flat Sheets.
  - 2. WWR Style: 6 by 12-W12 by W5.

## 2.5 CONCRETE MATERIALS

- A. Cement: ASTM C150/C150M, Type I - Normal Portland type.
- B. Fine and Coarse Structural Aggregates: ASTM C33/C33M.
- C. Lightweight Structural Aggregate: ASTM C330/C330M.
- D. Surface Finish Aggregate: Clean, washed natural gravel; from single source throughout.
- E. Color Additives: Pure, concentrated mineral pigments specifically intended for mixing into concrete and complying with ASTM C979/C979M.
  - 1. Concentration: Base dosage rates on weight of Portland cement, fly ash, silica fume, and other cementitious materials but not aggregate or sand.
  - 2. Color(s): As indicated on drawings.
- F. Water: ASTM C1602/C1602M; clean, potable, and not detrimental to concrete.
- G. Fiber Reinforcement: Synthetic fiber shown to be resistant to long-term deterioration when exposed to moisture and alkalis; 1/2 inch length.

H. Air Entrainment Admixture: ASTM C260/C260M.

I. Grout:

1. Non-shrink, non-metallic, minimum 10,000 psi, 28 day strength.

## 2.6 FORM LINERS

A. Material: Acrylonitrile butadiene styrene.

## 2.7 SUPPORT DEVICES

A. Connecting and Support Devices; Anchors and Inserts: ASTM A36/A36M steel; hot-dip galvanized in accordance with ASTM A153/A153M.

1. Clean surfaces of rust, scale, grease, and foreign matter.
2. Prime paint in one coat, except surfaces in direct contact with concrete or requiring field welding.

B. Bolts, Nuts, and Washers: ASTM A307 heavy hex bolts, Type A, hot-dip galvanized, with matching ASTM A563 (ASTM A563M) nuts and matching washers.

C. Primer: Zinc rich type.

## 2.8 ACCESSORIES

A. Flashings: Provide stainless steel break metal closure flashings as specified in Section 07 62 00.

B. Membrane Flashing: Provide self-adhering membrane flashing as specified in Section 07 27 00.

C. Weeps/Vents: Provide polyester mesh similar to that specified for brick weeps in Section 04 20 00.

D. Sealant: Silicone, polyurethane, or silyl-terminated polyether/polyurethane or other type required or recommended by precast manufacturer.

E. Joint Filler: Closed cell neoprene sponge; oversized 50 percent to joint width; self expanding; in maximum lengths available; Hohmann & Barnard, Inc.

F. Bearing Pads: High density plastic; Shore A Durometer ; 1/8 inch thick, smooth both sides.

G. Shims: Stainless steel or interlocking high density plastic as recommended by precast manufacturer.

## 2.9 FABRICATION

A. Fabricate in compliance with PCI MNL-117 and PCI MNL-135.

B. Fabricate and handle epoxy-coated reinforcing bars in accordance with ASTM D3963/D3963M.

C. Maintain plant records and quality control program during production of precast units. Make records available upon request.

- D. Use rigid molds, constructed to maintain precast unit uniform in shape, size, and finish.
- E. Use form liners in accordance with manufacturer's instructions.
- F. Maintain consistent quality during manufacture.
- G. Fabricate connecting devices, plates, angles, items fit to steel framing members, inserts, bolts, and accessories. Fabricate to permit initial placement and final attachment.
- H. Embed reinforcing steel, anchors, inserts plates, angles, and other cast-in items.
- I. Provide cast-in reglets, slots, holes, and other accessories in precast architectural concrete units to receive windows, clamps, dowels, reglets, waterstops, flashings, scuppers, and other similar work as shown on the Drawings.
- J. Locate hoisting devices to permit removal after erection.
- K. Cure units to develop concrete quality, and to minimize appearance blemishes such as non-uniformity, staining, or surface cracking.
- L. Minor patching in plant is acceptable, providing structural adequacy and appearance of units is not impaired.

## 2.10 FABRICATION TOLERANCES

- A. Comply with PCI MNL-117 and PCI MNL-135, except as specifically amended below.
  - 1. Maximum Variation From Nominal Face Dimensions: Plus or minus 3/32 in.
  - 2. Maximum Variation From Square or Designated Skew: Plus or minus 1/8 inch in 10 feet.
  - 3. Maximum Variation from Thickness: Plus or minus 1/8 in.
  - 4. Maximum Misalignment of Anchors, Inserts, Openings: Plus or minus 1/8 inch.
  - 5. Maximum Bowing of Members: Plus or minus length/360.

## 2.11 SOURCE QUALITY CONTROL

- A. Test and inspect precast concrete according to PCI MNL-117 requirements and ACI 301.
- B. Testing: If there is evidence that the concrete strength of precast concrete units may be deficient or may not comply with ACI 318 requirements, Precaster will employ an independent testing agency to obtain, prepare, and test cores drilled from hardened concrete to determine compressive strength according to ASTM C 42/C42M
  - 1. A minimum of three representative cores will be taken from units of suspect strength, from locations directed by Architect.
  - 2. Cores will be tested in an air-dry condition.

3. Strength of concrete for each series of 3 cores will be considered satisfactory if the average compressive strength is equal to at least 85 percent of the 28-day design compressive strength and no single core is less than 75 percent of the 28-day design compressive strength.
  4. Take water absorption test in accordance with PCI MNL-117.
  5. Test results will be made in writing on the same day that tests are performed, with copies to Architect, Contractor, and precast concrete fabricator. Test reports will include the following:
    - a. Project identification name and number.
    - b. Date when tests were performed.
    - c. Name of precast concrete fabricator.
    - d. Name of concrete testing agency.
    - e. Identification letter, name, and type of precast concrete units or units represented by core tests; design compressive strength; type of break; compressive strength at breaks, corrected for length-diameter ratio; and direction of applied load to core in relation to horizontal plane of concrete as placed.
- C. Patching: If core test results are satisfactory and precast concrete units comply with requirements, clean and dampen core holes and solidly fill with precast concrete mix that has no coarse aggregate, and finish to match adjacent precast concrete surfaces.
- D. Defective Work: Architectural precast concrete units that do not comply with acceptability requirements in PCI MNL 117, including concrete strength, manufacturing tolerances, and color and texture range are unacceptable. The Architect reserves the right to reject any unit if it does not match the accepted samples and visual mock-up. Replace unacceptable units with precast concrete units that comply with requirements

### PART 3 EXECUTION

#### 3.1 EXAMINATION

- A. Verify that building structure, anchors, devices, and openings are ready to receive work of this section.

#### 3.2 PREPARATION

- A. Provide for erection procedures and induced loads during erection. Maintain temporary bracing in place until final support is provided.

#### 3.3 ERECTION

- A. Erect units without damage to shape or finish. Replace or repair damaged panels.
- B. Erect units level and plumb within allowable tolerances.
- C. Align and maintain uniform horizontal and vertical joints as erection progresses.

- D. When units require adjustment beyond design or tolerance criteria, discontinue affected work; advise Architect.
- E. Coordinate installation of cast stone units with installation of adjacent masonry.
- F. Provide non-combustible shields during welding operations.
- G. Touch-up scratched or damaged primed painted surfaces.
- H. Set vertical units dry, without grout, attaining joint dimension with lead or plastic spacers.
- I. Exposed Joint Dimension: Nominal 3/4 inch. Adjust units so that joint dimensions are within tolerances. Coordinate with sealant selection and joint dimension shown on the drawings.
- J. Field cutting of precast elements is not permitted without approval of the Architect.

### 3.4 TOLERANCES

- A. Erect members level and plumb within allowable tolerances. Comply with PCI MNL-135, except as specifically amended below.
  - 1. Plan Location from Building Grid Datum: Plus or minus 3/8 in.
  - 2. Top Elevation from Nominal Top Elevation: Plus or minus 3/8 inch.
  - 3. Maximum Plumb Variation Over Height of Structure or 100 ft (whichever is less): Plus or minus 1/2 inch.
  - 4. Exposed Joint Dimension: Plus or minus 3/16 inch.
  - 5. Maximum Jog in Alignment of Matching Faces or Edges: Plus or minus 3/16 inch.
  - 6. Differential Bowing or Camber as Erected Between Similar Adjacent Members: Plus or minus 3/16 inch.

### 3.5 REPAIRS AND CLEANING

- A. Clean mortar, weld slag, and any other deleterious material from concrete surfaces and adjacent materials immediately.
- B. Clean exposed surfaces of precast concrete units after erection and completion of joint treatment to remove residual weld marks, other markings, dirt, and stains.
  - 1. Perform cleaning procedures, if necessary, according to precast concrete fabricator's recommendations. Clean soiled precast concrete surfaces with detergent and water, using stiff fiber brushes and sponges, and rinse with clean water. Protect other work from staining or damage due to cleaning operations.
  - 2. Do not use cleaning materials or processes that could change the appearance of exposed concrete finishes or damage adjacent materials.

- C. Replace any unit which exhibits damage to surfaces, finish, corners, or edges due to shrinkage, transportation, handling, or erection;
- D. Repairs: Repair in place procedures may be completed upon specific approval of the Architect, providing repaired units match the visual mock-up. The Architect reserves the right to reject any repaired unit if it does not match the accepted samples and visual mock-up. Replace unacceptable units with new precast concrete units that comply with requirements

### 3.6 PROTECTION

- A. Protect installed precast units from subsequent construction operations.

END OF SECTION

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## SECTION 04 20 00 - UNIT MASONRY

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Concrete block.
- B. Concrete building brick.
- C. Mortar and grout.
- D. Reinforcement and anchorage.
- E. Flashings.
- F. Lintels.
- G. Accessories.

#### 1.2 RELATED REQUIREMENTS

- A. Section 03 45 00 - Precast Architectural Concrete: Precast stone units installed with masonry.
- B. Section 05 50 00 - Metal Fabrications: Loose steel lintels.
- C. Section 07 14 00 - Fluid Applied Waterproofing:
- D. Section 07 21 00 - Thermal Insulation: Insulation for cavity spaces.
- E. Section 07 62 00 - Sheet Metal Flashing and Trim: Through-wall masonry flashings.
- F. Section 07 91 00 - Preformed Joint Seals
- G. Section 07 92 00 - Joint Sealants: Sealing control and expansion joints.

#### 1.3 REFERENCE STANDARDS

- A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware 2016a.
- B. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement 2020.
- C. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar 2015.
- D. ASTM C55 - Standard Specification for Concrete Building Brick 2017.
- E. ASTM C90 - Standard Specification for Loadbearing Concrete Masonry Units 2016a.
- F. ASTM C91/C91M - Standard Specification for Masonry Cement 2018.

- G. ASTM C129 - Standard Specification for Nonloadbearing Concrete Masonry Units 2017.
- H. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar 2018.
- I. ASTM C150/C150M - Standard Specification for Portland Cement 2021.
- J. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes 2018.
- K. ASTM C270 - Standard Specification for Mortar for Unit Masonry 2019a.
- L. ASTM C404 - Standard Specification for Aggregates for Masonry Grout 2018.
- M. ASTM C476 - Standard Specification for Grout for Masonry 2020.
- N. ASTM C1364 - Standard Specification for Architectural Cast Stone
- O. BIA Technical Notes No. 7 - Water Penetration Resistance – Design and Detailing 2017.
- P. BIA Technical Notes No. 28B - Brick Veneer/Steel Stud Walls 2005.
- Q. BIA Technical Notes No. 46 - Maintenance of Brick Masonry 2017.
- R. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures 2016.

#### 1.4 SUBMITTALS

- A. See Section 01 33 00 for submittal procedures.
- B. Product Data: Provide data for masonry units, fabricated wire reinforcement, mortar, and masonry accessories.
- C. Shop Drawings: Indicate pertinent dimensions, materials, anchorage, size and type of fasteners, and accessories for cast stone support system.
- D. Samples: Submit four samples of facing brick and stone units to illustrate color, texture, and extremes of color range.
- E. Manufacturer's Certificate: Certify that masonry units meet or exceed specified requirements.
- F. Source Quality Control Test Reports.
- G. Manufacturer's Qualification Data: Documentation showing compliance with specified requirements.

#### 1.5 QUALITY ASSURANCE

- A. Comply with provisions of ACI 530/530.1/ERTA, except where exceeded by requirements of the contract documents.
- B. Single Source Responsibility: Face Brick: Uniform texture and color, or uniform blend within ranges accepted for these characteristics, from one manufacturer for each product required.

- C. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section with minimum five years of documented experience.
- D. Installer Qualifications: Company specializing in performing work of the type specified and with at least five years of documented experience.

#### 1.6 FIELD SAMPLE

- A. General: Comply with Section 01 43 89.
- B. Sample Installation: Construct field samples 40 inch long by 40 inch high of each color of brick with color of mortar.
  - 1. Locate on site where directed.
  - 2. Show construction techniques, including following:
    - a. Color range of exposed masonry and mortar joints;
    - b. Tooled joints;
    - c. Back-up CMU conditions.
    - d. Ties, anchors, and fasteners.

#### 1.7 MOCK-UPS

- A. Construct masonry mockup as indicated for the Exterior Technical Wall Mockup Panel specified in Section 01 43 89. Mockup shall include brick, mortar and accessories with structural backup.
- B. Approved mockup shall be a standard for workmanship and material quality for remaining work.

#### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, handle, and store masonry units by means that will prevent mechanical damage and contamination by other materials.
- B. Store masonry units off the ground to avoid staining. Cover material with a vapor permeable tarp.
- C. Cast Stone Units: Comply with Cast Stone Institute Technical Bulletin No. 37.
  - 1. Transporting: Use care in transporting cast stone units to project site. Handle members in manner to prevent excessive stresses, spalling, or cracking.
- D. Reinforcement, Anchors, and Ties: Store steel reinforcing bars, coated anchors, ties, and joint reinforcement above the ground. Maintain steel reinforcing bars and uncoated ties free of loose mill scale and loose rust.

- E. Cementitious Materials, Sand and Aggregates: Deliver cementitious and other packaged materials in unopened containers, plainly marked and labeled with manufacturers' names and brands. Store cementitious material in dry, weathertight enclosures or completely cover. Handle cementitious materials in a manner that will prevent the inclusion of foreign materials and damage by water or dampness. Store sand and aggregates in a manner to prevent contamination and segregation.

## PART 2 PRODUCTS

### 2.1 CONCRETE MASONRY UNITS

- A. Concrete Block: Comply with referenced standards and as follows:
1. Size: Standard units with nominal face dimensions of 16 by 8 inches and nominal depth of 8 inches except as noted otherwise on the drawings.
  2. Load-Bearing Units: ASTM C90, lightweight.
    - a. Hollow block, as indicated.
    - b. Exposed Faces: Manufacturer's standard color and texture where indicated.
  3. Nonloadbearing Units: ASTM C129.
    - a. Hollow block, as indicated.
    - b. Lightweight.
  4. Standard Units with Factory-Installed Insulation Inserts: ASTM C90, normal weight.
    - a. Provide at all conditions between conditioned enclosed space and unconditioned spaces (indoor or outdoor) where continuous insulation is not provided as part of the finish.
    - b. Size: Standard units with nominal face dimensions of 16 by 8 inches and nominal depth of 8 inches.
    - c. Insulation Type: Manufacturer's standard expanded polystyrene (XPS); ASTM C578 Type X.
- B. Concrete Brick:
1. Size: As indicated on drawings.
  2. Concrete Building Brick: ASTM C55; lightweight, solid, for interior or concealed use.

### 2.2 BRICK UNITS

- A. Facing Brick: Refer to Section 04 26 13.

### 2.3 MORTAR AND GROUT MATERIALS

- A. Masonry Cement: ASTM C91/C91M, Type N.

1. Colored Mortar: Premixed cement as required to match Architect's color sample.
- B. Portland Cement: ASTM C150/C150M, Type I; color as required to produce approved color sample.
  1. Not more than 0.60 percent alkali.
- C. Hydrated Lime: ASTM C207, Type S.
- D. Mortar Aggregate: ASTM C144.
- E. Grout Aggregate: ASTM C404.
- F. Water: Clean and potable.
- G. Packaged Dry Material for Mortar for Unit Masonry: Premixed mortar may be provided in lieu of site mixed mortar above; Premixed Portland cement, hydrated lime, and sand; complying with ASTM C387/C387M and capable of producing mortar of the specified strength in accordance with ASTM C270 with the addition of water only.
  1. Type: Type N.
  2. Typical Color: Standard gray.
  3. Colored Mortar where indicated: Mineral pigments added as required to produce approved color sample.
- H. Packaged Dry Material for Grout for Masonry: Premixed cementitious materials and dried aggregates; capable of producing grout of the specified strength in accordance with ASTM C476 with the addition of water only.
  1. Type: Fine.

## 2.4 REINFORCEMENT AND ANCHORAGE

- A. Manufacturers:
  1. Hohmann & Barnard, Inc: [www.h-b.com/sle](http://www.h-b.com/sle).
- B. Reinforcing Steel: ASTM A615/A615M, Grade 40 (40,000 psi), deformed billet bars; galvanized.
- C. Joint Reinforcement: Use ladder type joint reinforcement where vertical reinforcement is involved and truss type elsewhere, unless otherwise indicated.
- D. Strap Anchors: Bent steel shapes, 1-1/2 inch width, 0.105 inch thick, 24 inch length, with 1-1/2 inch long, 90 degree bend at each end to form a U or Z shape or with cross pins, hot dip galvanized to ASTM A153/A153M Class B.
- E. Corrugated Metal Ties: Not allowed.

- F. Masonry Veneer Anchors: 2-piece anchors that permit differential movement between masonry veneer and structural backup, hot dip galvanized to ASTM A 153/A 153M, Class B.
  - 1. Basis of Design: Veneer Anchor Plates, HB-213-2X as manufactured by Hohmann & Barnard, Inc or approved equal.
  - 2. Anchor plates: Not less than 0.075 inch thick, designed for fastening to structural backup through sheathing by two fasteners.
  - 3. Wire ties: Manufacturer's standard shape, 0.1875 inch thick, with minimum of 2 hooks into anchor plate.
  - 4. Vertical adjustment: Not less than 2 inches.

- G. Loose Lintels and Relieving Angles: Refer to Section 05 51 00 for material requirements.

## 2.5 FLASHINGS

- A. Metal Flashing Materials:
  - 1. Stainless Steel Flashing: ASTM A666, Type 304, soft temper; 26 gauge, 0.0187 inch thick; finish 2B to 2D.
- B. Membrane Asphaltic Flashing Materials:
  - 1. Rubberized Asphalt Flashing: Self-adhering polymer modified asphalt sheet; 40 mils (0.040 inch) minimum total thickness; 8 mil cross-laminated polyethylene bonded to adhesive rubberized asphalt, with a removable release liner.
- C. Factory-Fabricated Flashing Corners and End Dams: Stainless steel.
- D. Flashing Sealant/Adhesives: Silicone, polyurethane, or silyl-terminated polyether/polyurethane or other type required or recommended by flashing manufacturer; type capable of adhering to type of flashing used.
- E. Termination Bars: Stainless steel; compatible with membrane and adhesives.

## 2.6 ACCESSORIES

- A. Preformed Control Joints: Rubber material. Provide with corner and tee accessories, fused joints.
- B. Cleaning Solution: Non-acidic, not harmful to masonry work or adjacent materials.

## 2.7 LINTELS

- A. Brickwork Support System: Offset steel relief angles or lintels with hanger brackets for support of brickwork above horizontal masonry joints and openings to allow insulation to span continuously behind brick and eliminate continuous thermal bridges associated with support systems that interrupt continuous insulation.

1. Configuration: Relief angle or lintel with welded hanger brackets anchored to structure.
2. Sizes: Component and anchor sizes and spacing to be determined by manufacturer from calculations or prescriptive design tables to suit project loading conditions and cavity width indicated on drawings.
3. Materials: Steel, hot dip galvanized to ASTM A153/A153M class B.

## 2.8 MORTAR AND GROUT MIXING

- A. Mortar for Unit Masonry: ASTM C270, using the Proportion Specification.
  1. Masonry below grade and in contact with earth: Type S.
  2. Exterior, loadbearing masonry: Type N.
  3. Exterior, non-loadbearing masonry: Type N.
  4. Interior, loadbearing masonry: Type N.
  5. Interior, non-loadbearing masonry: Type O.
- B. Colored Mortar: Proportion selected pigments and other ingredients to match Architect's sample, without exceeding manufacturer's recommended pigment-to-cement ratio.
- C. Grout: ASTM C476; consistency required to fill completely volumes indicated for grouting; fine grout for spaces with smallest horizontal dimension of 2 inches or less; coarse grout for spaces with smallest horizontal dimension greater than 2 inches.
- D. Mixing: Use mechanical batch mixer and comply with referenced standards.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive masonry.
- B. Verify that related items provided under other sections are properly sized and located.
- C. Verify that built-in items are in proper location, and ready for roughing into masonry work.

### 3.2 PREPARATION

- A. Direct and coordinate placement of metal anchors supplied for installation under other sections.
- B. Provide temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent bracing.
- C. Wetting Masonry:
  1. CMU: Do not wet concrete masonry units.

2. Brick: Wet brick made from clay or shale which have initial rates of absorption (suction) of more than 20 grams per 30 square inches per minute when tested in accordance with ASTM C67. Use wetting methods recommended by manufacturer to achieve optimum bonding with mortar.

### 3.3 COLD AND HOT WEATHER REQUIREMENTS

- A. Comply with requirements of TMS 402/602 or applicable building code, whichever is more stringent.

### 3.4 COURSING

- A. Establish lines, levels, and coursing indicated. Protect from displacement.
- B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.
- C. Concrete Masonry Units:
  1. Bond: Running.
  2. Coursing: One unit and one mortar joint to equal 8 inches.
  3. Mortar Joints: Concave unless indicated otherwise.

### 3.5 PLACING AND BONDING

- A. Lay hollow masonry units with face shell bedding on head and bed joints.
- B. Buttering corners of joints or excessive furrowing of mortar joints is not permitted.
- C. Remove excess mortar and mortar smears as work progresses.
- D. Interlock intersections and external corners.
- E. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.
- F. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.
- G. Cut mortar joints flush where wall tile is scheduled or resilient base is scheduled.
- H. Isolate masonry partitions from vertical structural framing members with a control joint as indicated.
- I. Isolate top joint of masonry partitions from horizontal structural framing members and slabs or decks with compressible joint filler.

### 3.6 REINFORCEMENT AND ANCHORAGE - GENERAL, SINGLE WYTHE MASONRY, AND CAVITY WALL MASONRY

- A. Unless otherwise indicated on drawings or specified under specific wall type, install horizontal joint reinforcement 16 inches on center.

- B. Place masonry joint reinforcement in first and second horizontal joints above and below openings.  
Extend minimum 16 inches each side of opening.
- C. Place continuous joint reinforcement in first and second joint below top of walls.
- D. Embed longitudinal wires of joint reinforcement in mortar joint with at least 5/8 inch mortar cover on each side.
- E. Lap joint reinforcement ends minimum 6 inches.

### 3.7 INSTALLATION OF CAST STONE AND STONE VENEER

- A. Install in accordance with manufacturer's instructions.
- B. Install stone and cast stone components in conjunction with masonry, complying with requirements of brick masonry above.
- C. Mechanically anchor stone and cast stone units indicated; set remainder in mortar.
- D. Setting:
  1. Drench cast stone components with clear, running water immediately before installation.
  2. Set units in a full bed of mortar unless otherwise indicated.
  3. Fill all joints with mortar, raked and caulked.
  4. Head joints in copings, and joints adjacent to other units with exposed horizontal surfaces to receive sealant.
  5. Fill dowel holes and anchor slots completely with mortar or non-shrink grout.

### 3.8 MASONRY FLASHINGS

- A. Whether or not specifically indicated, install masonry flashing to divert water to exterior at all locations where downward flow of water will be interrupted.
  1. Extend flashings full width at such interruptions and at least 4 inches, minimum, into adjacent masonry or turn up at least 8 inches, minimum, to form watertight pan at non-masonry construction.
  2. Remove or cover protrusions or sharp edges that could puncture flashings.
  3. Seal lapped ends and penetrations of flashing before covering with mortar.
- B. Terminate flashing up 8 inches minimum on vertical surface of backing:
  1. Install vertical leg of flashing behind water-resistive barrier sheet over backing.
- C. Extend metal flashings and drip edges through exterior face of masonry and turn down to form drip. Install joint sealer below drip edge to prevent moisture migration under flashing.

- D. Lap end joints of flashings at least 6 inches, minimum, and seal watertight with flashing sealant/adhesive.
- E. Where flashing does not extend continuously for full length of wall such as at the end of lintels and under sills at openings, form watertight end dams at each end of flashing into brick head joints.
- F. Anchor cast stone sills with dowels through flashing. Seal penetrations as required by flashing manufacturer.
- G. Through-Wall Flashing: Locate continuous under copings and at locations indicated.

### 3.9 LINTELS

- A. Install relieving angles and loose steel lintels over openings as indicated.
- B. Maintain minimum 8 inch bearing on each side of opening.
- C. Splices over windows are not permitted.
- D. Install thermal brick support system in accordance with manufacturer's instructions at locations indicated on drawings

### 3.10 GROUTED COMPONENTS

- A. Lap splices minimum 24 bar diameters.
- B. Support and secure reinforcing bars from displacement. Maintain position within 1/2 inch of dimensioned position.
- C. Place and consolidate grout fill without displacing reinforcing.

### 3.11 CONTROL AND EXPANSION JOINTS

- A. Do not continue horizontal joint reinforcement through control or expansion joints.
- B. Install preformed control joint device in continuous lengths. Seal butt and corner joints in accordance with manufacturer's instructions.
- C. Horizontal Expansion Joints: Install joint filler in joint underneath shelf angles, beams, slabs, and decks and sealant tape as secondary seal behind primary joint sealant to establish weather barrier at face of assembly.
  - 1. Joint Sealant: See Section 07 92 00.
    - a. Locations: Install where indicated on Drawings. If joints are not indicated, install at each floor.
- D. Vertical Control Joints:
  - 1. Exterior Brick Veneer Joints: Install joint fillers through veneer wythes.
  - 2. CMU Joints: Install CMU Control Joint Strip in slots in CMU Sash Units through CMU wythes.

3. Brick and CMU Joints in Composite Walls: Coincide.
4. Ensure joints are free from mortar and horizontal reinforcing.
5. Utilize control joint filler to maintain width and depth of clear joint. Locate to permit proper placement of primary joint sealant and joint backer material.
6. Joint Sealant: See Section 07 92 00.
7. Locations: Install where indicated on Drawings and at building expansion joints in addition to locations shown on drawings. Install in accordance with following:
  - a. At control or expansion joints in structure.
  - b. At 30 feet OC maximum horizontal run of uninterrupted wall and around corners.
  - c. At 15 feet OC maximum horizontal run for parapets, balconies, and free-standing walls and at their junctions with walls of other building areas. Extend joints through masonry parapets and from top of parapet down to horizontal expansion joint.
  - d. Within 10 feet of inside and outside corners on one wall. Provide next vertical control joint around corner on other wall with distance between joints within maximum spacing requirements above.
  - e. At offsets and setbacks in wall.
  - f. At changes in thickness, height, or direction of wall.
  - g. At openings greater than 24 inches wide. Provide for independent movement of loose lintels at vertical control joints by means of slip plane formed of masonry flashing and joint sealant in accordance with recommendations in BIA Technical Note 18A.
  - h. Where more than one of above conditions occur in area, combine above requirements to minimize number of joints while creating continuous expansion control and visual appearance.

### 3.12 TOLERANCES

- A. Maximum Variation From Unit to Adjacent Unit: 1/16 inch.
- B. Maximum Variation from Plane of Wall: 1/4 inch in 10 ft and 1/2 inch in 20 ft or more.
- C. Maximum Variation from Plumb: 1/4 inch per story non-cumulative; 1/2 inch in two stories or more.
- D. Maximum Variation from Level Coursing: 1/8 inch in 3 ft and 1/4 inch in 10 ft; 1/2 inch in 30 ft.
- E. Maximum Variation of Mortar Joint Thickness: Head joint, minus 1/4 inch, plus 3/8 inch.
- F. Maximum Variation from Cross Sectional Thickness of Walls: 1/4 inch.

### 3.13 CUTTING AND FITTING

- A. Cut and fit for chases, pipes, conduit, and sleeves. Coordinate with other sections of work to provide correct size, shape, and location.
- B. Obtain approval prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.

### 3.14 CLEANING

- A. Remove excess mortar and mortar droppings.
- B. Replace defective mortar. Match adjacent work.
- C. Clean soiled surfaces with cleaning solution.
- D. Use non-metallic tools in cleaning operations.
- E. Cleaning: Test cleaning products at mock-up panel or other location as directed.
  1. Brick: BIA Tech Note 20; recommended methods.
  2. Clean stained surfaces with non-acidic solution of type which will not harm masonry or adjacent materials. Follow manufacturer's instructions. Consult masonry manufacturer for acceptable cleaners.
  3. Do not allow cleaning solution to etch mortar joints, or adjacent surfaces such as masonry, metal, stone, concrete surfaces, foundations, or windows. Protect adjacent surfaces. Immediately remove cleaning products from adjacent surfaces when deposits occur.

### 3.15 PROTECTION

- A. Without damaging completed work, provide protective boards at exposed external corners that are subject to damage by construction activities.

END OF SECTION

## SECTION 04 26 13 - MASONRY VENEER

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Clay facing brick.
- B. Stone units
- C. Reinforcement and anchorage.
- D. Flashings.
- E. Installation of lintels.
- F. Accessories.

#### 1.2 RELATED REQUIREMENTS

- A. Section 04 20 00 - Masonry Units: Mortar and grout, flashings, and accessories; Structural masonry.
- B. Section 04 05 11 - Mortar and Masonry Grout.
- C. Section 05 50 00 - Metal Fabrications: Loose steel lintels.
- D. Section 07 62 00 - Sheet Metal Flashing and Trim: Through-wall masonry flashings.
- E. Section 07 92 00 - Joint Sealants: Sealing control and expansion joints.

#### 1.3 REFERENCE STANDARDS

- A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware 2016a.
- B. ASTM C216 - Standard Specification for Facing Brick (Solid Masonry Units Made From Clay or Shale) 2021.
- C. ASTM C615/C615M - Standard Specification for Granite Dimension Stone 2018, with Editorial Revision.
- D. ASTM C979/C979M - Standard Specification for Pigments for Integrally Colored Concrete 2016.
- E. BIA Technical Notes No. 7 - Water Penetration Resistance – Design and Detailing 2017.
- F. BIA Technical Notes No. 28B - Brick Veneer/Steel Stud Walls 2005.
- G. BIA Technical Notes No. 46 - Maintenance of Brick Masonry 2017.
- H. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures 2016.

#### 1.4 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene one week before starting Masonry work .

#### 1.5 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures, for general submittal requirements.
- B. Product Data: Provide data for masonry units and fabricated wire reinforcement.
- C. Samples: Submit four samples of facing brick and stone units to illustrate color, texture, and extremes of color range.
- D. Manufacturer's Certificate: Certify that masonry units meet or exceed specified requirements.

#### 1.6 QUALITY ASSURANCE

- A. Comply with provisions of TMS 402/602, except where exceeded by requirements of Contract Documents.
- B. Single Source Responsibility: Face Brick: Uniform texture and color, or uniform blend within ranges accepted for these characteristics, from one manufacturer for each product required.
- C. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section with minimum three years of documented experience.
- D. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

#### 1.7 MOCK-UP

- A. Construct masonry mockup as indicated for the Exterior Technical Wall Mockup Panel specified in Section 01 43 89. Mockup shall include brick, mortar and accessories with structural backup.
- B. Approved mockup shall be a standard for workmanship and material quality for remaining work.

#### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, handle, and store masonry units by means that will prevent mechanical damage and contamination by other materials.

#### 1.9 FIELD CONDITIONS

- A. Cold and Hot Weather Requirements: Comply with requirements of TMS 402/602 or applicable building code, whichever is more stringent.

### PART 2 PRODUCTS

#### 2.1 BRICK UNITS

- A. Facing Brick: ASTM C216, Type FBS Smooth, Grade SW.

1. Color and texture to match Architect's sample.
2. Color and Texture: Basis of Design - Watsontown Manhattan Coal; Acceptable Alternates - Belden Black Diamond Velour, Endicott Manganese Ironspot Velour.
3. Nominal Size: As indicated on drawings.

## 2.2 GRANITE BASE

- A. Granite: complying with ASTM C615/C615M.
  1. Provided by Polycor ([www.polycor.com](http://www.polycor.com))
  2. Surface Texture: Honed.
  3. Color: Nordic Black.
  4. Thickness: see drawings
  5. Tolerance: 1/8" tolerance face dimensions.
  6. Face Size: As indicated
  7. Setting Bed: As indicated
  8. Select stone for intended use to prevent fabricated units from containing cracks, seams, and starts that could impair structural integrity or function.

## 2.3 MORTAR AND GROUT MATERIALS

- A. Mortar and Grout: As specified in Section 04 20 00.
- B. Pigments for Colored Mortar: Pure, concentrated mineral pigments specifically intended for mixing into mortar and complying with ASTM C979/C979M.
  1. Color(s): Basis of Design - WR 2070 Graphite, concave mortar joint..
- C. Water: Clean and potable.

## 2.4 REINFORCEMENT AND ANCHORAGE

- A. Masonry Veneer Anchors: 2-piece anchors that permit differential movement between masonry veneer and structural backup, hot dip galvanized to ASTM A 153/A 153M, Class B.
  1. Anchor plates: Not less than 0.075 inch thick, designed for fastening to structural backup through sheathing by two fasteners; provide design with legs that penetrate sheathing and insulation to provide positive anchorage.
  2. Wire ties: Manufacturer's standard shape, 0.1875 inch thick.
  3. Vertical adjustment: Not less than 3-1/2 inches.

- B. Metal-to-Metal Fasteners: Self-drilling, self-tapping screws; corrosion resistant finish or hot dip galvanized to ASTM A153/A153M.

## 2.5 FLASHINGS

- A. Metal Flashing Materials:

1. Stainless Steel Flashing: ASTM A666, Type 304, soft temper; 26 gage, 0.0187 inch thick; finish 2B to 2D.

- B. Membrane Non-Asphaltic Flashing Materials:

1. Composite Polymer Flashings - Self-Adhering: Composite polyethylene; 40 mil thick with pressure-sensitive adhesive and release paper.

- C. Termination Bars: Stainless steel; compatible with membrane and adhesives.

## 2.6 ACCESSORIES

- A. Preformed Control Joints: Neoprene material. Provide with corner and tee accessories, fused joints.

- B. Weeps:

1. Type: Extruded propylene with honeycomb design.

2. Acceptable Manufacturers:

- a. Advanced Building Products, Inc; Mortar Maze Weep Vents:  
[www.advancedbuildingproducts.com/#sle](http://www.advancedbuildingproducts.com/#sle).

- C. Cavity Vents:

1. Type: Extruded propylene with honeycomb design.

2. Color(s): As selected by the Architect to match the mortar color.

3. Manufacturers:

- D. Cavity Mortar Control: Semi-rigid polyethylene or polyester mesh panels, sized to thickness of wall cavity, and designed to prevent mortar droppings from clogging weeps and cavity vents and allow proper cavity drainage.

1. Mortar Diverter: Panels installed at flashing locations.

- E. Cleaning Solution: Non-acidic, not harmful to masonry work or adjacent materials.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive masonry.

- B. Verify that related items provided under other sections are properly sized and located.

### 3.2 COURSING

- A. Establish lines, levels, and coursing indicated. Protect from displacement.
- B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.
- C. Brick Units:
  1. Bond: As indicated for different locations.
  2. Coursing: Three units and three mortar joints to equal 8 inches.
  3. Mortar Joints: Concave.

### 3.3 PLACING AND BONDING

- A. Lay solid masonry units in full bed of mortar, with full head joints, uniformly jointed with other work.
- B. Buttering corners of joints or excessive furrowing of mortar joints is not permitted.
- C. Interlock intersections and external corners, except for units laid in stack bond.
- D. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.
- E. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.
- F. Isolate top joint of masonry veneer from horizontal structural framing members or support angles with compressible joint filler.

### 3.4 WEEPS/CAVITY VENTS

- A. Install weeps in veneer walls at 24 inches on center horizontally on top of through-wall flashing above shelf angles and lintels and at bottom of walls.
- B. Install cavity vents in veneer walls at 32 inches on center horizontally below shelf angles and lintels and at top of walls.

### 3.5 CAVITY MORTAR CONTROL

- A. Do not permit mortar to drop or accumulate into cavity air space or to plug weep/cavity vents.
- B. For cavity walls, build inner wythe ahead of outer wythe to accommodate accessories.
- C. Install cavity mortar diverter at base of cavity and at other flashing locations as recommended by manufacturer to prevent mortar droppings from blocking weep/cavity vents.

### 3.6 REINFORCEMENT AND ANCHORAGE - MASONRY VENEER

- A. Masonry Back-Up: Embed anchors to bond veneer at maximum 16 inches on center vertically and 36 inches on center horizontally. Place additional anchors at perimeter of openings and ends of panels, so maximum spacing of anchors is 8 inches on center.
- B. Stud Back-Up: Secure veneer anchors to stud framed back-up and embed into masonry veneer at maximum 16 inches on center vertically and 24 inches on center horizontally. Place additional anchors at perimeter of openings and ends of panels, so maximum spacing of anchors is 8 inches on center.
- C. Reinforce stack bonded unit joint corners and intersections with strap anchors 16 inches on center.

### 3.7 MASONRY FLASHINGS

- A. Whether or not specifically indicated, install masonry flashing to divert water to exterior at all locations where downward flow of water will be interrupted.
  1. Extend flashings full width at such interruptions and at least 6 inches, minimum, into adjacent masonry or turn up at least 1 inch, minimum, to form watertight pan at non-masonry construction.
  2. Remove or cover protrusions or sharp edges that could puncture flashings.
  3. Seal lapped ends and penetrations of flashing before covering with mortar.
- B. Terminate membrane flashing up 8 inches minimum on vertical surface of backing:
  1. Install vertical leg of flashing behind water-resistive barrier sheet over backing.
  2. Anchor vertical leg of flashing into backing with a termination bar and sealant.
  3. Apply cap bead of sealant on top edge of self-adhered flashing.
- C. Extend metal flashings through exterior face of masonry and terminate in an angled drip with hemmed edge. Install joint sealer below drip edge to prevent moisture migration under flashing.
- D. Support flexible flashings across gaps and openings.
- E. Lap end joints of flashings at least 6 inches, minimum, and seal watertight with flashing sealant/adhesive.

### 3.8 LINTELS

- A. Install loose steel lintels over openings.

### 3.9 CONTROL AND EXPANSION JOINTS

- A. Do not continue horizontal joint reinforcement through control or expansion joints.
- B. Install preformed control joint device in continuous lengths. Seal butt and corner joints in accordance with manufacturer's instructions.
- C. Size control joints as indicated on drawings; if not indicated, 3/4 inch wide and deep.

### 3.10 TOLERANCES

- A. Install masonry within the site tolerances found in TMS 402/602.
- B. Maximum Variation From Unit to Adjacent Unit: 1/16 inch.
- C. Maximum Variation from Plane of Wall: 1/4 inch in 10 ft and 1/2 inch in 20 ft or more.
- D. Maximum Variation from Plumb: 1/4 inch per story non-cumulative; 1/2 inch in two stories or more.
- E. Maximum Variation from Level Coursing: 1/8 inch in 3 ft and 1/4 inch in 10 ft; 1/2 inch in 30 ft.
- F. Maximum Variation of Mortar Joint Thickness: Head joint, minus 1/4 inch, plus 3/8 inch.

### 3.11 CUTTING AND FITTING

- A. Cut and fit for pipes and conduit. Coordinate with other sections of work to provide correct size, shape, and location.
- B. Obtain approval prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.

### 3.12 CLEANING

- A. Remove excess mortar and mortar smears as work progresses.
- B. Replace defective mortar. Match adjacent work.
- C. Clean soiled surfaces with cleaning solution.
- D. Use non-metallic tools in cleaning operations.

### 3.13 PROTECTION

- A. Without damaging completed work, provide protective boards at exposed external corners that are subject to damage by construction activities.

END OF SECTION

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## SECTION 05 12 00 - STRUCTURAL STEEL

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

#### 1.2 DESCRIPTION

- A. Extent of structural steel work is shown on drawings, including schedules, notes and details to show size and location of members, typical connections, and type of steel required.
- B. Section includes structural steel as defined by the AISC Code of Standard Practice.
- C. Products furnished but not installed under this section:
  1. Steel anchorages cast in concrete or installed in masonry.
  2. Loose lintels in masonry walls.
  3. Anchor bolts and leveling plates.
- D. General: Unless otherwise specifically approved in writing, furnish exact section, weights, and kinds of material specified, using details and dimensions shown.
- E. Details shown are typical; similar details apply to similar conditions, unless otherwise indicated.
- F. Substitution of other shapes of equivalent or greater strength and no greater dimension may be allowed by the Architect, but only under normal substitution procedures.

#### 1.3 QUALITY ASSURANCE

- A. Welding Procedures: Establish that joint welding procedures are prequalified or test in accordance with AWS D1.1 qualification procedures.
- B. Welder Qualifications: Welders must be currently certified under American Welding Society qualification procedures. If recertification is required, retesting will be the Contractor's responsibility.
- C. Regulatory Requirements: Unless other requirements of governing authorities or particular requirements of this specification are more stringent, comply with provisions of the following:
  1. AISC "Code of Standard Practice for Steel Buildings and Bridges"
  2. AISC "Specification for Structural Steel Buildings--Allowable Stress Design and Plastic Design," with Commentary and Supplements
  3. AISC "Load and Resistance Factor Design (LRFD) Specification for Structural Steel Buildings"
  4. ASTM A6 "Specification for General Requirements for Rolled Steel Plate, Shapes, Sheet Piling and Bars for Structural Use"

5. Research Council on Structural Connections (RCSC) " Specification for Structural Joints Using ASTM A325 or A490 Bolts"
6. ANSI/AWS D1.1, "Structural Welding Code - Steel"
7. ASTM A 123 -- Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products. CRD - C 621 -- Corps of Engineers Specification for Nonshrink Grout; U.S. Army Corps of Engineers.

#### 1.4 SUBMITTALS

- A. Product Data: Submit producer's or manufacturer's data for products as follows, including sufficient data to show compliance with specified requirements:
  1. Structural steel primer
  2. Expansion bolts
  3. Headed Studs
  4. Slide bearing pads
- B. Shop Drawings: Submit complete shop drawings at 1/8 inch (1:100 mm) scale minimum for structural steel, including information on location, type, and size of all bolts, and welds, distinguishing between those made in the shop and those made in the field. (Reproduced contract drawings are not acceptable for use as erection plans.)
  1. Structural steel piece drawings shall denote the gravity load used to select the connection.
  2. Include holes and other pertinent data.
- C. Indicate weld lengths and sizes, using standard AWS welding symbols. Distinguish between shop and field welds.
- D. Include setting drawings and templates for anchorages to be installed as work of other sections.
- E. Test Reports: The owner's testing and inspection agency will submit test reports for all specified tests of connections.
- F. Welder Qualifications: Submit evidence that welders employed in the work are currently certified under AWS qualification procedures.
- G. Surveys: Submit copies of specified surveys, showing locations and elevations of all critical elements. Indicate discrepancies between field data and information shown on contract documents.
- H. LEED - Product Data: For products having recycled content, provide documentation indicating percentages by weight of post-consumer and pre-consumer recycled content. Include statement indicating cost for each product having recycled content.
- I. LEED – Regional Materials: Document manufacturing plant location and determine if the manufacturer is within 100 miles of the project. Submit documentation.
- J. LEED – Laboratory Test Reports: For primers, provide 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".

## PART 2 - PRODUCTS

### 2.1 STEEL MATERIALS

- A. Metal Surfaces, General: For fabrication of work which will be exposed to view, use only materials which are smooth and free of surface blemishes including pitting, rust and scale seam marks, roller marks, rolled trade names and roughness. Remove such blemishes by grinding, or by welding and grinding, prior to cleaning, treating and application of surface finishes.
- B. Structural Steel Angles, Channels, Plates, and Bars: ASTM A 36.
- C. Structural Steel Wide Flange Shapes: High-Strength, Low-Alloy Columbium-Vanadium Steels: ASTM A 992, Grade 50.
- D. Cold-Formed Structural Tubing: ASTM A 500, Grade B.
- E. Steel Pipe: ASTM A 53. Type E or S, Grade B.
- F. Anchor Bolts: ASTM A 36
- G. Shear Connectors: Headed stud type, ASTM A 108, Grade 1010 through 1020, made from cold drawn bar stock and cold-finished carbon steel, with dimensions complying with AISC specifications.
- H. High-Strength Threaded Fasteners: Heavy hexagon structural bolts, heavy hexagon nuts, and hardened washers, quenched and tempered medium-carbon steel, complying with ASTM A 325 unless otherwise indicated, Provide galvanized bolts for all galvanized steel, and where indicated.
- I. Electrodes for Welding: Comply with AWS Code, use E70XX Series.
- J. Slide Bearings: Proprietary system of sliding bearing elements each fabricated using reinforced tetraflouoethylene sheets bonded with high temperature epoxy adhesive to steel plates in sizes and thicknesses indicated as manufactured by the Fluorocarbon Company, Pine Brook, New Jersey or approved equal.
- K. Standard Primer Paint: High solids, low VOC, rust inhibitive, all-purpose shop primer which is free of lead, chromates, and other heavy metals.
- L. Channel Slot Receivers for Masonry Anchors: 16 gage (1.372 mm) hot dipped galvanized, Heckmann No. 130 (8" long) [203.2 mm] or No. 133 (continuous) or approved equal.
- M. Non-shrink Grout: Premixed, nonmetallic, noncorrosive, nonstaining product containing selected silica sands, portland cement, shrinkage compensating agents, plasticizing and water reducing agents, complying with CRD-C621. Products: Masterflow 713; Master Builders. Five Star Grout; U.S. Grout Corp or approve equal.
- N. Expansion Bolts: Zinc plated steel bolts as specified on Drawings. "HSL heavy-duty expansion anchors" and "Kwik-Bolts" as manufactured by Hilti, Inc. or approved equal.

- O. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds and repair painting galvanized steel, with dry film containing not less than 93 percent zinc dust by weight, and complying with DOD-P-21025A or SSPC-Paint 20.
- P. LEED – Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than the following:
  - 1. W-Shapes: 60 percent.
  - 2. Channels, Angles and Shapes: 60 percent.
  - 3. Plate and Bar: 25 percent.
  - 4. Cold Formed Hollow Tubing: 25 percent.
  - 5. Steel Pipe:[25 percent.

## 2.2 FABRICATION

- A. Shop Fabrication and Assembly: Fabricate and assemble structural assemblies in the shop to greatest extent possible. Fabricate items of structural steel in accordance with AISC Specifications and as indicated on final shop drawings. Provide camber in structural members where indicated.
- B. Properly mark and match-mark materials for field assembly. Fabricate for delivery sequence, which will expedite erection and minimize field handling of materials.
- C. Where finishing is required, complete assembly, including welding of units, before start of finishing operations. Provide finish surfaces of members exposed in final structure free of markings, burrs and other defects.
- D. Architecturally Exposed Structural Steel: Fabricate architecturally exposed structural steel with exposed surfaces smooth, square, and free of surface blemishes, including pitting, rust and scale seam marks, roller marks, rolled trade names and roughness.
  - 1. Remove blemishes by filling, grinding, or by welding and grinding, prior to cleaning, treating and shop priming.
  - 2. Comply with fabrication requirements, including tolerance limits, of AISC's "Code of Standard Practice for Steel Building and Bridges" for architecturally exposed structural steel.
- E. Provide high-strength threaded fasteners for all bolted connections, except where unfinished bolts are shown.
  - 1. High-Strength Bolted Construction: Install high-strength threaded fasteners in accordance with AISC "Specifications for Structural Joints using ASTM A 325 or A 490 Bolts."
  - 2. Bolts need only to be tightened to a snug tight condition in accordance with the RCSC specification for shear/bearing bolts except for those identified as slip critical bolts. Slip critical connections are defined as follows:
    - a. All connections at braced bays including bracing, beams and columns.
    - b. All connections noted as such on the plans.
- F. Welded Construction: Comply with AWS Code for procedures, appearance, and quality of welds, and methods used in correcting welding work.

- G. Assemble and weld built-up sections by methods, which will produce true alignment of axes without warp.
- H. Holes for other Work: Provide holes required for securing other work to structural steel framing, and for the passage of other work through steel framing members as shown on the final shop drawings. Provide threaded nuts welded to framing, and other specialty items as shown to receive other work.
- I. Cut drill or punch holes perpendicular to metal surfaces. Do not flame cut holes or enlarge holes by burning. Drill holes in bearing plates.
- J. Accessories: Provide accessories for masonry as follows:
  - 1. Shop welded strap anchors on beams and columns where indicated.
  - 2. Continuous channel slot receivers on columns adjacent to masonry walls.
  - 3. Vertically applied channel slot receivers at 32 inches (800 mm) on center on all beams adjacent to masonry walls.
- K. Galvanizing: Provide a zinc coating for those items indicated or specified to be galvanized, as follows:
  - 1. ASTM A 153 for galvanizing iron and steel hardware.
  - 2. ASTM A 123 for galvanizing rolled, pressed and forged steel shapes, plates, bars and strip 1/8 (3.175 mm): thick and heavier.
  - 3. ASTM A 386 for galvanizing assembled steel products.

## 2.3 SHOP PAINTING

- A. General: Shop paint structural steel, except those members or portions of members to be embedded in concrete, mortar or those members to be fire-proofed. Paint embedded steel, which is partially exposed on exposed portions and initial 2" (50.8 mm) of embedded areas only.
- B. Surface Preparation: After inspection, clean steel work to be painted. Remove loose rust, loose mill scale, and spatter, slag or flux deposits. Clean steel in accordance with Steel Structures Painting Council (SSPC) as follows:
  - 1. SSPC - SP-3 "Power Tool Clean" for concealed steel.
  - 2. SSPC - SP-10 "Near-White Blast Cleaning" for Architecturally Exposed Structural Steel.
- C. Painting: Immediately after surface preparation, apply structural steel primer paint in accordance with manufacturer's instructions and at a rate to provide dry film thickness of not less than 1.5 mils (0.038 mm). Use a painting method, which results in full coverage of joints, corners, edges and exposed surfaces. Apply two coats of paint to those surfaces, which are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

## 2.4 FINISH

- A. Unpainted Finishes:
  - 1. Steel members in contact with concrete: Unpainted.
  - 2. Steel members which receive spray-on-fireproofing: Unpainted.

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3. Interior concealed steel members.
- B. Galvanizing:
1. Hot-Dip Galvanized Finish: Apply zinc coating by hot-dip process to structural steel according to ASTM A123.
  2. Fill vent and drain holes that are exposed in the finished Work unless they function as weep holes, by plugging with zinc solder and filing off smooth.
  3. Galvanize shelf angles and lintels located in exterior walls.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Erector must examine the areas and conditions under which structural steel work is to be installed and notify the Contractor, in writing, of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the Erector.
- B. Erector must survey as-built anchor bolt, bearing plate and embedded plates used for beam connection layouts prior to setting structural steel. If structural steel is set prior to surveying, erector is responsible for all modifications necessitated by improperly located bolts or plates.
- C. Erector must inform the Architect when the erection of steel deviates from the approved shop drawings due to fabrication errors, misalignment of embeds and any additional type of deviation. The erector must submit, for review, a report of the deviation condition in writing, including cause and possible solution. A written acceptance of all deviations must be maintained at the jobsite for review by the Owner's testing laboratory.
- D. Temporary Support: Provide temporary guys, braces, falsework, cribbing, or other elements required to secure the steel framing against loads equal in intensity to design loads. Remove such temporary support only when permanent connections have been made and the steel framing is fully capable of supporting design loads, including any temporary construction loads.

### 3.2 DELIVERY, STORAGE, AND HANDLING

- A. Shipping: Deliver steel in timely fashion, to permit the most efficient and economical flow of work. Deliver steel members properly marked for field assembly and erection.
- B. Deliver lintels, anchor bolts, washers, and other anchorage devices to be built into other work in time to avoid delays and permit their proper installation.
- C. Storage: Protect steel and other materials of this section from damage and corrosion. If temporary storage at the project site is required, keep steel members off the ground, using platforms or pallets, in location easily accessible for inspection.

### 3.3 ERECTION

- A. General: Erect structural steel in compliance with AISC Code and Specifications.
- B. Set structural frames accurately to the lines and elevations indicated. Align and adjust the various members forming a part of a complete frame or structure before permanently fastening. Clean bearing surfaces and other surfaces, which will be in permanent contact before assembly. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
- C. Level and plumb individual members of the structure within specified AISC tolerances.
- D. Establish required leveling and plumbing measurements on the mean operating temperature of the structure. Make allowances for the difference between temperature at time of erection and the mean temperature at which the structure will be when completed and in service.
- E. Clean concrete and masonry bearing surfaces of bond-reducing materials and roughen to improve bond to surfaces. Clean bottom surface of base and bearing plates.
- F. Set loose and attached base plates and bearing plates for structural members on wedges or other adjusting devices.
- G. Tighten anchor bolts after supported members have been positioned and plumbed. Do not remove wedges or shims, but if protruding, cut off flush with edge of base or bearing plate prior to packing with grout.
- H. Pack grout solidly between bearing surfaces and bases or plates to ensure that no voids remain. Finish exposed surfaces, protect installed materials, and allow to cure. For proprietary grout materials, comply with manufacturer's instructions.
- I. Splice members only where indicated and accepted on final shop drawings.
- J. Erection Bolts: On exposed welded construction, remove erection bolts, fill holes with plug welds and grind smooth at exposed surfaces.
- K. Comply with AISC specifications for bearing, adequacy for temporary connections, alignment and the removal of paint on surfaces adjacent to field welds.
- L. Do not enlarge unfair holes in members by burning or by the use of drift pins, except in secondary bracing members. Ream holes must be enlarged to admit bolts.
- M. Gas Cutting: Do not use gas cutting torches in the field for correcting fabrication errors in primary structural framing. Cutting will be permitted only on secondary members, which are not under stress, as acceptable to the Architect. Finish gas-cut sections equal to a sheared appearance when permitted.
- N. Expansion Bolts: Install in accordance with manufacturer's instructions using only acceptable carbide bits for drilling. Provide bolts with a minimum embedment of 5" unless otherwise noted on drawings.
  - 1. Expansion Bolts to Masonry: Anchor only to solid grouted masonry. If masonry is not grouted at the time of anchor installation, immediately notify General Contractor of condition. Do not proceed until condition is corrected by grouting masonry and curing for a minimum of three days.

- O. Touch-up Painting: After erection, wire brush clean and paint scarred areas, welds, rust spots on steel, using same type of shop paint used on adjacent surfaces. Use galvanized repair paint on galvanized surfaces.

### 3.4 FIELD QUALITY CONTROL

- A. Owner will engage an independent testing and inspection agency to inspect high-strength bolted connections and welded connections and to perform tests and prepare test reports for all field inspections.
- B. The testing agency shall visit the fabricator's plant and verify that the fabricator's detailed fabrication and quality control procedures are in place and conform to industry standards. If the fabricator can demonstrate that they currently comply with the AISC quality certification program category I, the testing agency's plant inspection may be omitted.
- C. The testing agency will conduct tests in accordance with industry standards and the Special Inspections requirements of the building code. The testing agency shall prepare a report for each visit. Each report will state whether or not the tests comply with the requirements and specifically state any deviations.
- D. Deficiencies that were listed in the inspections and laboratory test reports need to be corrected at the Contractor's expense. Perform any additional tests to reconfirm if there is any more non-compliances of the original work and show compliance of corrected work.
- E. Shop Bolted Connections: Inspect in accordance with AISC specifications.
- F. Shop Welding: Inspect and test during fabrication of structural steel assemblies, as follows:
1. Verify welders' certifications and conduct inspections and tests as required. Record types and locations of defects found in the work. Record work required and performed to correct deficiencies.
  2. Perform visual inspection of all welds.
  3. Test ultrasonic inspection of all full penetration welds to comply with ASTM E 164.
  4. Perform additional testing at the testing agency's option using ASTM E165, ASTM E704, ASTM E94 or ASTM E142.
- G. Field Bolted Connections: Inspect in accordance with AISC specifications.
- H. Field Welding: Inspect and test during erection of structural steel as follows:
1. Perform visual inspection of all field welds.
  2. Test all full penetration welds. Test ultrasonic inspection of all full penetration welds to comply with ASTM E 164.
  3. All expansion bolts shall be inspected in accordance with manufacturer's requirements.
- I. Shear Connectors: Perform visual inspection and bend tests:
1. Acoustic Inspection:
    - a. Perform acoustic inspection for 100% of studs.
    - b. Studs which do not ring when struck with a hammer shall be bent 15 degree. If no fracture occurs, stud is considered acceptable and left bent.

2. In addition to above, test not less than 1 of each 100 studs by bending 15 degrees. If no fracture occurs, stud is considered acceptable and left bent.
3. Rejectable studs:
  - a. If the number of rejectable studs on any building level exceeds 3% of those tested, perform additional testing on 1 of each 25 studs.

END OF SECTION 05 12 00

## SECTION 05 36 00 – COMPOSITE METAL DECK WITH DOVETAIL PROFILE

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions and Supplementary Conditions and Division-1 Specification Sections, apply to work of this Section.
- B. Related Work: The following related work is not part of this section:
  1. Division 1 – Cast-in-place concrete: Concrete fill, reinforcing steel and temporary shoring.
  2. Division 5 – Structural steel: Supplementary framing, deck supports, and edge angle.
  3. Division 9 – Finishes: Preparation for and application of field finishes.

#### 1.2 DESCRIPTION

- A. The requirements of this specification section include all materials, equipment, and labor necessary to furnish and install a composite floor or roof deck system.

#### 1.3 QUALITY ASSURANCE

- A. Codes and Standards: Comply with provisions of the following codes and standards, except as otherwise indicated:
  1. American Iron and Steel Institute (AISI), "Specification for the Design of Cold-Formed Steel Structural Members."
  2. American Welding Society (AWS), D1.3 "Structural Welding Code - Sheet Steel."
  3. Steel Deck Institute (SDI), "Design Manual for Composite Decks, Form Decks and Roof Decks."
- B. Fabricator Qualifications: Deck manufacturer shall have been regularly engaged in the production of specialized deck with dovetail rib profiles for a period of ten years. Deck units shall be cold-formed by the continuous roll-forming process to assure quality and uniformity of profile.
- C. Section Properties: Shall be computed in accordance with the American Iron and Steel Institute (AISI) Cold Formed Steel Design Manual.
- D. Materials: Shall be in accordance with ASTM, American Society for Testing and Materials.
- E. Welding: Shall comply with applicable provisions of the American Welding Society (AWS) D1.3 Structural Welding Code – Sheet Steel.
- F. Superimposed Load and Diaphragm Shear Capacities: Loads and capacities shall be computed in accordance with the requirements of the applicable Design Manuals and the Steel Deck Institute (SDI). Superimposed load capacity shall be verified by full scale tests.

- G. Fire Resistance: Composite Floor Deck Units shall be listed in the Underwriters Laboratories (U.L.) fire resistance index. All units shall bear the appropriate U.L. Classification marking. Provide Fire Resistance of assembly as specified on the Contract Drawings.
- H. Deck installer shall have installed products similar in material, design, and extent to that specified for this project and whose work has resulted in construction with a record of successful in-service performance for a period of at least 5 years.
- I. Specialty Engineer Qualifications: Professional Engineer registered in the state of the proposed project whose specialization is structural design and the design of shoring of composite concrete floor systems.
- J. Cast-in-Place Concrete: Shoring and reinforcing shall be in accordance with the applicable section of the ACI 318 Building Code Requirements for Reinforced Concrete.
- K. Admixtures containing chloride salts shall not be used. Additionally, all concrete constituents including but not limited to aggregates, sand, and water shall be closely monitored to assure that chlorides do not exceed the limits proscribed in ACI 318.

#### 1.4 SUBMITTALS

- A. Product Data: Submit product data consisting of manufacturer's specifications, section properties, load tables, diaphragm shear tables, dimensions, finishes, and fire resistance ratings.
- B. Deck Shop Drawings: Submit deck placement drawings showing profiles, material thicknesses, finishes, layout, anchorage details, shoring requirements, openings as shown on the contract documents and conditions requiring closure strips, supplementary framing, cut openings, special jointing, and other accessories.
- C. Shoring Shop Drawings: Submit drawings and calculations for shoring system prepared and sealed by a Specialty Engineer licensed in the state of the proposed project. Design of formwork are Contractor's responsibility.
  - 1. Shoring and Reshoring: Indicate proposed schedule and sequence of shoring removal, and installing and removing reshoring.
- D. **LEED - Product Data for Credit MR 4: For products having recycled content, provide documentation indicating percentages by weight of post-consumer and pre-consumer recycled content. Include statement indicating cost for each product having recycled content.**
- E. **LEED – Regional Materials for Credit MR 5: Document manufacturing plant location and determine if the manufacturer is within 500 miles of the project. Submit documentation.**

#### 1.5 DELIVERY, STORAGE AND HANDLING

- A. Deck units shall be protected from damage during delivery, storage and handling. Deck units shall be elevated above the ground, sloped to provide drainage, and if required, protected from weather with a ventilated covering.
- B. Coordinate field cleaning and finishes to achieve proper adhesion to the composite deck.

- C. Protection: When the Composite Floor Slab is used in an exterior application (such as a balcony), the steel deck shall be adequately protected by field priming and painting with a rust inhibitive paint or by stuccoing the deck. The surface of the concrete shall also be adequately sealed. The composite deck provides positive reinforcement for the slab; therefore, the finish on the steel deck must be specified by the architect and engineer for the environment it will be used in to protect the steel deck for the life of the structure.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the work include but are not limited to the following:
1. Epic Metals Corporation, Rankin, PA
  2. Marcore Composite Deck, Tampa FL
  3. Versa-Dek Composite Deck, New Millennium Building Systems
- B. Deck units, design thickness, section properties, and composite slab capacities shall be as shown on the structural design drawings. These units shall be capable of supporting the design loads shown.

### 2.2 MATERIALS

- A. Deck units shall be cold-formed from steel coils conforming to ASTM A653, Structural Quality, and Grade 45 with minimum yield strength of 45 ksi.
- B. Before forming, the steel coils shall have received a hot-dip protective coating of zinc conforming to ASTM A924, Class G60 or G90 as defined in ASTM A653.
- C. The minimum uncoated thickness of materials furnished shall not be less than 95% of the design thickness.
- D. Sheet Metal Accessories: ASTM A 526, commercial quality, galvanized.
- E. Galvanizing Repair: Where galvanized surfaces are damaged, prepare surfaces and repair in accordance with procedures specified in ASTM A780.
- F. **LEED – Recycled Content of Steel Products: Steel materials shall contain a minimum of [25%] (50%) recycled content**

### 2.3 FABRICATION

- A. Deck units shall be cold-formed by the continuous roll forming process.
1. Composite Floor Deck units shall have continuous dovetail-shaped ribs spaced at 8" o.c. and formed to the following nominal dimensions: 2" depth, 1-1/8" minimum rib width at top, and 1/8" maximum rib opening at bottom to furnish mechanical bond with concrete slabs.
  2. Alternating ribs shall have integral embossed locking lugs to enhance shear bond.

3. Deck units shall have full depth positive registering sidelaps that can be fastened by welds or screws.
4. When exposed, the bottom surfaces of deck units shall be prime painted at the factory. Before painting, the galvanized steel shall be chemically cleaned, pretreated, and coated with a .2 mil epoxy primer, oven-cured, then followed by a second coat of a .5 mil polyester prime paint and then oven-cured. Compatibility of field-applied finish paint with factory-applied prime paint shall be the responsibility of the painting contractor.

## 2.4 ACCESSORIES

- A. Manufacturer's standard column closures and side closures shall be provided where necessary to eliminate the loss of concrete during casting.
- B. Slab edge screed/pour stop angles shall be galvanized 14 ga steel bent plates unless noted otherwise on drawings.

## PART 3 - EXECUTION

### 3.1 GENERAL

- A. Composite floor deck system shall be installed in strict accordance with the manufacturer's instructions, approved erection drawings and applicable safety regulations.
- B. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work. Use welded washers were recommended by deck manufacturer.

### 3.2 EXAMINATION/SHORING

- A. The supporting frame or other related work shall be inspected and accepted by the erector of the deck system prior to the commencement of installation.
- B. Except for very short spans, temporary shoring of the decking is required until the concrete is cast and cured. Shoring spacing shall be determined by the decking supplier and shall be reflected in the engineered shoring drawings. Allowable unshored spans shall be reduced if construction live loads are expected to exceed 20 psf or if less slab deflection is required.
- C. Formwork and temporary shoring shall be installed per approved shop drawings prepared by Specialty Engineer. The installation of formwork and temporary shoring shall be examined prior to loading deck or installing concrete.
- D. A minimum of one level of primary shoring and two levels of reshoring must be used. The primary shoring shall remain in place until the concrete has attained 75% of the design strength. Once the 75% design strength is achieved, the primary shoring can be relieved and the floor immediately reshored. Concrete strength shall be substantiated by field-constructed and field-cured concrete cylinders.

- E. The primary shoring must be relieved and reshored prior to casting the floor/roof above to allow the slab to deflect and distribute the loads to the permanent supporting structure.
- F. The removal of shores shall not occur until after the concrete has reached its full compressive strength  $f'_c$  and has cured for a minimum of 15 days.

### 3.3 PREPARATION

- A. Construction material shall not be located on the deck in such a manner that overloads of any of the individual framing or supporting members. Designed formwork shall be in place for any cast-in-place portions of the floor/roof prior to placing the decking.

### 3.4 INSTALLATION

- A. Deck units and related accessories shall be installed in accordance with manufacturer's approved erection drawings, SDI Publication No. 30, SDI Manual of Construction with Steel Deck, and all federal and state safety regulations.
- B. Before being permanently fastened, deck units shall be placed on the supporting frame and adjusted to final position with ends adequately bearing on the supporting frame. A minimum bearing of 1-1/2" shall be maintained. Consistent coverage shall be maintained.
- C. Cutting of deck units to suit jobsite conditions shall be performed in a neat and workmanlike manner. Only those openings indicated on the structural drawings shall be cut. Other openings shall be cut and reinforced by those requiring the opening as approved by the structural engineer.
- D. Deck units shall be fastened to all supporting members with fasteners as specified at 8" c/c or as indicated on the erection drawings. Fasten to formwork and masonry supports as required for safety.
  - 1. The sides of deck units located at the perimeter of the building shall be fastened to supporting members at a maximum spacing of 24" o.c. or less as indicated on the manufacturer's erection drawings.
- E. The sidelaps of deck units shall be fastened together by 1 inch-long fillet welds or #10 screws, (1-1/2" – long fillet welds or #12 screws if a shear diaphragm is required) at a maximum spacing of 24" o.c. or less as indicated on the erection drawings.
- F. Construction loads shall not be applied to units until after the units are permanently fastened to supporting members and sidelaps have been attached, and shall not exceed the load-carrying capacity of the units.
- G. Joint Covers: Provide metal joint covers or bend down dovetail ends at abutting ends, deck ends, and changes in direction of floor deck units.
- H. Shear Connectors: Weld shear connectors to supports through decking units in accordance with manufacturer's instructions. Do not weld shear connectors through two layers (lapped ends) of decking units. Weld only on clean, dry deck surface.

- I. Closure Strips: Provide metal closure strips at opened uncovered ends and edges of roof decking and in voids between decking and other construction. Weld into position to provide a complete decking installation.
- J. Paint: Touch-up painted and galvanized surfaces with same type of shop paint used on adjacent surfaces.

### 3.5 COMPOSITE SLAB BEAMS

- A. Composite Slab Beams shall be formed and shored in accordance with the ACI Code and with local code provisions. The formwork shall provide a level and continuous support for the adjacent deck units. Place reinforcing steel in strict accordance with contract drawings and approved shop drawings; including clear cover, bar placement, and bar extensions. After form removal, the exposed beam shall provide a surface level with the units and acceptable for directly applied ceiling materials.

### 3.6 FIELD QUALITY CONTROL

- A. Owner will engage an independent testing and inspection agency to inspect deck configuration, welded connections and to perform tests and prepare test reports for all field inspections.
- B. The testing agency will conduct tests in accordance with industry standards and the Special Inspections requirements of the Building Code. The report will state whether or not the tests comply with the requirements. If the test does not comply with the specifications, the report will specifically state any deviations.
- C. Deficiencies that were listed in the inspections and laboratory test reports need to be corrected at the Contractor's expense. Perform any additional tests to reconfirm if there is any more non-compliance of the original work and show compliance of corrected work.
- D. Field Welding: Inspect weld size and spacing for conformance to the shop drawings.
- E. Field Screws: Inspect screw size and spacing for conformance to the shop drawings.

END OF SECTION 05 36 00

## SECTION 05 40 00 - COLD-FORMED METAL FRAMING

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Formed steel stud exterior wall and interior wall framing.
- B. Exterior wall sheathing.

#### 1.2 RELATED REQUIREMENTS

- A. Section 04 26 13 - Masonry Veneer: Veneer masonry supported by wall stud metal framing.
- B. Section 06 10 00 - Rough Carpentry: Wood blocking and miscellaneous framing.
- C. Section 07 21 00 - Thermal Insulation: Insulation within framing members.
- D. Section 07 25 00 - Weather Barriers: A barrier over sheathing.
- E. Section 07 62 00 - Sheet Metal Flashing and Trim: Head and sill flashings.
- F. Section 07 92 00 - Joint Sealants.
- G. Section 09 21 16 - Gypsum Board Assemblies: Lightweight, non-load bearing metal stud framing.

#### 1.3 REFERENCE STANDARDS

- A. AISI S100 - North American Specification for the Design of Cold-Formed Steel Structural Members 2016, with Supplement (2018).
- B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware 2016a.
- C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2020.
- D. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable 2021a.
- E. ASTM C955 - Standard Specification for Cold-Formed Steel Structural Framing Members 2018, with Editorial Revision.
- F. ASTM C1007 - Standard Specification for Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories 2020.
- G. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing 2017.
- H. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic") 2002 (Ed. 2004).

#### 1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate with work of other sections that is to be installed in or adjacent to the metal framing system, including but not limited to structural anchors, cladding anchors, utilities, insulation, and firestopping.

#### 1.5 SUBMITTALS

- A. See Section 01 33 00 for general submittal procedures.
- B. Product Data: Provide data on standard framing members; describe materials and finish, product criteria, limitations.
- C. Shop Drawings: Indicate component details, framed openings, bearing, anchorage, loading, welds, and type and location of fasteners, and accessories or items required of related work.
  - 1. Describe method for securing studs to tracks and for bolted framing connections.
  - 2. Design data:
    - a. Shop drawings signed and sealed by a professional structural engineer.
- D. Manufacturer's Installation Instructions: Indicate special procedures, conditions requiring special attention.
- E. Designer's Qualification Statement.

#### 1.6 QUALITY ASSURANCE

- A. Designer Qualifications: Design framing system under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located.
- B. Manufacturer Qualifications: Company specializing in manufacturing the types of products specified in this section, and with minimum three years of documented experience.
- C. Installer Qualifications: Company specializing in performing the work of this section with minimum three years documented experience.

#### 1.7 MOCK-UP

- A. Construct exterior wall framing mockup as indicated for the Exterior Technical Wall Mockup Panel specified in Section 01 43 89. Mock up components shall include materials specified herein and other components as indicated.
- B. Location: As directed.

## PART 2 PRODUCTS

### 2.1 FRAMING SYSTEM

- A. Provide primary and secondary framing members, bridging, bracing, plates, gussets, clips, fittings, reinforcement, and fastenings as required to provide a complete framing system.
- B. Design Requirements: Provide completed framing system having the following characteristics:
  - 1. Design: Calculate structural characteristics of cold-formed steel framing members according to AISI S100.
  - 2. Structural Performance: Design, engineer, fabricate, and erect to withstand specified design loads for project conditions within required limits.
  - 3. Design Loads: In accordance with applicable codes.
  - 4. Live load deflection meeting the following, unless otherwise indicated:
    - a. Floors: Maximum vertical deflection under live load of 1/480 of span.
    - b. Roofs: Maximum vertical deflection under live load of 1/240 of span.
    - c. Exterior Walls: Maximum horizontal deflection under wind load of 1/180 of span.
    - d. Design non-axial loadbearing framing to accommodate not less than 1/2 in vertical deflection.
  - 5. Able to tolerate movement of components without damage, failure of joint seals, undue stress on fasteners, or other detrimental effects when subject to seasonal or cyclic day/night temperature ranges.
  - 6. Able to accommodate construction tolerances, deflection of building structural members, and clearances of intended openings.

### 2.2 FRAMING MATERIALS

- A. Studs and Track: ASTM C955; studs formed to channel, C- or Sigma-shaped with punched web; U-shaped track in matching nominal width and compatible height.
  - 1. Gauge and Depth: As required to meet specified performance levels.
  - 2. Galvanized in accordance with ASTM A653/A653M, G90/Z275 coating.
  - 3. Provide components fabricated from ASTM A1008/A1008M Designation SS (structural steel).
- B. Framing Connectors: Factory-made, formed steel sheet.
  - 1. Material: ASTM A653/A653M SS Grade 33 and 40 (minimum), with G90/Z275 hot dipped galvanized coating for base metal thickness less than 10 gauge, 0.1345 inch, and factory punched holes and slots.

2. Structural Performance: Maintain load and movement capacity required by applicable code, when evaluated in accordance with AISI S100.
3. Movement Connections: Provide mechanical anchorage devices that accommodate movement using slotted holes, shouldered screws or screws and anti-friction or stepped bushings, while maintaining structural performance of framing. Provide movement connections where indicated on drawings.
  - a. Where continuous studs bypass elevated floor slab, connect stud to slab in manner allowing vertical and horizontal movement of slab without affecting studs; allow for minimum movement of 1/2 inch.
  - b. Where top of stud wall terminates below structural floor or roof, connect studs to structure in manner allowing vertical and horizontal movement of slab without affecting studs; allow for minimum movement of 1/2 inch.
4. Fixed Connections: Provide non-movement connections for tie-down to foundation, floor-to-floor tie-down, roof-to-wall tie-down, joist hangers, gusset plates, and stiffeners.
5. Wall Stud Bridging Connections: Provide mechanical load-transferring devices that accommodate wind load torsion and weak axis buckling induced by axial compression loads. Provide bridging connections where indicated on the drawings.

### 2.3 FASTENERS

- A. Self-Drilling, Self-Tapping Screws, Bolts, Nuts and Washers: Hot dip galvanized per ASTM A153/A153M.
- B. Anchorage Devices: Powder actuated.

### 2.4 WALL SHEATHING

- A. Glass mat faced gypsum board; ASTM C1177/C1177M, square long edges, 5/8 inch thick, Type X - Fire Resistant.

### 2.5 ACCESSORIES

- A. Bracing, Furring, Bridging: Formed sheet steel, thickness determined for conditions encountered; finish to match framing components.
- B. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20 Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify that substrate surfaces are ready to receive work.
- B. Verify field measurements and adjust installation as required.

### 3.2 INSTALLATION OF STUDS

- A. Install components in accordance with manufacturers' instructions and ASTM C1007 requirements.
- B. Place studs at 12 inches on center or as called out on Drawings; not more than 2 inches from abutting walls and at each side of openings. Connect studs to tracks using clip and tie method.
- C. Construct corners using minimum of three studs. Install double studs at wall openings, door and window jambs.
- D. Install load-bearing studs full length in one piece. Splicing of studs is not permitted.
- E. Install load-bearing studs, brace, and reinforce to develop full strength and achieve design requirements.
- F. Coordinate placement of insulation in multiple stud spaces made inaccessible after erection.
- G. Install intermediate studs above and below openings to align with wall stud spacing.
- H. Provide deflection allowance in stud track, directly below horizontal building framing at non-load bearing framing.
- I. Attach cross studs to studs for attachment of fixtures anchored to walls.
- J. Install framing between studs for attachment of mechanical and electrical items, and to prevent stud rotation.
- K. Touch-up field welds and damaged galvanized surfaces with primer.

### 3.3 INSTALLATION OF WALL SHEATHING

- A. Install wall sheathing with long dimension perpendicular to wall studs, with ends over firm bearing and staggered, using self-tapping screws.
  - 1. Provide steel diagonal bracing at corners with foam insulation or gypsum board wall sheathing.

### 3.4 TOLERANCES

- A. Maximum Variation from True Position: 1/4 inch.
- B. Maximum Variation of any Member from Plane: 1/8 inch.

END OF SECTION

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## SECTION 05 50 00 - METAL FABRICATIONS

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Shop fabricated steel items.

#### 1.2 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Placement of metal fabrications in concrete.
- B. Section 03 38 00 - Post-Tensioned Concrete: Placement of metal fabrications in post-tensioned concrete.
- C. Section 04 20 00 - Unit Masonry: Placement of loose lintels, relieving angles and other metal fabrications in masonry.
- D. Section 05 52 13 - Pipe and Tube Railings.

#### 1.3 REFERENCE STANDARDS

- A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel 2019.
- B. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless 2020.
- C. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products 2017.
- D. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates 2018.
- E. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength 2021.
- F. ASTM A501/A501M - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing 2021.
- G. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination 2020.
- H. AWS D1.1/D1.1M - Structural Welding Code - Steel 2020.
- I. IAS AC172 - Accreditation Criteria for Fabricator Inspection Programs for Structural Steel 2018.
- J. SSPC-PA 1 - Shop, Field, and Maintenance Painting of Steel 2016.
- K. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer 1999 (Ed. 2004).
- L. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic") 2002 (Ed. 2004).
- M. SSPC-SP 2 - Hand Tool Cleaning 2018.

#### 1.4 SUBMITTALS

- A. See Section 01 33 00 for submittal procedures.
- B. Product Data: Provide manufacturer's data sheets on alternating tread stair system, including installation instructions.
- C. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.
  - 1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
- D. Sustainable Design Submittals: Refer to Section 01 81 13 for requirements for sustainable design submittals.
  - 1. Manufacturer's Certificate: Certify products meet or exceed specified sustainable design requirements.
    - a. Certify recycled material content for recycled content products.
    - b. Certify source for regional materials and distance from Project site.
  - 2. Product Cost Data: Submit cost of products to verify compliance with Project sustainable design requirements. Exclude cost of labor and equipment to install products.
    - a. Products with recycled material content.
    - b. Regional Products.
- E. Fabricator's Qualification Statement: Provide documentation showing steel fabricator is accredited under IAS AC172.

### PART 2 PRODUCTS

#### 2.1 MATERIALS - STEEL

- A. Steel Sections: ASTM A36/A36M.
- B. Steel Tubing: ASTM A501/A501M hot-formed structural tubing.
- C. Plates: ASTM A283/A283M.
- D. Pipe: ASTM A53/A53M, Grade B Schedule 40, black finish.
- E. Bolts, Nuts, and Washers: ASTM A307, Grade A, plain.
- F. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.
- G. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.

- H. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

## 2.2 FABRICATION

- A. Fit and shop assemble items in largest practical sections, for delivery to site.
- B. Fabricate items with joints tightly fitted and secured.
- C. Continuously seal joined members by intermittent welds and plastic filler.
- D. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.
- E. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.
- F. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

## 2.3 FABRICATED ITEMS

- A. Bumper Posts and Guard Rails: As detailed; prime paint finish.
- B. Bollards: Steel pipe, concrete filled, crowned cap, as detailed; prime paint finish.
- C. Ledge Angles and Shelf Angles Not Attached to Structural Framing: For support of masonry; prime paint finish.
- D. Lintels: As detailed; prime paint finish.
- E. Door Frames for Overhead Door Openings: Channel sections; prime paint finish.
- F. Elevator Hoistway Divider Beams: Beam sections; prime paint finish.

## 2.4 FINISHES - STEEL

- A. Prime paint steel items.
  1. Exceptions: Galvanize items to be embedded in concrete and items to be embedded in masonry.
  2. Exceptions: Do not prime surfaces in direct contact with concrete, where field welding is required, and items to be covered with sprayed fireproofing.
- B. Prepare surfaces to be primed in accordance with SSPC-SP 6.
- C. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.
- D. Prime Painting: Inorganic zinc-rich primer, One coat, minimum 3 - 5 mils DFT. Apply in accordance with SSPC-PA 1 and manufacturer's instructions.

- E. Galvanizing of Structural Steel Members: Galvanize after fabrication to ASTM A123/A123M requirements. Provide minimum 1.7 oz/sq ft galvanized coating.
- F. Galvanizing of Non-structural Items: Galvanize after fabrication to ASTM A123/A123M requirements.

## 2.5 FABRICATION TOLERANCES

- A. Squareness: 1/8 inch maximum difference in diagonal measurements.
- B. Maximum Offset Between Faces: 1/16 inch.
- C. Maximum Misalignment of Adjacent Members: 1/16 inch.
- D. Maximum Bow: 1/8 inch in 48 inches.
- E. Maximum Deviation From Plane: 1/16 inch in 48 inches.

# PART 3 EXECUTION

## 3.1 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive work.

## 3.2 PREPARATION

- A. Clean and strip primed steel items to bare metal where site welding is required.
- B. Furnish setting templates to the appropriate entities for steel items required to be cast into concrete or embedded in masonry.

## 3.3 INSTALLATION

- A. Install items plumb and level, accurately fitted, free from distortion or defects.
- B. Install alternating stair system in accordance with manufacturer's instructions.
- C. Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.
- D. Perform field welding in accordance with AWS D1.1/D1.1M.
- E. Obtain approval prior to site cutting or making adjustments not scheduled.
- F. After erection, prime welds, abrasions, and surfaces not shop primed , except surfaces to be in contact with concrete.
- G. Protect installed fabricated metal items and touch up damaged factory applied primer and galvanized coatings as needed with matching primer paint to prevent rusting and deterioration of steel surfaces prior to final finishes in the field.

### 3.4 TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.
- B. Maximum Offset From True Alignment: 1/4 inch.
- C. Maximum Out-of-Position: 1/4 inch.

END OF SECTION

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## SECTION 05 52 13 - PIPE AND TUBE RAILINGS

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Stair railings and guardrails.
- B. Free-standing railings at steps.

#### 1.2 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Placement of anchors in concrete.
- B. Section 04 20 00 - Unit Masonry: Placement of anchors in masonry.
- C. Section 05 70 00 - Decorative Metal: Balcony railings and guardrails.
- D. Section 09 21 16 - Gypsum Board Assemblies: Placement of backing plates in stud wall construction.

#### 1.3 REFERENCE STANDARDS

- A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design 2010.
- B. AISC 201 - AISC Certification Program for Structural Steel Fabricators, Standard for Steel Building Structures 2006.
- C. ANSI A117.1 - Accessible and Usable Buildings and Facilities
- D. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless 2020.
- E. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes 2021a.
- F. ASTM E935 - Standard Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings 2021.
- G. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination 2020.
- H. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification 2014 (Amended 2015).
- I. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer 1999 (Ed. 2004).

#### 1.4 SUBMITTALS

- A. See Section 01 33 00 for general submittal procedures.
- B. Shop Drawings: Indicate profiles, sizes, connection attachments, anchorage, size and type of fasteners, and accessories.

1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
2. Include the design engineer's seal and signature on each sheet of shop drawings.
- C. Welders' Qualification Statement: Welders' certificates in accordance with AWS B2.1/B2.1M and dated within the previous 12 months.
- D. Designer's Qualification Statement.

## 1.5 QUALITY ASSURANCE

- A. Structural Designer Qualifications: Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located, or personnel under direct supervision of such an engineer.
- B. Welder Qualifications: Welding processes and welding operators qualified within previous 12 months.
- C. Fabricator Qualifications:
  1. A qualified steel fabricator that is certified by the American Institute for Steel Construction (AISC) under AISC 201.

## PART 2 PRODUCTS

### 2.1 RAILINGS - GENERAL REQUIREMENTS

- A. Design, fabricate, and test railing assemblies in accordance with the most stringent requirements of applicable local code.
- B. Distributed Loads: Design railing assembly, wall rails, and attachments to resist distributed force of 75 pounds per linear foot applied to the top of the assembly and in any direction, without damage or permanent set. Test in accordance with ASTM E935.
- C. Concentrated Loads: Design railing assembly, wall rails, and attachments to resist a concentrated force of 200 pounds applied at any point on the top of the assembly and in any direction, without damage or permanent set. Test in accordance with ASTM E935.
- D. Allow for expansion and contraction of members and building movement without damage to connections or members.
- E. Dimensions: See drawings for configurations and heights.
- F. Provide anchors and other components as required to attach to structure, made of same materials as railing components unless otherwise indicated; where exposed fasteners are unavoidable provide flush countersunk fasteners.
  1. For anchorage to concrete, provide inserts to be cast into concrete, for bolting anchors.
  2. For anchorage to masonry, provide brackets to be embedded in masonry, for bolting anchors.

3. For anchorage to stud walls, provide backing plates, for bolting anchors.
- G. Provide mechanical and welding fittings where indicated to join lengths, seal open ends, and conceal exposed mounting bolts and nuts, including but not limited to elbows, T-shapes, splice connectors, flanges, escutcheons, and wall brackets.

## 2.2 STEEL RAILING SYSTEM

- A. Steel Tube: ASTM A500/A500M Grade B cold-formed structural tubing.
- B. Steel Pipe: ASTM A53/A53M Grade B Schedule 80, black finish.
- C. Non-Weld Mechanical Fittings: Slip-on, galvanized malleable iron castings, for Schedule 40 pipe, with flush setscrews for tightening by standard hex wrench, no bolts or screw fasteners.
- D. Welding Fittings: Factory- or shop-welded from matching pipe or tube; seams continuously welded; joints and seams ground smooth.
- E. Exposed Fasteners: No exposed bolts or screws.
- F. Straight Splice Connectors: Steel concealed spigots.
- G. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.

## 2.3 FABRICATION

- A. Accurately form components to suit specific project conditions and for proper connection to building structure.
- B. Fit and shop assemble components in largest practical sizes for delivery to site.
- C. Fabricate components with joints tightly fitted and secured. Provide spigots and sleeves to accommodate site assembly and installation.
- D. Welded Joints:
  1. Exterior Components: Continuously seal joined pieces by intermittent welds and plastic filler. Drill condensate drainage holes at bottom of members at locations that will not encourage water intrusion.
  2. Interior Components: Continuously seal joined pieces by intermittent welds and plastic filler.
  3. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive work.

### 3.2 PREPARATION

- A. Clean and strip primed steel items to bare metal where site welding is required.
- B. Supply items required to be cast into concrete or embedded in masonry with setting templates, for installation as work of other sections.

### 3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install components plumb and level, accurately fitted, free from distortion or defects, with tight joints.
- C. Install railings in compliance with ADA Standards and ANSI A117.1 for accessible design at applicable locations.
- D. Anchor railings securely to structure.
- E. Field weld anchors as indicated on drawings. Touch-up welds with primer. Grind welds smooth.
- F. Conceal anchor bolts and screws whenever possible. Where not concealed, use flush countersunk fastenings.

### 3.4 TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch per floor level, non-cumulative.
- B. Maximum Offset From True Alignment: 1/4 inch.
- C. Maximum Out-of-Position: 1/4 inch.

END OF SECTION

## SECTION 05 53 05 - METAL GRATINGS AND FLOOR PLATES

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Formed metal floor gratings.
- B. Perimeter closure.

#### 1.2 RELATED REQUIREMENTS

- A. Section 05 50 00 - Metal Fabrications.

#### 1.3 REFERENCE STANDARDS

- A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel 2019.
- B. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products 2017.
- C. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware 2016a.
- D. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination 2020.
- E. AWS D1.1/D1.1M - Structural Welding Code - Steel 2020.
- F. NAAMM MBG 532 - Heavy Duty Metal Bar Grating Manual 2009.
- G. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic") 2002 (Ed. 2004).

#### 1.4 SUBMITTALS

- A. See Section 01 33 00 for general submittal procedures.
- B. Product Data: Provide span and deflection tables.
- C. Shop Drawings: Indicate details of component supports, openings, perimeter construction details, and tolerances.
  1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
  2. Include the design engineer's seal and signature on each sheet of shop drawings.
- D. Samples: Submit two samples, 24 by 24 inch in size illustrating surface finish, color, and texture.
- E. Welders' Certificates: Submit certification for welders employed on the project, verifying AWS qualification within the previous 12 months.
- F. Designer's Qualification Statement.

- G. Manufacturer's Installation Instructions: Indicate special requirements for opening and perimeter framing.

## 1.5 QUALITY ASSURANCE

- A. Designer Qualifications: Design gratings and plates under direct supervision of a licensed Professional Engineer experienced in design of this type of work.
- B. Designer Qualifications: Design gratings and plates under direct supervision of a Professional Structural Engineer experienced in design of this type of work and licensed in the State in which the Project is located.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.
- B. Storage: Store materials in a clean, dry area in accordance with manufacturer's instructions. Allow adequate ventilation of products to prevent condensation forming on grating surfaces. Do not store for extended time in original banding or distortion may occur in products.
- C. Handling: Protect materials, surfaces, and finishes during handling and installation to prevent damage. .

# PART 2 PRODUCTS

## 2.1 INTAKE/EXHAUST SHAFT GRATE

- A. Bar Grating: Plain Steel or Galvanized Steel as indicated on the Drawings; welded construction; 36 inches by 240 inches panel sizes; GW Series 150A as manufactured by McNichols or approved equal. Refer to Section 01 25 00 for requirements regarding submittal and approval procedures for substitutions.

## 2.2 PERFORMANCE REQUIREMENTS

- A. Design Live (Pedestrian) Load: Uniform load of 100 lb/sq ft minimum; concentrated load of 300 lbs.
- B. Maximum Allowable Deflection Under Live Load: 1/240 of span; size components by single support design.
- C. Percent Open Area: As indicated on the mechanical drawings.

## 2.3 MATERIALS

- A. Steel Framing: ASTM A36/A36M shapes, unfinished.
- B. Cross Bars: ASTM B211 (ASTM B211M) solid bars.
- C. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.

- D. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20 Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

#### 2.4 ACCESSORIES

- A. Fasteners and Saddle Clips: Galvanized steel:
- B. Perimeter Closure: Of same material as grating.

#### 2.5 FABRICATION

- A. Fabricate grates to sizes indicated and to accomodate indicated loading.
- B. Weld joints of intersecting metal sections.
- C. Fabricate support framing for openings.
- D. Top Surface: smooth.

#### 2.6 FINISHES

- A. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.
- B. Galvanizing for Steel Shapes: ASTM A123/A123M.
- C. Galvanizing for Steel Hardware: ASTM A153/A153M.

### PART 3 EXECUTION

#### 3.1 EXAMINATION

- A. Verify that field measurements are as indicated on drawings.
- B. Verify that opening sizes and dimensional tolerances are acceptable.
- C. Verify that supports are correctly positioned.

#### 3.2 INSTALLATION

- A. Install components in accordance with manufacturer's instructions.
- B. Place frames in correct position, plumb and level.
- C. Anchor by welding.
- D. Set perimeter closure flush with top of grating and surrounding construction.
- E. Secure to prevent movement.

#### 3.3 TOLERANCES

- A. Comply with NAAMM MBG 532.

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## SECTION 05 70 00 - DECORATIVE METAL

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Wall-mounted handrails.
- B. Exterior Entrance canopies.
- C. Aluminum balcony and parapet railings.

#### 1.2 RELATED REQUIREMENTS

- A. Section 01 74 19 - Construction Waste Management and Disposal: Additional requirements for cleaning.
- B. Section 07 42 00 – Wall Panels: Trim at balcony railings and canopies, .

#### 1.3 REFERENCE STANDARDS

- A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials Current Edition.
- B. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix) 2017a.
- C. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design 2010.
- D. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes 2021.
- E. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric) 2021.
- F. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass 2018.
- G. ASTM C1172 - Standard Specification for Laminated Architectural Flat Glass 2019.
- H. ASTM E935 - Standard Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings 2021.

#### 1.4 ADMINISTRATIVE REQUIREMENTS

- A. Pre-Installation Meeting: Schedule and conduct a preinstallation meeting one week before starting work of this section. Attendees shall include, but not be limited to:
  1. Contractor.
  2. Manufacturer's representative.
  3. Architect.

4. Owner's representative.
5. Other subcontractors of adjacent work.

## 1.5 SYSTEM REQUIREMENTS

- A. Design Requirements: Drawings are diagrammatic and are intended to establish basic dimension of units, sight lines, and profiles of units.
  1. Fabricator: Responsible for designing system, including anchorage to structural system and necessary modifications to meet specified requirements and maintain visual design concepts.
  2. Employ registered professional engineer, licensed to practice structural engineering in Project Location State, to engineer each component of handrail and railing systems.
  3. Provide concealed fastening wherever possible.
  4. Extend railings 12 inches beyond top riser and 12 inches beyond plus one tread beyond bottom riser where not continuous.
- B. Make clear distance between components of guardrail infill such that 4 inch diameter sphere cannot pass through opening.
- C. Structural Requirements:
  1. Handrails: Capable of withstanding following loads applied as indicated.
    - a. Concentrated load of 200 pounds applied at any point in any direction.
    - b. Uniform load of 50 PLF applied in any direction.
    - c. Concentrated and uniform loads above need not be applied simultaneously.
  2. Wind Screen and Guardrail System: Capable of withstanding following loads applied as indicated.
    - a. Concentrated load of 200 pounds applied at any point and in any direction at top of guardrail system.
    - b. Uniform load of 50 PLF applied in any direction.
    - c. Concentrated and uniform loads above need not be applied simultaneously.
  3. Infill Area of Guardrail System: Intermediate rails, balusters, pickets, and panel fillers shall withstand horizontal load of 50 pounds on area not to exceed 1 SF at any point. Above load need not be assumed to be acting concurrently with horizontal loads on railing system.
- D. Interface with Adjacent Systems: Integrate design and connections with adjacent construction.
  1. Accommodate allowable tolerances and deflections for structural members in installation.

## 1.6 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures, for submittal procedures.
- B. Product Data: Submit manufacturer's product data, including description of materials, components, finishes, fabrication details, glass, anchors, and accessories.
- C. Shop Drawings: Indicate railing system elevations and sections, details of profile, dimensions, sizes, connection attachments, anchorage, size and type of fasteners, and accessories. Indicate anchor and joint locations, brazed connections, transitions, and terminations.
- D. Test Reports: Submit test reports from an independent testing agency showing compliance with specified design and performance requirements.
- E. Manufacturer's Installation Instructions.
- F. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

## 1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in installing entrance canopies, decorative stairs and railing systems and acceptable to manufacturer.
- B. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with not less than three years of documented experience.
- C. Templates: Supply installation templates, reinforcing, and required anchorage devices.

## 1.8 MOCK-UP

- A. Provide mock-up of exterior railing system, wall-mounted handrail, and guardrail, illustrating each type of material, cladding, and finish.
- B. Provide mock up of canopy systems as part of the exterior technical wall mockup. Refer to Section 01 43 89 for addition information.
- C. Locate where directed.
- D. Mock-up may remain as part of the work.

## 1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in factory-provided protective coverings and packaging.
- B. Protect materials against damage during transit, delivery, storage, and installation at site.
- C. Inspect materials upon delivery for damage. Repair damage to be indistinguishable from undamaged areas; if damage cannot be repaired to be indistinguishable from undamaged parts and finishes, replace damaged items.

- D. Prior to installation, store materials and components under cover in a dry location.

#### 1.10 FIELD CONDITIONS

- A. Do not install interior railings until project is enclosed and ambient temperature of space is minimum 65 degrees F and maximum 95 degrees F.
- B. Maintain ambient temperature of space at minimum 65 degrees F and maximum 95 degrees F for 24 hours before, during, and after railing installation.

#### 1.11 WARRANTY

- A. Warranty: Manufacturer's standard one year warranty against defects in materials, fabrication, finishes, and installation commencing on Date of Substantial Completion.

### PART 2 PRODUCTS

#### 2.1 ENTRANCE CANOPIES

- A. Custom cantilever canopy, metal panel clad, fabricated from structural steel shapes and plate. Develop fabrication design by Professional Engineer licensed in the Commonwealth of Virginia in accordance with the requirements of Section 01 40 00. Provide shop drawings for review of conformance of aesthetic design intent.
- B. Concealed drainage. Water shall drain from covered surfaces into intermediate trough and be directed to Front Scupper.
- C. Fasteners: 3/16 inch fasteners with a minimum shear stress of 350 lb. Pre-welded or factory-welded connections are not acceptable.
- D. Structural Framing members: Structural Steel shapes and plate as specified in Section 05 50 13.
- E. Cladding:
  1. Aluminum Composite Metal Panel as specified in Section 07 42 13.23.

#### 2.2 RAILING SYSTEMS

- A. Railing Systems - General: Factory- or shop-fabricated in design indicated, to suit specific project conditions, and for proper connection to building structure, and in largest practical sizes for delivery to site.
  1. Performance Requirements: Design and fabricate railings and anchorages to resist the following loads without failure, damage, or permanent set; loads do not need to be applied simultaneously.
    - a. Lateral Force: 75 lb minimum, at any point, when tested in accordance with ASTM E935.
    - b. Distributed Load: 50 lb/ft minimum, applied in any direction at the top of the handrail, when tested in accordance with ASTM E935.

- c. Concentrated Loads on Intermediate Rails: 50 psf, minimum.
  - d. Concentrated Load: 200 lbs minimum, applied in any direction at any point along the handrail system, when tested in accordance with ASTM E935.
  - 2. Assembly: Join lengths, seal open ends, and conceal exposed mounting bolts and nuts using slip-on non-weld mechanical fittings, flanges, escutcheons, and wall brackets; provide a minimum 5/16 inch vent/weep hole at bottom of all post located in exterior locations.
  - 3. Joints: Tightly fitted and secured, machined smooth with hairline seams.
  - 4. Field Connections: Provide sleeves to accommodate site assembly and installation.
- B. Metal Tube Railing: Engineered, extruded aluminum post supported railing system with metal infill.
- 1. Configuration: Guardrail only.
  - 2. Overall height: 42 inches.
  - 3. Top Rail: 1-7/16 inch by 2-1/4 inch, rectangular extrusion
  - 4. Trim-line Post: Aluminum, 2 inch square.
  - 5. Bottom Rail: Aluminum channel; 2 inch by 3/4 inch
  - 6. Fascia Mounted system with 3/8 inch stainless steel wedge anchor.
  - 7. Wall Mounted Components: Components necessary to support railing with 1-1/2 inch clearance from wall, and as follows:
    - a. Underslung support brackets: Supports at 60 inches, maximum.
  - 8. Fasteners: Concealed.
  - 9. Infill at Picket Railings: Vertical pickets.
    - a. Horizontal Spacing: Maximum 4 inches on center.
    - b. Material: Aluminum tube.
    - c. Shape: Square.
    - d. Size: 3/4 inch IPS / 1.05 inch OD.
    - e. Top Mounting: Mechanically attached by internal fittings.
    - f. Bottom Mounting: As indicated on drawings.
  - 10. Aluminum Finish, Exposed Surfaces: High performance organic finish.
  - 11. End and Intermediate Posts: As shown on drawings.

- a. Horizontal Spacing: As indicated on drawings.
  - b. Mounting: Welded.
- C. Glazed Post Railing System: Engineered, post supported railing system with glass infill panels for second floor terrace area railings.
- 1. Subject to compliance with requirements; provide Series 1100 Glass Railing system, fascia mount as manufactured by Hansen Architectural Systems or approved equal. Refer to Section 01 25 00 for requirements for submittal and approval of proposed alternate products.
  - 2. Configuration: Guardrail only.
  - 3. Top and Bottom Rail: Rectangular, aluminum, 2 inch tall by 4 inch wide. Sealed insert at ends.
  - 4. In-line and Corner Posts: Rectangular, extruded aluminum 3 inch square with surface mounted base plates.
  - 5. Glass: Laminated fully tempered glass.
  - 6. Glass Mounts: 3/4 inch tube frame riveted to post and rail, same metal as railing; no holes drilled in glass.
  - 7. Aluminum Finish, Exposed Surfaces: High performance organic finish.
- D. Wall-Mounted Handrail:
- 1. 1-1/4 inch IPS / 1.66 inch OD aluminum, natural finish.
  - 2. Internal Connection Sleeves: Sleeve, material compatible with handrail and top cap material.
  - 3. Handrail Brackets: Manufacturer's standard aluminum brackets.
    - a. Finish: Clear anodized.

## 2.3 MATERIALS

- A. Aluminum Components: ASTM B221 or ASTM B221M.
- 1. Tubes: Schedule 40 pipe.
  - 2. High Performance Organic Finish: AAMA 2604; multiple coats, thermally cured fluoropolymer system. Color to match #2 paneling system color, Black Grey;
- B. Glass: Laminated safety glass; ASTM C1172 Type II, unless otherwise indicated.
- 1. Plastic Interlayer: Minimum 0.060 inch thick.
  - 2. Glass Lites: Fully tempered, ASTM C1048 clear.
  - 3. Impact Strength: Category II, tested in accordance with 16 CFR 1201.

4. Thickness: 1/2 inch unless indicated otherwise.
5. Edges: Ground smooth and polished.
6. Color: Clear, no tint.

## 2.4 ACCESSORIES

- A. Non-Weld Mechanical Fittings for Aluminum Railings: In-line aluminum fittings, with flush setscrews for tightening by standard hex wrench, no bolts or screw fasteners.
- B. Welding Fittings: Factory- or shop-welded from matching pipe or tube; joints and seams ground smooth.
- C. Anchors and Fasteners: Provide anchors and other materials as required to attach to structure, made of same materials as railing components unless otherwise indicated; where exposed fasteners are unavoidable provide flush countersunk fasteners.
  1. Provide stainless steel fasteners and anchors at all railing mounting at exterior locations.
  2. For anchorage to concrete, provide inserts to be cast into concrete for bolt anchors.
  3. For anchorage to masonry, provide brackets to be embedded in masonry for bolt anchors.
  4. For anchorage to stud walls, provide backing plates for bolt anchors.
  5. Exposed Fasteners: No exposed bolts or screws.
- D. Bituminous Coating: Cold-applied asphalt mastic, noncorrosive compound free of asbestos, sulfur, and other deleterious impurities; 0.015 inch dry film thickness per coat.
- E. Sealant: Silicone; black.
- F. Finish Touch-Up Materials: As recommended by manufacturer for field application.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify that substrate and site conditions are acceptable and ready to receive work.
- B. Verify field dimensions of locations and areas to receive work.
- C. Notify Architect immediately of conditions that would prevent satisfactory installation.
- D. Do not proceed with work until detrimental conditions have been corrected.
- E. Furnish components to be installed in other work to installer of that other work, including but not limited to blocking, sleeves, inserts, anchor bolts, embedded plates, and supports for attachment of anchors.

### 3.2 PREPARATION

- A. Review installation drawings before beginning installation. Coordinate diagrams, templates, instructions, and directions for installation of anchorages and fasteners.
- B. Clean surfaces to receive units. Remove materials and substances detrimental to the installation.

### 3.3 INSTALLATION

- A. Comply with manufacturer's drawings and written instructions.
- B. Install components plumb and level, accurately fitted, free from distortion or defects, and with tight joints, except where necessary for expansion.
- C. Anchor securely to structure.
- D. Conceal anchor bolts and screws whenever possible. Where not concealed, use flush countersunk fastenings.
- E. Isolate dissimilar materials with bituminous coating, bushings, grommets, or washers to prevent electrolytic corrosion.

### 3.4 TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch per floor level, non-cumulative.
- B. Maximum Offset From True Alignment: 1/4 inch.
- C. Maximum Out-of-Position: 1/4 inch.

### 3.5 FIELD QUALITY CONTROL

- A. Field Services: Provide the services of the manufacturer for field observation of installation of railings.

### 3.6 CLEANING

- A. Remove protective film from exposed metal surfaces.
- B. Metal: Clean exposed metal finishes with potable water and mild detergent, in accordance with manufacturer recommendations; do not use abrasive materials or chemicals, detergents, or other substances that may damage the material or finish.
- C. Glass and Glazing: Clean glazing surfaces; remove excess glazing sealant compounds, dirt, and other substances.
- D. See Section 01 74 19 - Construction Waste Management and Disposal, for additional requirements.

### 3.7 PROTECTION

- A. Protect installed components and finishes from damage after installation.

- B. Repair damage to exposed finishes to be indistinguishable from undamaged areas.
  1. If damage to finishes and components cannot be repaired to be indistinguishable from undamaged finishes and components, replace damaged items.

END OF SECTION

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## SECTION 06 10 53 - MISCELLANEOUS ROUGH CARPENTRY

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Roof-mounted curbs.
- B. Preservative treated wood materials.
- C. Communications and electrical room mounting boards.
- D. Concealed wood blocking, nailers, and supports.
- E. Miscellaneous wood nailers, furring, and grounds.

#### 1.2 REFERENCE STANDARDS

- A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware 2016a.
- B. ASTM C557 - Standard Specification for Adhesives for Fastening Gypsum Wallboard to Wood Framing 2003 (Reapproved 2017).
- C. ASTM D3498 - Standard Specification for Adhesives for Field-Gluing Wood Structural Panels (Plywood or Oriented Strand Board) to Wood Based Floor System Framing 2019a.
- D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2021a.
- E. AWPA U1 - Use Category System: User Specification for Treated Wood 2018.
- F. PS 1 - Structural Plywood 2009 (Revised 2019).
- G. PS 20 - American Softwood Lumber Standard 2020.

#### 1.3 DELIVERY, STORAGE, AND HANDLING

- A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.

### PART 2 PRODUCTS

#### 2.1 GENERAL REQUIREMENTS

- A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.
  - 1. If no species is specified, provide species graded by the agency specified; if no grading agency is specified, provide lumber graded by grading agency meeting the specified requirements.

2. Grading Agency: Grading agency whose rules are approved by the Board of Review, American Lumber Standard Committee ([www.alsc.org](http://www.alsc.org)) and who provides grading service for the species and grade specified; provide lumber stamped with grade mark unless otherwise indicated.
- B. Provide wood harvested within a 500 mile radius of the project site.

## 2.2 DIMENSION LUMBER FOR CONCEALED APPLICATIONS

- A. Sizes: Nominal sizes as indicated on drawings, S4S.
- B. Moisture Content: S-dry or MC19.
- C. Miscellaneous Framing, Blocking, Nailers, Grounds, and Furring:
  1. Lumber: S4S, No.2 or Standard Grade.
  2. Boards: Standard or No.3.

## 2.3 CONSTRUCTION PANELS

- A. Communications and Electrical Room Mounting Boards: PS 1, A-D plywood, or medium density fiberboard; 3/4 inch thick; flame spread index of 25 or less, smoke developed index of 450 or less, when tested in accordance with ASTM E84.
- B. Other Applications:
  1. Plywood Concealed From View But Located Within Exterior Enclosure: PS 1, C-C Plugged or better, Exterior grade.
  2. Plywood Exposed to View But Not Exposed to Weather: PS 1, A-D, or better.
  3. Other Locations: PS 1, C-D Plugged or better.

## 2.4 ACCESSORIES

- A. Fasteners and Anchors:
  1. Metal and Finish: Hot-dipped galvanized steel complying with ASTM A153/A153M for high humidity and preservative-treated wood locations, unfinished steel elsewhere.
  2. Anchors: Toggle bolt type for anchorage to hollow masonry.
- B. Construction Adhesives: Adhesives complying with ASTM C557 or ASTM D3498.

## 2.5 FACTORY WOOD TREATMENT

- A. Treated Lumber and Plywood: Comply with requirements of AWPA U1 - Use Category System for wood treatments determined by use categories, expected service conditions, and specific applications.

1. Preservative-Treated Wood: Provide lumber and plywood marked or stamped by an ALSC-accredited testing agency, certifying level and type of treatment in accordance with AWPA standards.
- B. Preservative Treatment:
  1. Preservative Pressure Treatment of Lumber Above Grade: AWPA U1, Use Category UC3B, Commodity Specification A using waterborne preservative.
    - a. Kiln dry lumber after treatment to maximum moisture content of 19 percent.
    - b. Treat lumber in contact with roofing, flashing, or waterproofing.
    - c. Treat lumber in contact with masonry or concrete.

## PART 3 EXECUTION

### 3.1 PREPARATION

- A. Coordinate installation of rough carpentry members specified in other sections.

### 3.2 INSTALLATION - GENERAL

- A. Select material sizes to minimize waste.
- B. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including: shims, bracing, and blocking.
- C. Where treated wood is used on interior, provide temporary ventilation during and immediately after installation sufficient to remove indoor air contaminants.

### 3.3 BLOCKING, NAILERS, AND SUPPORTS

- A. Provide framing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim.
- B. In framed assemblies that have concealed spaces, provide solid wood fireblocking as required by applicable local code, to close concealed draft openings between floors and between top story and roof/attic space; other material acceptable to code authorities may be used in lieu of solid wood blocking.
- C. In metal stud walls, provide continuous blocking around door and window openings for anchorage of frames, securely attached to stud framing.
- D. In walls, provide blocking attached to studs as backing and support for wall-mounted items, unless item can be securely fastened to two or more studs or other method of support is explicitly indicated.
- E. Where ceiling-mounting is indicated, provide blocking and supplementary supports above ceiling, unless other method of support is explicitly indicated.
- F. Provide the following specific nonstructural framing and blocking:

1. Cabinets and shelf supports.
2. Handrails.
3. Grab bars.
4. Joints of rigid wall coverings that occur between studs.

### 3.4 ROOF-RELATED CARPENTRY

- A. Coordinate installation of roofing carpentry with deck construction, framing of roof openings, and roofing assembly installation.
- B. Provide wood curb at roof openings except where specifically indicated otherwise. Form corners by alternating lapping side members.

### 3.5 INSTALLATION OF CONSTRUCTION PANELS

- A. Communications and Electrical Room Mounting Boards: Secure with screws to studs with edges over firm bearing; space fasteners at maximum 24 inches on center on edges and into studs in field of board.
  1. At fire-rated walls, install board over wall board indicated as part of the fire-rated assembly.
  2. Where boards are indicated as full floor-to-ceiling height, install with long edge of board parallel to studs.
  3. Install adjacent boards without gaps.
  4. Size: 48 by 96 inches, installed horizontally at ceiling height.

### 3.6 CLEANING

- A. Waste Disposal: See Section 01 74 19 - Construction Waste Management and Disposal.
  1. Comply with applicable regulations.
  2. Do not burn scrap on project site.
  3. Do not burn scraps that have been pressure treated.
  4. Do not send materials treated with pentachlorophenol, CCA, or ACA to co-generation facilities or “waste-to-energy” facilities.
- B. Do not leave wood, shavings, sawdust, etc. on the ground or buried in fill.
- C. Prevent sawdust and wood shavings from entering the storm drainage system.

END OF SECTION

## SECTION 06 15 33 - WOOD PATIO DECKING

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Wood decking and framing.

#### 1.2 RELATED REQUIREMENTS:

- A. Section 072500 "Weather Barriers" for flexible flashing used with patio decking.
- B. Section 076200 "Sheet Metal Flashing and Trim" for sheet metal flashing used with patio decking.

#### 1.3 DEFINITIONS

- A. Boards: Lumber of less than 2 inches nominal (38 mm actual) in thickness and 2 inches nominal (38 mm actual) or greater in width.
- B. Dimension Lumber: Lumber of 2 inches nominal (38 mm actual) or greater but less than 5 inches nominal (114 mm actual) in least dimension.
- C. Timber: Lumber of 5 inches nominal (114 mm actual) or greater in least dimension.
- D. Lumber grading agencies, and the abbreviations used to reference them, include the following:
  1. NeLMA: Northeastern Lumber Manufacturers' Association.
  2. NLGA: National Lumber Grades Authority.
  3. RIS: Redwood Inspection Service.
  4. SPIB: The Southern Pine Inspection Bureau.
  5. WCLIB: West Coast Lumber Inspection Bureau.
  6. WWPA: Western Wood Products Association.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For preservative-treated wood products and anchor systems.
  1. For preservative-treated wood products. Include chemical treatment manufacturer's written instructions for handling, storing, installing, and finishing treated material.
- B. Sustainable Design Submittals:

1. Product Data for LEED v2009 Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
2. Product Certificates for LEED v2009 Credit MR 5: For products and materials required to comply with requirements for regional materials, certificates indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating distance to Project, cost for each regional material, and fraction by weight that is considered regional.

## 1.5 INFORMATIONAL SUBMITTALS

### A. Material Certificates:

1. For lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by ALSC's Board of Review.
  2. For preservative-treated wood products. Indicate type of preservative used and net amount of preservative retained. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
- B. Certificates of Inspection: Issued by lumber grading agency for exposed wood products not marked with grade stamp.
- C. Evaluation Reports: For the following, from ICC-ES:
1. Preservative-treated wood products.
  2. Expansion anchors.
  3. Metal framing anchors.
  4. Decking fasteners.

## 1.6 QUALITY ASSURANCE

### A. Mockups: See materials schedule for additional information

1. Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion. If mockup is not retained, remove and properly dispose of mock-up.
3. Install a 4 ft x 4 ft mockup for review and approval by owner and landscape architect prior to construction. Mockup shall show typical conditions as well as at least one of edge conditions found in the project.

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store materials under cover and protected from weather and contact with damp or wet surfaces. Stack lumber flat with spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings.
- B. Handle and store plastic lumber to comply with manufacturer's written instructions.

## PART 2 - PRODUCTS

### 2.1 LUMBER, GENERAL

- A. Comply with DOC PS 20 and with grading rules of lumber grading agencies certified by ALSC's Board of Review as applicable. If no grading agency is indicated, comply with the applicable rules of any rules-writing agency certified by ALSC's Board of Review.
  1. Factory mark each item with grade stamp of grading agency.
  2. For items that are exposed to view in the completed Work, mark grade stamp on end or back of each piece or omit grade stamp and provide certificates of grade compliance issued by grading agency.
  3. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry wood products.
  4. Provide dressed lumber, S4S, unless otherwise indicated.

- B. Maximum Moisture Content:

1. Boards: 15 percent.
  2. Dimension Lumber: 19 percent.

### 2.2 DIMENSION LUMBER FRAMING

- A. Deck and Stair Framing: No. 2 grade and any of the following species:
  1. Hem-fir (North); NLGA.
  2. Southern pine; SPIB.
  3. Douglas fir-larch; WCLIB or WWPA.
  4. Mixed southern pine; SPIB.
  5. Spruce-pine-fir; NLGA.
  6. Douglas fir-south; WWPA.
  7. Hem-fir; WCLIB or WWPA.

8. Douglas fir-larch (North); NLGA.
9. Spruce-pine-fir (South); NeLMA, WCLIB, or WWPA.

## 2.3 PRESERVATIVE TREATMENT

- A. Pressure treat boards and dimension lumber with waterborne preservative according to AWPA U1; Use Category UC3b for exterior construction not in contact with the ground, and Use Category UC4a for items in contact with the ground.
- B. Pressure treat timber with waterborne preservative according to AWPA U1; Use Category UC4a.
- C. Pressure treat poles with waterborne preservative according to AWPA U1; Use Category UC4a.
- D. Preservative Chemicals: Acceptable to authorities having jurisdiction.
  1. Do not use chemicals containing arsenic or chromium.
- E. Use process that includes water-repellent treatment.
- F. Use process that does not include water repellents or other substances that might interfere with application of indicated finishes.
- G. After treatment, redry dimension lumber to 19 percent maximum moisture content.
- H. Mark treated wood with treatment quality mark of an inspection agency approved by ALSC's Board of Review.
  1. For items indicated to receive a stained or natural finish, omit marking and provide certificates of treatment compliance issued by inspection agency.
- I. Application: Treat items indicated on Drawings and the following:
  1. Framing members.
  2. Sills and ledgers.
  3. Members in contact with masonry or concrete.
  4. Posts.
  5. Decking.
  6. Stair treads.

## 2.4 FASTENERS

- A. General: Provide fasteners of size and type indicated, acceptable to authorities having jurisdiction, and that comply with requirements specified in this article for material and manufacture. Provide nails or screws, in sufficient length, to penetrate not less than 1-1/2 inches (38 mm) into wood substrate.

1. Use fasteners with hot-dip zinc coating complying with ASTM A153/A153M or ASTM F2329 unless otherwise indicated.
  2. For pressure-preservative-treated wood, use stainless-steel fasteners.
  3. For wood decking, use stainless-steel fasteners where fasteners are exposed to view.
- B. Hidden Fasteners: See materials schedule.
- C. Nails: ASTM F1667.
- D. Power-Driven Fasteners: ICC-ES AC70.
- E. Wood Screws and Lag Screws: ASME B18.2.1, ASME B18.6.1, or ICC-ES AC233.
- F. Carbon-Steel Bolts: ASTM A307 (ASTM F568M) with ASTM A563 (ASTM A563M) hex nuts and, where indicated, flat washers all hot-dip zinc coated.
- G. Stainless-Steel Bolts: ASTM F593, Alloy Group 1 or 2 (ASTM F738M, Grade A1 or Grade A4); with ASTM F594, Alloy Group 1 or 2 (ASTM F836M, Grade A1 or Grade A4) hex nuts and, where indicated, flat washers.
- H. Postinstalled Anchors: Stainless-steel anchors with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing according to ASTM E488 conducted by a qualified independent testing and inspecting agency.
1. Stainless-steel bolts and nuts complying with ASTM F593 and ASTM F594, Alloy Group 1 or 2 (ASTM F738M and ASTM F836M, Grade A1 or Grade A4).

## 2.5 PEDESTALS AND SHIM FRAMING SUPPORTS

- A. Subject to compliance with requirements, provide the following:
1. See materials schedule.

## 2.6 DECKING

- A. See materials schedule.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Clean substrates of projections and substances detrimental to application.

### 3.3 INSTALLATION, GENERAL

- A. Set work to required levels and lines, with members plumb, true to line, cut, and fitted. Fit work to other construction; scribe and cope as needed for accurate fit.
- B. Framing Standard: Comply with AF&PA WCD1 unless otherwise indicated.
- C. Install wood decking and stair treads with crown up (bark side down).
- D. Install plastic lumber to comply with manufacturer's written instructions.
- E. Secure decking to framing with fastening system. Utilize 3/16-inch joint between all deck boards.
- F. Install metal framing anchors to comply with manufacturer's written instructions.
- G. Do not splice structural members between supports unless otherwise indicated.
- H. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.
- I. Sort and select lumber so that natural characteristics do not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of members or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- J. Apply copper naphthenate field treatment to comply with AWPA M4, to cut surfaces of preservative-treated lumber.
- K. Securely attach exterior rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
  1. ICC-ES AC70 for power-driven fasteners.
  2. "Fastening Schedule" in ICC's International Building Code.
  3. "Fastener Schedule for Structural Members" and "Alternate Attachments" in ICC's International Residential Code for One- and Two-Family Dwellings.
- L. Use common wire nails unless otherwise indicated. Select fasteners of size that do not fully penetrate members where opposite side is exposed to view. Make tight connections between members. Install fasteners without splitting wood; do not countersink nail heads unless otherwise indicated.
- M. For exposed work, arrange fasteners in straight rows parallel with edges of members, with fasteners evenly spaced and with adjacent rows staggered.

### 3.4 ELEVATED DECK JOIST FRAMING INSTALLATION

- A. General: Install joists with crown edge up and support ends of each member with not less than 1- 1/2 inches (38 mm) of bearing on wood or metal, or 3 inches (76 mm) on masonry. Attach floor joists where framed into wood supporting members by using wood ledgers as indicated or, if not indicated, by using metal joist hangers. Do not notch joists.
- B. Frame openings with headers and trimmers supported by metal joist hangers; double headers and trimmers where span of header exceeds 48 inches (1200 mm).
- C. Lap members framing from opposite sides of beams or girders not less than 4 inches (102 mm,) or securely tie opposing members together. Provide solid blocking of 2-inch nominal (38-mm actual) thickness by depth of joist over supports.
- D. Provide solid blocking of 2-inch nominal (38-mm actual) thickness by depth of joist at intervals of 96 inches (2438 mm) o.c., between joists.

### 3.5 FINAL INSPECTION, PROTECTION, AND CLEANING

- A. Protect all installed and finished decking from construction traffic, material storage, and equipment traffic
- B. Repair any damaged decking prior to Substantial Completion.
- C. Ensure that all field cut edges have been properly sealed/stained.
- D. Provide a final cleaning of all decking prior to Substantial Completion.

END OF SECTION

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## SECTION 06 20 00 - FINISH CARPENTRY

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Finish carpentry items.
- B. Wood door frames, glazed frames.
- C. Wood window sills with aprons, baseboards and moldings as indicated.
- D. Closet shelving with brackets and clothes rods.
- E. Exterior wood cladding and trim.

#### 1.2 RELATED REQUIREMENTS

- A. Section 06 20 13 - Exterior Finish Carpentry
- B. Section 09 90 00 - Painting: Painting of finish carpentry items.
- C. Section 12 35 30 - Residential Casework: Shop fabricated cabinet work.

#### 1.3 REFERENCE STANDARDS

- A. ANSI A135.7 - Engineered Wood Trim 2012 (R2020).
- B. ANSI A208.1 - American National Standard for Particleboard 2016.
- C. ANSI A208.2 - Medium Density Fiberboard (MDF) for Interior Applications 2016.
- D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2021a.
- E. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition 2014, with Errata (2016).
- F. AWPA U1 - Use Category System: User Specification for Treated Wood 2018.
- G. CPA A208.1 - Particleboard, Composite Panel Association 2016.
- H. NEMA LD 3 - High-Pressure Decorative Laminates 2005.

#### 1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate the work with plumbing rough-in, electrical rough-in, and installation of associated and adjacent components.
- B. Sequence installation to ensure utility connections are achieved in an orderly and expeditious manner.

#### 1.5 SUBMITTALS

- A. See Section 01 33 00 for submittal procedures.

B. Product Data:

1. Provide manufacturer's product data, storage and handling instructions for factory-fabricated units.
2. Provide data on fire retardant treatment materials and application instructions.

C. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories.

1. Scale of Drawings: 1-1/2 inch to 1 foot, minimum.
2. Provide the information required by AWI/AWMAC/WI (AWS).

## 1.6 QUALITY ASSURANCE

A. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum five years of documented experience.

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver factory-fabricated units to project site in original packages, containers or bundles bearing brand name and identification.
- B. Store finish carpentry items under cover, elevated above grade, and in a dry, well-ventilated area not exposed to heat or sunlight.
- C. Protect from moisture damage.
- D. Handle materials and products to prevent damage to edges, ends, or surfaces.

## PART 2 PRODUCTS

### 2.1 FINISH CARPENTRY ITEMS

- A. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS), unless noted otherwise.
- B. Surface Burning Characteristics: Provide materials having fire and smoke properties as required by applicable code.
- C. Interior Woodwork Items:
  1. Moldings, Bases, Casings, and Miscellaneous Trim: Clear white pine or MDF ; prepare for paint finish.
  2. Moldings, Bases, Casings, and Miscellaneous Trim: Clear fir ; prepare for stained finish.
  3. Loose Shelving: Birch plywood; prepare for paint finish.
  4. Modular Closet Systems: MDF with melamine finish.

- D. Exterior Wood Cladding: Accoya species, select grade; Renne by reSAWN Timber Co; S4S milled; FSC Certified; 3/4 inch thick by 5-3/4 inch width as indicated, random lengths.

1. Fasteners: Stainless steel fasteners where exposed to weather.

## 2.2 WOOD-BASED COMPONENTS

- A. Provide sustainably harvested wood, certified or labeled as specified in Section 01 60 00 - Product Requirements.
- B. Provide wood harvested within a 500 mile radius of the project site.

## 2.3 LUMBER MATERIALS

- A. Softwood Lumber: White pine or clear fir species, plain sawn, maximum moisture content of 6 percent; clear grain.
- B. Medium Density Fiberboard (MDF)
  1. ANSI A208.2
  2. Provide products with 80 percent total recovered materials content. Provide data identifying percentage of recycled content for MDF.

## 2.4 SHEET MATERIALS

- A. Softwood Plywood: Any face species, medium density fiberboard core; PS 1 Grade A-B, glue type as recommended for application.
- B. Particleboard: ANSI A208.1 Composed of wood chips, sawdust, or flakes of medium density, made with waterproof resin binders; of grade to suit application; sanded faces.

## 2.5 PLASTIC LAMINATE MATERIALS

- A. Plastic Laminate: NEMA LD 3; color as indicated; finish as selected.
- B. Laminate Backing Sheet: NEMA LD 3, BKL; undecorated plastic laminate.
- C. Laminate Adhesive: Type recommended by laminate manufacturer to suit application; not containing formaldehyde or other volatile organic compounds.

## 2.6 FASTENINGS

- A. Adhesive for Purposes Other Than Laminate Installation: Suitable for the purpose; not containing formaldehyde or other volatile organic compounds.
- B. Fasteners: Of size and type to suit application; corrosion-resistant finish in concealed locations and chrome finish in exposed locations.
- C. Concealed Joint Fasteners: Threaded steel.

## 2.7 ACCESSORIES

- A. Primer: Alkyd primer sealer.
- B. Wood Filler: Solvent base, tinted to match surface finish color.

## 2.8 WOOD TREATMENT

- A. Factory-Treated Lumber: Comply with requirements of AWPA U1 - Use Category System for pressure impregnated wood treatments determined by use categories, expected service conditions, and specific applications.
- B. Fire Retardant Treatment (FR-S Type): Chemically treated and pressure impregnated; capable of providing flame spread index of 25, maximum, and smoke developed index of 450, maximum, when tested in accordance with ASTM E84.
- C. Wood Preservative by Pressure Treatment (PT Type): Provide AWPA U1 treatment using waterborne preservative with 0.25 percent retainage.
- D. Shop pressure treat wood materials requiring fire rating to concealed wood blocking.
- E. Provide identification on fire retardant treated material.
- F. Deliver fire retardant treated materials cut to required sizes. Minimize field cutting.
- G. Redry wood after pressure treatment to maximum 19 percent moisture content.

## 2.9 SITE FINISHING MATERIALS

- A. Field Finishing: See Section 09 91 23.

## 2.10 MODULAR CLOSET SYSTEMS

- A. Provide wall or rail mounted modular closet system for all walk-in closets. System shall be fully adjustable upon installation.
- B. Base Bid Closet System: Wire Storage Shelving System, Rubbermaid FastTrack Closet System: Factory-assembled coated wire mesh shelf assemblies for wall-mounting, with components and connections required to produce a rigid structure that is free of buckling and warping.
  1. Construction: Cold-drawn steel wire with average tensile strength of 100,000 psi resistance welded into uniform mesh units, square, rigid, flat, and free of dents or other distortions, with wires trimmed smooth.
  2. Coating: PVC or epoxy, applied after fabrication, covering surfaces.
  3. PVC Coating: 9 to 11 mils thick.
  4. Epoxy Coating: Nontoxic epoxy-polyester powder coating baked-on finish, 3 to 5 mils thick.

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- 5. Standard Mesh Shelves: Cross deck wires spaced at 1 inch. 12 inch depth unless noted otherwise.
  - 6. Free-Sliding Hanging Rod: Integral hanging rod that permits uninterrupted sliding of hangers the full width of the shelf.
  - 7. Corner Units: Same wire spacing as standard mesh shelves; provide wherever shelves meet at right angles.
  - 8. Mounting Hardware for Wire Shelving: Provide manufacturer's standard mounting hardware; include support braces, wall brackets, back clips, end clips, poles, and other accessories as required for complete and secure installation; factory finished to match shelving.
- C. Alternate Closet Storage System: System shall consist of panels or rails with brackets supporting thermally fused lamimate clad components and accessories, as indicated on drawings. Basis of Design - Vista Collection by Modular Closets
- 1. Storage System Nominal Dimensions: Unless otherwise indicated, provide cabinets, shelves, drawers, and hanging areas of widths and heights indicated on drawings.
  - 2. System Depth: 14 inches, unless otherwise indicated.
  - 3. Weight Load Capacity: 170 lbs per linear foot minimum.
  - 4. Laminated Storage Components:
    - a. Particleboard with thermal-fused melamine surfaces.
    - b. Edge Finish: Hot-melt PVC edge banding, matching color.
    - c. Substrate Thickness: 3/4 inch, nominal.
    - d. Color: White.
    - e. Color: As selected by Architect from storage manufacturer's full line.
  - 5. Shelves: Manufacturer's standard adjustable shelves and shelf supports.
    - a. Shelf Width: 18 inches, unless otherwise indicated.
  - 6. Cabinet Hardware: As selected from manufacturer's standard types, styles and finishes.
  - 7. Mounting Hardware for Modular Storage System: Provide manufacturer's standard mounting rail, mounting fasteners, shelf hardware, hanging rod assembly, and other accessories for a complete installation of the storage system.

## 2.11 FABRICATION

- A. Shop assemble work for delivery to site, permitting passage through building openings.
- B. Fit exposed sheet material edges with 3/8 inch hardwood edging. Use one piece for full length only.

- C. Cap exposed plastic laminate finish edges with material of same finish and pattern.
- D. When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide trim for scribing and site cutting.
- E. Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners. Slightly bevel arises. Locate counter butt joints minimum 2 feet from sink cut-outs.
- F. Apply laminate backing sheet to reverse face of plastic laminate finished surfaces.

## 2.12 SHOP FINISHING

- A. Sand work smooth and set exposed nails and screws.
- B. Apply wood filler in exposed nail and screw indentations.
- C. On items to receive transparent finishes, use wood filler that matches surrounding surfaces and is of type recommended for the applicable finish.
- D. Stain, seal, and varnish exposed to view surfaces. Brush apply only.
- E. Seal internal surfaces and semi-concealed surfaces. Brush apply only.
- F. Prime paint surfaces in contact with cementitious materials.
- G. Back prime woodwork items to be field finished, prior to installation.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify adequacy of backing and support framing.
- B. Verify mechanical, electrical, and building items affecting work of this section are placed and ready to receive this work.

### 3.2 INSTALLATION

- A. Install custom fabrications in accordance with AWI/AWMAC/WI (AWS) requirements for grade indicated.
- B. Set and secure materials and components in place, plumb and level.
- C. Carefully scribe work abutting other components, with maximum gaps of 1/32 inch. Do not use additional overlay trim to conceal larger gaps.

### 3.3 INSTALLATION OF WOOD CLADDING

- A. Install wood cladding in accordance with manufacturer's recommendations and instructions.

- B. Fasten or adhere as appropriate for the substrate the cladding in place, level and plumb.
- C. Position cut ends over bearing surfaces, and sand cut edges smooth and clean.
- D. Touch-up, repair, or replace wood siding materials having damaged factory-applied finish; notify Architect of damaged materials, and confirm acceptable process prior to completion of this work.
- E. Sand work smooth and set exposed nails and screws.

#### 3.4 PREPARATION FOR SITE FINISHING

- A. Set exposed fasteners. Apply wood filler in exposed fastener indentations. Sand work smooth.
- B. Site Finishing: See Section 09 90 00.
- C. Before installation, prime paint surfaces of items or assemblies to be in contact with cementitious materials.

#### 3.5 TOLERANCES

- A. Maximum Variation from True Position: 1/16 inch.
- B. Maximum Offset from True Alignment with Abutting Materials: 1/32 inch.

END OF SECTION

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## SECTION 07 13 00 - SHEET WATERPROOFING

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Sheet Waterproofing:
  - 1. Self-adhered modified bituminous sheet membrane.
  - 2. Self-adhered HDPE sheet membrane.
  - 3. Self-adhered HDPE sheet membrane, post applied.
  - 4. Blindsides HDPE reinforced sheet membrane.

#### 1.2 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Concrete substrate.
- B. Section 22 10 06 - Plumbing Piping Specialties: Roof drain and plumbing vent flashing flanges.
- C. Section 33 41 00 - Subdrainage: Coordination with foundation subdrainage system.

#### 1.3 REFERENCE STANDARDS

- A. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers--Tension 2016 (Reapproved 2021).
- B. ASTM D751 - Standard Test Methods for Coated Fabrics 2019.
- C. ASTM D882 - Standard Test Method for Tensile Properties of Thin Plastic Sheeting 2018.
- D. ASTM D903 - Standard Test Method for Peel or Stripping Strength of Adhesive Bonds 1998 (Reapproved 2017).
- E. ASTM D1876 - Standard Test Method for Peel Resistance of Adhesives (T-Peel Test) 2008, with Editorial Revision (2015).
- F. ASTM D1970/D1970M - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection 2021.
- G. ASTM D5295/D5295M - Standard Guide for Preparation of Concrete Surfaces for Adhered (Bonded) Membrane Waterproofing Systems 2018.
- H. ASTM D5385/D5385M - Standard Test Method for Hydrostatic Pressure Resistance of Waterproofing Membranes 2020.
- I. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials 2016.

J. ASTM E154/E154M - Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover 2008a (Reapproved 2019).

K. NRCA (WM) - The NRCA Waterproofing Manual 2005.

#### 1.4 SUBMITTALS

A. See Section 01 33 00 for general submittal procedures.

B. Product Data: Provide data for membrane, joint cover sheet, and joint and crack sealants.

C. Shop Drawings: Indicate special joint or termination conditions and conditions of interface with other materials.

D. Certificate: Certify that products meet or exceed specified requirements.

E. Manufacturer's Installation Instructions: Indicate special procedures.

F. Manufacturer's Qualification Statement.

G. Installer's Qualification Statement.

H. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

#### 1.5 QUALITY ASSURANCE

A. Membrane Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

#### 1.6 FIELD CONDITIONS

A. Maintain ambient temperatures above 40 degrees F for 24 hours before and during application and until liquid or mastic accessories have cured.

B. Substrate shall be solid and smooth with no gaps or voids. Installation over earth or stone requires substrate to be well compacted, free of loose aggregate and sharp protrusions, and all standing water removed.

#### 1.7 WARRANTY

A. Contractor shall correct defective Work within a five year period after Date of Substantial Completion; remove and replace materials concealing waterproofing at no extra cost to Owner.

B. Provide five year manufacturer warranty for waterproofing failing to resist penetration of water, except where such failures are the result of structural failures of building. Hairline cracking of concrete due to temperature change or shrinkage is not considered a structural failure.

## PART 2 PRODUCTS

### 2.1 MEMBRANE MATERIALS

- A. Self-Adhered HDPE Sheet Membrane: Recommended by manufacturer for placement below concrete slabs and on outside face of below grade walls before placement of concrete.
  - 1. Sheet Thickness: 46 mil (0.046 inch), minimum below slabs and 32 mil (0.032 inch) at vertical conditions.
  - 2. Low Temperature Flexibility: Unaffected when tested in accordance with ASTM D1970/D1970M at minus 20 degrees F, 180 degree bend on 1 inch mandrel.
  - 3. Hydrostatic Pressure Resistance: Resists pressure of 231 ft head of water, when tested in accordance with ASTM D5385/D5385M.
  - 4. Elongation at Break: 500 percent, minimum, measured in accordance with ASTM D412.
  - 5. Tensile Strength, Film: 3,500 psi, minimum, measured in accordance with ASTM D412.
  - 6. Lap Peel Adhesion: 8 lb per inch, minimum, when tested in accordance with ASTM D1876.
  - 7. Water Vapor Permeance: 0.01 perm, maximum, measured in accordance with ASTM E96/E96M.
  - 8. Bond to Concrete: 5 lb per inch, minimum, measured in accordance with ASTM D903.
  - 9. Lateral Water Migration Resistance: Resists pressure of 231 ft head of water, when tested in accordance with ASTM D5385/D5385M.
  - 10. Adhesives, Sealants, Tapes, and Accessories: As recommended by membrane manufacturer.
  - 11. Products:
    - a. GCP Applied Technologies; Preprufe 300R Plus: [www.gcpat.com/#sle](http://www.gcpat.com/#sle).
    - b. GCP Applied Technologies; Preprufe 160R Plus: [www.gcpat.com/#sle](http://www.gcpat.com/#sle).
    - c. Substitutions: Refer to Section 01 25 00 - Substitution Procedures. .
- B. Self-Adhered HDPE Sheet Membrane, Post-Applied: Recommended by manufacturer for placement on outside face of below grade concrete and concrete masonry unit (CMU) backfilled walls and select horizontal applications.
  - 1. Sheet Thickness: 30 mil, 0.030 inch, minimum, and with 20 mil, 0.020 inch thick adhesive.
  - 2. Hydrostatic Resistance: Resists pressure of 400 psi when tested in accordance with ASTM D751.
  - 3. Elongation at Break: 577 percent, minimum, measured in accordance with ASTM D412.
  - 4. Tensile Strength, Film: 5,000 psi, minimum, measured in accordance with ASTM D882.

5. Lap Adhesion: 6.8 lb per inch, minimum, when tested in accordance with ASTM D1876.
  6. Water Vapor Permeance: Less than 0.1 perm, measured in accordance with ASTM E96/E96M.
  7. Peel Strength: 6.7 lb per inch, minimum, when tested in accordance with ASTM D903.
  8. Adhesives, Sealants, Tapes, and Accessories: As recommended by membrane manufacturer.
- C. Blindside HDPE Reinforced Sheet Membrane: Sheet membrane with cross-laminated, high-density HDPE backing laminated to waterproofing adhesive compound integrated into nonwoven geotextile fabric.
1. Application: Install vertically, over timber lagging substrate with composite drainage system, in accordance with project requirements.
  2. Sheet Thickness: 73 mil, 0.073 inch, minimum.
  3. Puncture Resistance: 217 lb, minimum, in accordance with ASTM E154/E154M.
  4. Products: Basis of Design Henry Pre-Seal

## 2.2 ACCESSORIES

- A. Sealant for Cracks and Joints In Substrates: Resilient elastomeric joint sealant compatible with substrates and waterproofing materials.
- B. Protection Board: Provide type capable of preventing damage to waterproofing due to backfilling and construction traffic.
1. Asphalt impregnated wood fiberboard, 1/4 inch thick.
- C. Drainage Panel: Drainage layer with geotextile filter fabric on earth side.
1. Composition: Dimpled polystyrene core; polypropylene filter fabric. Basis of Design - Hydroduct 660.
  2. Thickness: As indicated on drawings.
- D. Cant Strips: Premolded composition material.
- E. Flexible Flashings: Type recommended by membrane manufacturer.
- F. Termination Bars: Aluminum; compatible with membrane and adhesives.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify existing conditions are acceptable prior to starting this work.

- B. Verify substrate surfaces are durable; free of matter detrimental to adhesion or application of waterproofing system.
- C. Verify items that penetrate surfaces to receive waterproofing are securely installed.

### 3.2 PREPARATION

- A. Protect adjacent surfaces from damage not designated to receive waterproofing.
- B. Clean and prepare surfaces to receive waterproofing in accordance with manufacturer's instructions; vacuum substrate clean.
- C. Do not apply waterproofing to surfaces unacceptable to membrane manufacturer.
- D. Fill nonmoving joints and cracks with a filler compatible with waterproofing materials.
- E. Seal moving cracks with sealant and nonrigid filler, using procedures recommended by sealant and waterproofing manufacturers.
- F. Prepare building expansion joints at locations as indicated on drawings.
- G. Surfaces for Adhesive Bonding: Apply surface conditioner at a rate recommended by manufacturer, and protect conditioner from rain or frost until dry.
- H. Concrete Surfaces for Adhesive Bonding: Prepare concrete substrate in accordance with ASTM D5295/D5295M.
  - 1. Remove substances that inhibit adhesion including form release agents, curing compounds admixtures, laitance, moisture, dust, dirt, grease and oil.
  - 2. Repair surface defects including honeycombs, fins, tie holes, bug holes, sharp offsets, rutted cracks, ragged corners, deviations in surface plane, spalling and delaminations, as described in the reference standard.

### 3.3 INSTALLATION - MEMBRANE

- A. Install membrane waterproofing in accordance with manufacturer's instructions and NRCA (WM) applicable requirements.
- B. Roll out membrane, and minimize wrinkles and bubbles.
- C. Self-Adhering Membrane: Remove release paper layer, and roll out onto substrate with a mechanical roller to provide full contact bond.
- D. Overlap edges and ends, minimum 3 inches, seal permanently waterproof by method recommended by manufacturer, and apply uniform bead of sealant to joint edge.
- E. Reinforce membrane with multiple thickness of membrane material over joints, whether joints are static or dynamic.

- F. Weather lap joints on sloped substrate in direction of drainage, and seal joints and seams.
- G. Coordinate with drain installation; see Section 22 10 06.
- H. Flexible Flashings: Seal items watertight that penetrate through waterproofing membrane with flexible flashings.
- I. Extend membrane over cants and up intersecting surfaces at membrane perimeter minimum 6 inches above horizontal surface for first ply and 6 inches at subsequent plies laid in shingle fashion.
- J. Seal membrane and flashings to adjoining surfaces.
  - 1. Install termination bar along edges.

#### 3.4 INSTALLATION - DRAINAGE PANEL AND PROTECTION BOARD

- A. Place protection board directly against drainage panel and butt joints; scribe and cut boards around projections, penetrations, and interruptions.

#### 3.5 REMOVAL OF FORMWORK

- A. Where waterproofing membrane is blindside installed against formwork, concrete shall obtain minimum compressive strength of 3000 psi prior to stripping formwork. Premature stripping may result in displacement of membrane.

#### 3.6 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements for additional requirements.
- B. Owner will provide testing services in accordance with Section 01 40 00 - Quality Requirements, and Contractor will provide temporary construction and materials for testing.
- C. Upon completion of horizontal membrane installation, dam installation area in preparation for flood testing.
- D. Flood to minimum depth of 1 inch with clean water, and after 48 hours inspect for leaks.
- E. If leaking is found, remove water, repair leaking areas with new waterproofing materials as directed by Architect; repeat flood test, and repair damage to building.
- F. When area is proven watertight, drain water and remove dam.

#### 3.7 PROTECTION

- A. Do not permit traffic over unprotected or uncovered membrane.

END OF SECTION

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## SECTION 07 16 16 - CRYSTALLINE WATERPROOFING COATING

### PART 1 GENERAL

#### 1.1 SUMMARY

- A. Cementitious crystalline waterproofing to masonry and concrete substrates at horizontal and vertical surfaces of elevator pits.
  - 1. Cementitious dry pac application for sealing construction joints and repair of cracks, and honeycombing. .
  - 2. Related Sections:
    - a. Section 03 30 00 - Cast in place Concrete.
    - b. Section 04 20 00 - Unit Masonry

#### 1.2 SYSTEM DESCRIPTION

- A. Cementitious Crystalline Waterproofing: Blend of Portland cement, fine treated silica sand and active proprietary chemicals.

#### 1.3 SYSTEM PERFORMANCE REQUIREMENTS

- A. Testing Requirements: Crystalline waterproofing system shall be tested in accordance with the following standards and conditions, and the testing results shall meet or exceed the performance requirements as specified herein.
- B. Independent Laboratory: Testing shall be performed by an independent laboratory meeting the requirements of ASTM E 329-95 and certified by the United States Bureau of Standards. Testing laboratory shall obtain all concrete samples and waterproofing product samples.
- C. Crystalline Penetration: Crystallizing capability of waterproofing material shall be evidenced by independent SEM (Scanning Electron Microscope) photographs documenting penetration of crystal-forming waterproofing material to a depth of 2 inches (50 mm).
- D. Permeability: Concrete samples (treated and untreated) to have design strength of 2000 psi (13.8 MPa) and thickness of 2 inches (50 mm). No admixtures permitted.
  - 1. Coatings to have maximum thickness of 0.05 inches (1 mm) per coat with up to two coats permitted.
  - 2. Samples to be pressure tested to 175 psi (405 foot head of water) or 1.2 MPa (123.4 m head of water).
  - 3. Treated samples, after crystalline growth has occurred, shall exhibit no measurable leakage.
- E. Chemical Resistance: Independent testing shall be performed according to ASTM C 267-77 "Chemical Resistance of Mortars" and ASTM C 39-86 "Compressive Strength of Cylindrical Concrete Specimens".

1. Concrete samples (treated and untreated) to have design strength of 4000 psi (27.6 MPa). No admixtures permitted.
2. Coatings to have maximum thickness of 0.05 inches (1 mm) per coat with up to two coats permitted.
3. Untreated and treated specimens to be immersed for a minimum of 84 days in following chemical solutions: hydrochloric acid (3.5pH), brake fluid, transformer oil, ethylene glycol, toluene, caustic soda.
4. Treated specimens shall exhibit no detrimental effects after exposure, and shall have a minimum of 14% increase in compressive strength versus untreated control specimens.

#### 1.4 SUBMITTALS

- A. General: Refer to Section 01 33 00 for submittal procedures.
- B. Shop Drawing: Indicate intended locations and installation of crystalline waterproofing.
- C. Product Data: Submit product data, including manufacturer's specifications, installation instructions, and general recommendations for waterproofing applications.
- D. Test Reports: Submit for acceptance, complete test reports from approved independent testing laboratories certifying that waterproofing system conforms to performance characteristics and testing requirements specified herein.
- E. Manufacturer's Certification: Provide certificates signed by manufacturer or manufacturer's representative certifying that the materials to be installed comply in all respects with the requirements of this specification, and that the applicator is qualified and approved to install the materials in accordance with manufacturer's product data.
- F. Manufacturer's Field Report: Provide copy of report from manufacturer's representative confirming that the surfaces to which waterproofing material is to be applied are in a condition suitable to receive same.

#### 1.5 QUALITY ASSURANCE

- A. Refer to Section 01 40 00 for general information regarding quality assurance
- B. Manufacturer Qualifications: Manufacturer shall be ISO 9001 registered, and shall have no less than 10 years experience in manufacturing the cementitious crystalline waterproofing materials for the required work.
- C. Applicator: Waterproofing applicator shall be experienced in the installation of cementitious crystalline waterproofing materials as demonstrated by previous successful installations, and shall be approved by the manufacturer in writing.
- D. Pre-Installation Conference: Prior to installation of waterproofing, conduct meeting with waterproofing applicator, installers of work adjacent to or which penetrates waterproofing, Architect, owner's representative, and waterproofing manufacturer's representative to verify and review the following:

1. Project requirements for waterproofing as set out in Contract Document.
  2. Manufacturer's product data including application instructions.
  3. Substrate conditions, and procedures for substrate preparation and waterproofing installation.
- E. Technical Consultation: The waterproofing manufacturer's representative shall provide technical consultation on waterproofing application.

#### 1.6 DELIVERY, STORAGE AND HANDLING

- A. Refer to Section 01 60 00 for general information regarding delivery, storage and handling.
- B. Delivery: Deliver packaged waterproofing materials to project site in original undamaged containers, with manufacturer's labels and seals intact.

#### 1.7 PROJECT CONDITIONS

- A. Compliance: Comply with manufacturer's product data regarding condition of substrate to receive waterproofing, weather conditions before and during installation, and protection of the installed waterproofing system.
- B. Proceed with waterproofing only after pipe sleeves, vents, curbs, inserts, drains, and other projections through the substrate to be waterproofed have been completed.

#### 1.8 WARRANTY

- A. Special Warranty: Prepare and submit in accordance with Section 01 78 00.
  1. Warranty with attachments for full replacement value of completed installation signed by manufacturer, applicator and Contractor warranting against water infiltration and defects of materials and workmanship for period of two years. If manufacturer will not allow installer and Contractor to sign manufacturer's warranty, append installer and Contractor's warranty to manufacturer's warranty to create warranty that covers labor and workmanship, including labor for access to waterproofing, for watertight warranty.
    - a. Warrant penetrations, terminations, changes of direction, and membrane.
    - b. Warranty shall include removing and reinstalling superimposed work covering waterproofing.

### PART 2 - PRODUCTS

#### 2.1 MATERIALS

- A. Acceptable Manufacturers:
  1. Basis of Design - Xypex Concentrate; Xypex crystalline waterproofing materials; Xypex Chemical Corporation.
  2. Acceptable alternate manufacturers:

- a. CEM-KOTE CW Plus, Capillary/Crystalline Waterproofing; Gemite Products Inc.
  - b. Or approved equal.
- B. Substitutions: Refer to Section 01 25 00 for requirements for substitution submittals.
- C. Source Quality: Obtain crystalline waterproofing products from a single manufacturer.

## 2.2 MIXES

- A. General: Mix waterproofing material by volume with clean water which is free from salt and deleterious materials. Mix waterproofing material in quantities that can be applied within 20 to 30 minutes from time of mixing. As mixture thickens, stir frequently, but do not add additional water. Do not mix bonding agents or admixtures with crystalline waterproofing materials.
- B. Brush Application Mix: Measure dry powder and place in mixing container. Measure water and mix into the dry powder with a paddle on a slow speed electric drill (250 RPM) or other type mixer which is acceptable to manufacturer. Mixing proportions shall be as follows:

Coverage	Proportions (by Volume)
1.5 lb./sq. yd. (0.8 kg/m <sup>2</sup> )	5 powder to 2 water
2.0 lb./sq. yd. (1.0 kg/m <sup>2</sup> )	3 powder to 1 water

- C. Spray Application Mix: Mixing shall be same as specified for brush application except that mixture shall be thinner. Use following proportions as a guide only. Adjust proportions to match type of spray equipment and pressures used. Mixing proportions shall be as follows:

Coverage	Proportions (by Volume)
1.5 lb./sq. yd. (0.8 kg/m <sup>2</sup> )	5 powder to 3 water

- D. Dry-Pac Mix: Using a trowel, mix 1 part clean water with 6 parts Xypex Concentrate powder for 10 to 15 seconds. It is acceptable that lumps may be present in mixture. Mix only as much as can be applied in 15 minutes.

## 2.3 ACCESSORY MATERIALS

- A. Patching compound: Factory-premixed cementitious repair mortar, crack filler, or sealant recommended by waterproofing manufacturer for filling and patching tie holes, honeycombs, reveals, and other imperfections.
- B. Plugging compound: Factory-premixed cementitious compound with hydrophobic properties and recommended by waterproofing manufacturer; resistant to water and moisture but vapor permeable for all standard applications
- C. Polymer Admixture for Protective topping: Polymer bonding agent and admixture designed to improve adhesion to prepared substrate and not to create a vapor barrier

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Site Visit: Prior to waterproofing installation, arrange visit to project site with water-proofing manufacturer's representative. Representative shall inspect and certify that concrete and masonry surfaces are in acceptable condition to receive waterproofing treatment.
- B. Verification of Substrates: Verify that concrete and masonry surfaces are sound and clean.
- C. Examination for Defects: Examine surfaces to be waterproofed for structural defects such as faulty construction joints and cracks. Repair such defects in accordance with manufacturer's product data.

### 3.2 PREPARATION

- A. Repair of Defects: Repair surface defects as follows:
  1. Cracks: Chip out defective areas in a "U" shaped slot one inch (25 mm) wide and a minimum of one inch (25 mm) deep. Clean slot of debris and dust. Soak area with water and remove excess surface water. Apply a slurry coat of crystalline waterproofing at the rate of 1.5 lb./sq. yd. to the slot. Allow slurry to reach an initial set, then fill cavity with Dry-Pac mix. Compress tightly into cavity using pneumatic packer or block and hammer.
  2. Stop active water leaks with plugging compound according to waterproofing manufacturer's written instructions.
- B. Wetting Substrate: Prior to application of waterproofing treatment, thoroughly saturate substrate surfaces with clean water as required to ensure migration of crystalline chemicals into voids and capillary tracts of the CMU. Remove free surface water before application.

### 3.3 APPLICATION

- A. Surface Application: After repairs and surface preparation have been completed in accordance with manufacturer's product data and as specified herein, apply crystalline waterproofing treatment uniformly to masonry surfaces with semi-stiff bristle brush or broom, or suitable spray equipment. Application rates and locations shall be in accordance with manufacturer's product data. When brushing, work slurry well into surface of the masonry, filling surface pores and hairline cracks. When spraying, hold nozzle close enough to ensure that slurry is forced into pores and hairline cracks.
  1. First Coat (of one or two coat application): Apply crystalline waterproofing slurry coat to locations indicated in accordance with manufacturer's product data.
  2. Second Coat (of two coat application): Where indicated or as required by manufacturer's product data, apply crystalline waterproofing slurry coat while first coat is still "green" but after it has reached an initial set. Use light prewatering between coats when rapid drying conditions exist.

### 3.4 CURING

- A. General: Begin curing as soon as crystalline waterproofing has hardened sufficiently so as not to be damaged by a fine spray. Cure waterproofing treatment with a mist fog spray of clean water three times a day for 2 to 3 days, or cover treated surfaces with damp burlap for the prescribed period. In warm climates, more than three sprayings per day may be necessary to prevent excessive drying of coating.
- B. Air Circulation: Do not lay plastic sheeting directly on the waterproofing coating as air contact is required for proper curing. If poor circulation exists in treated areas, it may be necessary to provide fans or blown air to aid in curing of waterproofing treatment.
- C. Protection: During the curing period, protect treated surfaces from damage by wind, sun, rain and temperatures below 36oF. If plastic sheeting is used for protection, it must be raised off of waterproofing coating to allow sufficient air circulation.
- D. Curing Agent: If moist curing is not possible, use a chemical curing agent that is specifically designed for or compatible with the approved crystalline waterproofing treatment. Curing agent shall be approved by waterproofing manufacturer in writing.

### 3.5 INTERFACE WITH OTHER MATERIALS

- A. Paint, Epoxy or Similar Coatings: Do not apply paint or other coatings until waterproofing treatment has cured and set for a minimum of 21 days. Before applying paint or coating, neutralize treated surface by dampening with water and then washing waterproofed surface with 15% muriatic acid, diluted in a ratio of one part acid to four parts water by volume. Flush acid off treated concrete surfaces.
- B. Grout, Cement Parge Coat, Plaster or Stucco: Provide a suitable bonding agent for proper bonding of cementitious systems to waterproofing surface. Trial applications are recommended to ensure that adhesion requirements are satisfied.

### 3.6 FIELD QUALITY CONTROL

- A. Observation: Do not conceal installed waterproofing system before it has been observed by Architect, waterproofing manufacturer's representative and other designated entities.
- B. Manufacturer's Field Services: Comply with Section 01 40 00.
  1. Notify manufacturer in timely manner to arrange for manufacturer's technical representative's site visits to ensure proper installation, verify work is in accordance with manufacturer's recommendations, and warranty requirements have been met.
  2. Manufacturer's Qualified Technical Representative: Monitor activities and advise applicator of proper installation procedures and precautions.
  3. Minimum Site Visits:
    - a. Preinstallation meeting.
    - b. First day of waterproofing on site including acceptance of substrate conditions.

- c. Completion of waterproofing work on site.
- 4. Submit reports; include site observations, instructions, and monitoring activities.
- C. Thickness Tests: Continually monitor installation thickness to verify minimum thicknesses are being achieved.

### 3.7 CLEANING AND PROTECTION

- A. Cleaning: Clean spillage and soiling from adjacent surfaces using appropriate cleaning agents and procedures.
- B. Protection: Take measures to protect completed crystalline waterproofing coating from damage after application.

END OF SECTION

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## SECTION 07 18 00 - TRAFFIC COATINGS

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Vehicular Traffic bearing waterproof membrane at parking garage ramps, loading dock, and curbs.
- B. Pedestrian Traffic coatings at balconies.
- C. Coatings at bottom of mechanical shafts.
- D. Concrete Sealer at mechanical penthouse, retail floor slabs, and garage parking levels.

#### 1.2 REFERENCE STANDARDS

- A. ASTM C957/C957M - Standard Specification for High-Solids Content, Cold Liquid-Applied Elastomeric Waterproofing Membrane With Integral Wearing Surface 2017.
- B. ASTM C1127/C1127M - Standard Guide for Use of High Solids Content, Cold Liquid-Applied Elastomeric Waterproofing Membrane with an Integral Wearing Surface 2015.
- C. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers--Tension 2016 (Reapproved 2021).
- D. ASTM D5095 - Standard Test Method for Determination of the Nonvolatile Content in Silanes, Siloxanes, and Silane-Siloxane Blends Used in Masonry Water Repellent Treatments 1991 (Reapproved 2013).
- E. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring 2021.

#### 1.3 SUBMITTALS

- A. See Section 01 33 00 for general submittal procedures.
- B. Product Data: Include product characteristics and limitations. Identify dissolving solvents, fuels, and potential destructive compounds.
- C. Manufacturer's Installation Instructions: Include special field conditions required to install traffic membrane and potential incompatibilities with adjacent materials.
- D. Certify volatile organic compound content for each traffic coating product.
- E. Manufacturer's qualification statement.
- F. Applicator's qualification statement.
- G. Maintenance Data: Include procedures for stain removal, repairing surface, and cleaning.
- H. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

#### 1.4 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with specified requirements and with applicable regulations limiting volatile organic compound (VOC) content of coatings to be applied. Conduct and report measurement of volatile organic compounds in coatings in accordance with EPA TM-24.
- B. Single Source Responsibility: Furnish each product from one manufacturer, unless otherwise acceptable to Architect.
- C. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section, with not less than three years of documented experience.
- D. In Place Mockup: Refer to Section 01 43 89 for general requirements. Build 100 sq-ft mockup or size of balcony at location directed by the Architect, to receive traffic coating to demonstrate surface preparation, joint and crack treatment, thickness, texture, color, and standard of workmanship. Mockup intended to set quality standards for materials and execution.
- E. Testing: Refer to Section 01 40 00. Employ independent testing agency to conduct moisture vapor transmission testing and random adhesion testing of coatings.
- F. Certifications: Manufacturer's Certification on manufacturer's letterhead:
  - 1. Submit manufacturer's approval of installer.
  - 2. Certify materials ordered and supplied meet membrane manufacturer's published performance standards and requirements of this Specification, including VOC and TDI content.
  - 3. Certify materials ordered and supplied are compatible with each other, suited for locale and purpose intended and shipped in sufficient quantity to ensure proper timely installation.
  - 4. Certify waterproofing materials have express warranty of fitness for particular purposes of this Project.
  - 5. Certify submittal details meet manufacturer's warranty requirements for this specific Project.
  - 6. Certify manufacturer has reviewed Drawings, Specifications, submittals, and project conditions and will issue warranty upon successful completion of installation.
  - 7. Certify that products are installed in accordance with Contract Documents based on inspection and testing specified as part of Field Quality Control.

#### 1.5 IN PLACE MOCKUP

- A. General: Comply with Section 01 43 89 for additional information.
- B. Sample Installation: Construct a full size sample of the Pedestrian Coating system on a balcony selected by the Architect.
  - 1. Illustrate finished work, including detail work at internal or external corners, sealing, flashings, treatment of cracks and joints, expansion joints, texture, control joints, and color.

- C. Acceptance: Make adjustments necessary to obtain approval from Architect. Do not proceed with further work until sample installation has been approval by Architect.
  - 1. Approved installation establishes minimum quality standards for workmanship and materials for Project.
  - 2. Approved Sample: May remain as part of Work.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. See Section 01 74 19 - Construction Waste Management and Disposal for packaging waste requirements.
- B. Maintain storage area at minimum ambient temperature of 55 degrees F.
- C. Keep away from fire or open flame.

## 1.7 FIELD CONDITIONS

- A. Do not install materials when temperature is below 50 degrees F or above 90 degrees F.
- B. Maintain this temperature range, 24 hours before, during and 72 hours after application.
- C. Restrict traffic from area where materials are being installed or are curing.

## 1.8 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.
- B. Correct defective Work within a five year period after Date of Substantial Completion.
- C. Provide a Five year manufacturer's warranty for the following:
  - 1. Coating: Warranty signed by manufacturer warranting work to be free from defective materials and workmanship, and agreeing to replace coating which fails within five years.
  - 2. Failed materials and workmanship includes spalling, cracking, and delamination.

# PART 2 PRODUCTS

## 2.1 TRAFFIC COATINGS

- A. Pedestrian Coating: ASTM C957/C957M; Two coat fluid-applied polyurethane system with slip-reducing aggregate surface.
  - 1. Basis of Design: Peda-Gard with Flashing Tape for penetrations and terminations, reinforcing fabric for transitions and corners by Neogard Crop. or approved equal. Refer to Section 01 25 00 for requirements regarding submittal and approval for substitutions.
  - 2. Application: Balcony traffic surfaces.
  - 3. Aggregate: 16/30 mesh silica quartz sand.

4. Wear Coat: Two-part polyurethane coatings used as the elastomeric, waterproofing membrane and basecoat.
  5. Top Coat: A two-part, aliphatic, 98+ percent solids polyurethane topcoat providing tough and durable chemical resistant, UV stable, wearing surface.
  6. System coating thickness: 32 dry mils exclusive of primer and aggregate
  7. Performance Criteria: Typical physical properties of cured Wear Coat urethane used on this project are:
    - a. Tensile Strength, ASTM D412 , 2,500 psi
    - b. Elongation, ASTM D412 , 400%
    - c. Permanent Set, ASTM D412 , < 30%
    - d. Tear Resistance, ASTM D1004, 200 pli
    - e. Shore A, ASTM D2240, 75–80
    - f. Adhesion, ASTM D4541, 300 psi
    - g. Water Resistance, ASTM D471, < 3% (7 days)
    - h. Taber Abrasion, ASTM D4060, 25 mg (1,000 CS-17)
- B. Vehicular Coating: ASTM C957/C957M; Fluid-applied three coat polyurethane system with slip-reducing aggregate surface.
1. Basis of Design: Auto-Gard by Neogard Corp. . Refer to Section 01 25 00 for requirements regarding submittal and approval for substitutions.
  2. Application: Garage floor area, Loading dock area, and "back of house" service areas.
  3. Sealant: NeoGard #70991 urethane sealant.
  4. Aggregate: NeoGard #7992 silica quartz sand.
  5. Base Coat: NeoGard #FC7500/FC7960 urethane coating.
  6. Wear Coat: NeoGard #FC7510/FC7961 urethane coating.
  7. Topcoat: NeoGard #FC7530/FC7963 aliphatic urethane coating, 98+ percent solids providing tough and durable chemical resistant, UV stable, wearing surface..
  8. Typical physical properties of cured Wear Coat urethane used on this project are:
    - a. Tensile Strength, ASTM D412, 2,200 psi
    - b. Elongation, ASTM D412, 80%

- c. Permanent Set, ASTM D412, < 10%
  - d. Tear Resistance, ASTM D1004, 165 pli
  - e. Water Resistance, ASTM D471, <1% (7 days)
  - f. MVT (20 mils), ASTM E96, 0.4 English Perm
  - g. Taber Abrasion, ASTM D4060, 55 mg (1,000 CS-17)
  - h. Shore A, ASTM D2240, 84–90
  - i. Adhesion, ASTM D4541, 400 psi
9. Typical physical properties of cured Aliphatic Topcoat urethane used on this project are:
- a. Tensile Strength, ASTM D412, 4,000 psi
  - b. Elongation, ASTM D412, 350%
  - c. Permanent Set, ASTM D412, < 20%
  - d. Tear Resistance, ASTM D1004, 400 pli
  - e. Water Resistance, ASTM D471, 1% (7 days)
  - f. MVT (20 mils), ASTM E96, 2.7 English Perm
  - g. Taber Abrasion, ASTM D4060, 10 mg (1,000 CS-17)
  - h. Shore A, ASTM D2240, 92–96
  - i. Adhesion, ASTM D4541, > 400 psi
- C. Exposed Concrete Sealer: Modified "neat" silane system protecting horizontal and vertical concrete and masonry surfaces against water and waterborne contaminants.
1. Basis of Design: SL100 Water Repellent as manufactured by Prococo or approved equal meeting the following requirements. Refer to Section 01 25 00 for submittal and acceptance requirements for proposed substitutions.
    - a. Form: Clear, slightly yellow liquid with slight alcohol odor
    - b. Specific Gravity: 0.920
    - c. Active Content: 98 percent.
    - d. Weight/gallon: 7.65 pounds
    - e. Total Solids: 62 percent per ASTM D5095
    - f. Flash point: 94 degrees F per ASTM D3278

g. VOC Content: Maximum VOC Content 360 grams per Liter. Reactive penetrant sealer.

## 2.2 ACCESSORY MATERIALS

- A. Primer: Concrete and metal primers as required by coating manufacturer.
- B. Reinforcing Fabric: As recommended by coating manufacturer for application.
- C. Surfacing: 20-30 mesh (1.0-1.5 mm diameter) silica sand or alumina oxide,
- D. Filler and Primer: As recommended by membrane manufacturer.
- E. Pavement-Marking Paint: MPI #32 Alkyd Traffic Marking Paint; color white.
- F. Sealant: As recommended by membrane manufacturer, and compatible with system and adjacent materials.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify that substrate is ready to receive work, surface is clean, dry and free of substances that could adversely effect bond.
- B. Consult manufacturer's rep to examine substrate to receive traffic coating. Prepare written report, endorsed by installer, confirming substrate is acceptable for application or listing conditions detrimental to performance of traffic-coating work, if applicable. Include comments on compatibility and installation requirements between urethane traffic coating and asphalt-based air barrier membrane.
- C. Do not begin work until concrete substrate has cured at least 28 days and moisture content is 16 percent or less.
- D. Test concrete surfaces according to ASTM F710 for acceptable level of alkalinity.

### 3.2 PREPARATION

- A. Clean substrate surface free of foreign matter. Remove grease, oil, paints, and other penetrating contaminants from substrate. Remove laitance, glaze, efflorescence, curing compounds, concrete hardeners, form-release agents, and other incompatible materials that might affect coating adhesion.
- B. Patch concrete substrate with filler in accordance with ASTM C1127/C1127M and manufacturer's recommendations to produce surface conducive to bond. Correct unsatisfactory substrate conditions and flash all penetrations through the substrate per manufacturer's typical instructions.
- C. Mechanically abrade surface to a uniform profile acceptable to manufacturer, according to ASTM D4259. Cut a 1/4 inch wide by 1/4 inch deep keyway into the concrete surface at any point where the coating will have an exposed terminating edge. That is; any point where the coating will end in an open area subject to traffic.

- D. Protect adjacent surfaces: Mask adjoining surfaces not receiving traffic coatings to prevent overspray, spillage, leaking, and migration of coatings. Prevent traffic-coating materials from entering deck substrate penetrations and clogging weep holes and drains.

### 3.3 INSTALLATION

- A. Apply system materials in accordance with manufacturer's instructions.
- B. General:
  1. Provide sealant cants at penetrations and at reinforced and nonreinforced, deck-to-wall butt joints
  2. Terminate edges of deck-to-deck expansion joints with preparatory base-coat strip
  3. Install sheet flashings at deck-to-wall expansion and dynamic joints, and bond to deck and wall substrates according to manufacturer's written recommendations
  4. Apply traffic coatings to prepared wall terminations and vertical surfaces to height indicated; omit aggregate on vertical surface
  5. Extend primer, base and top coats up intersecting and perimeter vertical surfaces, a minimum of 8 inches. Terminate top edge in a straight line.
  6. Finish to smooth surface sloped to drains. Cove at vertical surfaces.
  7. Apply surfacing to top coat before set.
  8. Apply sealant to junction of horizontal and intersecting surfaces to achieve watertight seal.
- C. Pedestrian Surface Coating:
  1. Apply primer to prepared substrate to a dry film thickness recommended by the manufacturer.
  2. Apply wear coat to a total minimum dry film thickness of 20 mils over the entire area except at expansion joints. Allow to cure as recommended by the manufacturer.
  3. Apply top coat layer to a thickness of 12 mils; broadcast sand at a rate of 15-18 pounds per gallon into the wet top coat. Backroll the aggregate into the topcoat to fully incorporate the sand into the coating.
- D. Traffic Surface Coating:
  1. Apply primer to prepared substrate to a dry film thickness recommended by the manufacturer.
  2. When primer is tack free, apply one base coat of membrane to a total minimum dry film thickness of 20 mils. Allow to cure for 24 hours. Extend base coat over cracks and control joints which have received detail treatment.

3. When base coat is slightly tacky, apply wear coat with a heavy duty roller at a thickness of 8 mils minimum and immediately broadcast aggregate, evenly distributed, into wet coating at the rate of 15 lbs/100 sf. When dry, remove excess aggregate. Allow to cure overnight.
  4. Apply topcoat with brush, roller or spray to a thickness of 12 mils minimum.
  5. Standard system coating thickness is 40 dry mils exclusive of primer and aggregate.
- E. Concrete Sealer: Provide where indicated, coordinating with Section 03 30 00.
1. Vertical Application: Saturate surface with sealer in a single application. Use enough to thoroughly wet the surface. Thoroughly brush heavy runs and drips into the surface.
  2. Horizontal Application: Saturate in a single application. Use enough to keep the surface wet for 30 to 60 seconds before penetration. Broom out puddles until they penetrate the surface.
- F. Pavement Markings
1. Do not apply pavement-marking paint for striping and other markings until layout, colors, and placement have been verified with Architect and traffic coating has cured.
  2. Sweep and clean surface to eliminate loose material and dust.
  3. Apply pavement-marking paint with mechanical equipment to produce markings of dimensions indicated with uniform straight edges. Apply at manufacturer's recommended rates for a 15-mil-minimum, wet film thickness.
    - a. Apply graphic symbols and lettering with paint-resistant, die-cut stencils, firmly secured to surface. Mask an extended area beyond edges of each stencil to prevent paint application beyond stencil. Apply paint so that it cannot run beneath stencil.

#### 3.4 PROTECTION

- A. Do not permit traffic over unprotected surfaces.

END OF SECTION

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## SECTION 07 21 00 - THERMAL INSULATION

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Board insulation at cavity wall construction, over roof deck, and exterior wall behind metal panel wall finish.
- B. Batt insulation and vapor retarder in exterior wall, ceiling, and roof construction.
- C. Batt insulation for filling perimeter window and door shim spaces and crevices in exterior wall and roof.
- D. Faced mineral wool board at underside of structural deck at loading and garage areas.
- E. High density XPS foam board below concrete topping slabs, roofing, and at foundation perimeter.
- F. Wall variable-permeability vapor retarder.

#### 1.2 RELATED REQUIREMENTS

- A. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 07 14 00 - Fluid Applied Waterproofing: Insulation specified as part of waterproofing system at foundation and roof.
- C. Section 07 25 00 - Weather Barriers: Separate air barrier and vapor retarder materials.
- D. Section 07 84 00 - Firestopping: Insulation as part of fire-rated through-penetration assemblies.
- E. Section 09 21 16 - Gypsum Board Assemblies: Acoustic insulation inside walls and partitions.

#### 1.3 REFERENCE STANDARDS

- A. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus 2021.
- B. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications 2013 (Reapproved 2019).
- C. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation 2019.
- D. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation 2014 (Reapproved 2019).
- E. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing 2017.
- F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2021a.

- G. ASTM E136 - Standard Test Method for Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750°C 2019a.
- H. ASTM E2357 - Standard Test Method for Determining Air Leakage of Air Barrier Assemblies 2018.
- I. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components 2019.

#### 1.4 SUBMITTALS

- A. See Section 01 33 00 for submittal procedures.
- B. Product Data: Provide data on product characteristics, performance criteria, and product limitations.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- D. Manufacturer's Installation Instructions: Include information on special environmental conditions required for installation and installation techniques.

#### 1.5 FIELD CONDITIONS

- A. Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.

### PART 2 PRODUCTS

#### 2.1 APPLICATIONS

- A. Insulation Under Concrete Topping Slabs: Extruded polystyrene (XPS) board.
- B. Insulation at Perimeter of Foundation: Extruded polystyrene (XPS) board.
- C. Insulation Inside Masonry Cavity Walls: Mineral fiber board.
- D. Insulation on underside of Concrete garage ceilings: Mineral fiber board, pinned.
- E. Insulation in Metal Framed Walls: Batt insulation with separate variable permeability vapor retarder.
- F. Insulation Over Roof Deck: Extruded polystyrene (XPS) board, Refer to Section 07 50 50. .

#### 2.2 FOAM BOARD INSULATION MATERIALS

1. Type and Compressive Resistance: Type VII, 60 psi (414 kPa), minimum.
2. Flame Spread Index (FSI): Class A - 0 to 25, when tested in accordance with ASTM E84.
3. Smoke Developed Index (SDI): 450 or less, when tested in accordance with ASTM E84.
4. Type and Thermal Resistance, R-value: Type VII, 5.0 (0.88) per 1 inch thickness at 75 degrees F mean temperature.

5. Board Edges: Square.
6. Type and Water Absorption: Type VII, 0.3 percent by volume, maximum, by total immersion.
7. Manufacturers:
  - a. Dow Chemical Company; STYROFOAM HIGHLOAD 40:  
[www.dowbuildingsolutions.com/#sle](http://www.dowbuildingsolutions.com/#sle).
  - b. Owens Corning Corporation; FOAMULAR Extruded Polystyrene (XPS) Insulation:  
[www.ocbuildingspec.com/#sle](http://www.ocbuildingspec.com/#sle).
  - c. Substitutions: Refer to Section 01 25 00 for submittal and acceptance requirements for Substitutions..

## 2.3 FIBERBOARD INSULATION MATERIALS

- A. Where fiberboard insulation is indicated, either rock, slag, or glass mineral fiberboard insulation may be used, at Contractor's option.
- B. Mineral Fiberboard Insulation: Rigid mineral fiber, in accordance with ASTM C612.
  1. Facing: None, unfaced.
  2. Flame Spread Index: 25 or less, when tested with facing, if any, in accordance with ASTM E84.
  3. Smoke Developed Index: 50 or less, when tested with facing, if any, in accordance with ASTM E84.
  4. Board Thickness: As indicated.
  5. Board Edges: Square.
  6. Thermal Conductivity (k-factor): BTU inch/hr sq ft degrees F of 0.26 per inch at 75 degrees F when tested in accordance with ASTM C518.
  7. Maximum Density: 8.0 pounds per cubic foot.
- C. Mineral Fiberboard Insulation: Rigid or semi-rigid mineral fiber, ASTM C612 or ASTM C553; unfaced flame spread index of 0 (zero) when tested in accordance with ASTM E84.
  1. Facing: White kraft paper, fiberglass scrim, aluminum foil laminate (ASJ)
  2. Smoke Developed Index: 450 or less, when tested in accordance with ASTM E84.
  3. Board Thickness: as indicated.
  4. Thermal Resistance: R-value of 4.0 per inch at 75 degrees F, minimum, when tested according to ASTM C518.
  5. Maximum Density: 8.0 pounds per cubic foot, nominal.

6. Manufacturers: Basis of Design

- a. ROCKWOOL (ROXUL, Inc); CAVITYROCK MD: [www.rockwool.com/#sle](http://www.rockwool.com/#sle).
- b. Substitutions: Refer to Section 01 25 00 for submittal and acceptance requirements for Substitutions.

## 2.4 BATT INSULATION MATERIALS

- A. Where batt insulation is indicated, either glass fiber or mineral fiber batt insulation may be used, at Contractor's option.
- B. Glass Fiber Batt Insulation: Flexible preformed batt or blanket, complying with ASTM C665; friction fit.
  1. Flame Spread Index: 75 or less, when tested in accordance with ASTM E84.
  2. Smoke Developed Index: 450 or less, when tested in accordance with ASTM E84.
  3. Combustibility: Non-combustible, when tested in accordance with ASTM E136, except for facing, if any.
  4. Formaldehyde Content: Zero.
  5. Thickness: as indicated.
6. Manufacturers:
  - a. CertainTeed Corporation; Fiber Glass Building Insulation: [www.certainteed.com/#sle](http://www.certainteed.com/#sle).
  - b. Owens Corning Corporation; EcoTouch PINK FIBERGLAS Insulation: [www.ocbuildingspec.com/#sle](http://www.ocbuildingspec.com/#sle).
  - c. Substitutions: Refer to Section 01 25 00 for submittal and acceptance requirements for Substitutions..
- C. Mineral Fiber Batt Insulation: Flexible or semi-rigid preformed batt or blanket, complying with ASTM C665; friction fit; unfaced flame spread index of 0 (zero) when tested in accordance with ASTM E84.
  1. Flame Spread Index: 25 or less, when tested in accordance with ASTM E84.
  2. Smoke Developed Index: 0 (zero), when tested in accordance with ASTM E84.
  3. Thickness: as indicated.
4. Manufacturers:
  - a. Johns Manville; MinWool Sound Attenuation Fire Batts: [www.jm.com/#sle](http://www.jm.com/#sle).
  - b. Substitutions: Refer to Section 01 25 00 for submittal and acceptance requirements for Substitutions..

## 2.5 ACCESSORIES

- A. Variable Permeability Vapor Retarder: ASTM E84, Class A fire rated; 2 mil thick film of polyamide (nylon); Water vapor permeance less than 1.0 perm per ASTM E96 Desiccant method; MemBRAIN by Certainteed.
- B. Tape: Reinforced polyethylene film with acrylic pressure sensitive adhesive.
  - 1. Application: Sealing of interior circular penetrations, such as pipes or cables.
  - 2. Width: Are required for application.
- C. Flashing Tape: Special reinforced film with high performance adhesive.
  - 1. Application: Window and door opening flashing tape.
  - 2. Width: As required for application.
- D. Tape joints of rigid insulation in accordance with roofing and insulation manufacturers' instructions.
- E. Insulation Fasteners: Impaling clip of unfinished steel with washer retainer and clips, to be adhered to surface to receive insulation, length to suit insulation thickness and substrate, capable of securely and rigidly fastening insulation in place. Basis of design - products by AGM Industries, Inc., TACTOO Insul-Hangers or approved equal.
  - 1. Adhesively Attached, Spindle-Type Anchors: Plate attached to projecting spindle; capable of holding insulation thickness indicated securely in position indicated with self-locking washer in place; and complying with the following requirements:
    - a. Plate: Perforated stainless steel sheet, 0.03 in. thick by 2 in. square.
    - b. Spindle: Stainless steel, 0.105 in. diameter, length to suit depth of insulation indicated.
  - 2. Anchor Adhesives: Product with demonstrated capability to permanently bond insulation anchors securely to substrates indicated without damaging insulation, fasteners, and substrates.
  - 3. Insulation-Retaining Washers: Self-locking washers formed from 0.016 in. thick galvanized sheet.
- F. Adhesive: Type recommended by insulation manufacturer for application.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify that substrate, adjacent materials, and insulation materials are dry and that substrates are ready to receive insulation.
- B. Verify substrate surfaces are flat, free of honeycomb, fins, irregularities, or materials or substances that may impede adhesive bond.

### 3.2 BOARD INSTALLATION AT FOUNDATION PERIMETER

- A. Install boards horizontally on foundation perimeter.
  1. Install board directly to substrate with manufacturer recommended mechanical fasteners, and tape joints with manufacturer's minimum 4 inch wide sealant tape; comply with ASTM E2357.
  2. Install in running bond pattern.
  3. Butt edges and ends tightly to adjacent boards and to protrusions.
- B. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

### 3.3 BOARD INSTALLATION AT EXTERIOR WALLS

- A. Adhere 6 inches wide strip of polyethylene sheet over expansion joints with double beads of adhesive each side of joint.
- B. Install rigid insulation directly to steel studs or exterior grade sheathing at 16 inches on center with manufacturer recommended mechanical fasteners, and tape joints with manufacturer's minimum 4 inches wide sealant tape; comply with ASTM E2357.
- C. Install boards horizontally on walls using mechanical attachment.
  1. Install in running bond pattern.
  2. Butt edges and ends tightly to adjacent boards and protrusions.
- D. Extend boards over expansion joints, unbonded to wall on one side of joint.
- E. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

### 3.4 BOARD INSTALLATION UNDER ELEVATED SLABS

- A. Adhere a 6 inch wide strip of polyethylene sheet over expansion joints with double beads of adhesive each side of joint.
  1. Tape seal joints between sheets.
- B. Install boards on underside of concrete slab as indicated
  1. Place impale fastener locking discs.
  2. Place boards to maximize adhesive contact.
  3. Install in running bond pattern.
  4. Butt edges and ends tightly to adjacent boards and to protrusions.
- C. Extend boards over expansion joints, unbonded to wall on one side of joint.

- D. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.
- E. Tape insulation board joints and at pin locations.

### 3.5 BOARD INSTALLATION AT CAVITY WALLS AND PANEL WALL FINISHES

- A. Secure impale fasteners to substrate at following frequency:
  - 1. Six (6) per insulation board.
- B. Adhere a 6 inches wide strip of polyethylene sheet over expansion joints with double beads of adhesive each side of joint.
  - 1. Tape seal joints between sheets.
- C. Install boards to fit snugly between wall ties at cavity walls.
- D. Install boards horizontally on walls.
  - 1. Place boards to maximize adhesive contact.
  - 2. Install in running bond pattern.
  - 3. Butt edges and ends tightly to adjacent boards and protrusions.
  - 4. Place impale fastener locking discs.
- E. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

### 3.6 BOARD INSTALLATION UNDER CONCRETE SLABS

- A. Place insulation under slabs on grade after base for slab has been compacted.
- B. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.
- C. Prevent insulation from being displaced or damaged while placing vapor retarder and placing slab.

### 3.7 BATT INSTALLATION

- A. Install insulation and vapor retarder in accordance with manufacturer's instructions.
- B. Install to a depth providing a minimum of R-13 in exterior wall spaces without gaps or voids. Do not compress insulation.
- C. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.
- D. Fit insulation tightly in cavities and tightly to exterior side of mechanical and electrical services within the plane of the insulation. Maintain required clearance around recessed lighting fixtures not rated for or protected from contact with insulation.
- E. Retain insulation batts in place with spindle fasteners at 12 inches on center.

- F. At exterior wall metal framing, place variable permeable vapor retarder on warm side of insulation; lap and seal sheet retarder joints over member face.
- G. Tape seal tears or cuts in vapor retarder.
- H. Extend vapor retarder tightly to full perimeter of adjacent window and door frames and other items interrupting the plane of the membrane. Tape seal in place.
- I. Coordinate work of this section with construction of air barrier seal specified in Section 07 25 00.

### 3.8 VARIABLE PERMEABILITY VAPOR RETARDER

- A. Install variable-permeance vapor retarders in accordance with manufacturer's written instructions and the following:
  - 1. Place variable-permeance vapor retarders as indicated on drawings. Extend variable-permeance vapor retarder to extremities of areas to protect from vapor transmission. Extend variable-permeance vapor retarders to cover miscellaneous voids in insulated substrates, including those filled with loose-fiber insulation.
  - 2. Fasten with button cap fasteners to metal framing at top, end, and bottom edges; at perimeter of wall openings; and at lap joints. Space fasteners 12 in. o/c. Seal seams and penetration joints caused by pipes, conduits, electrical boxes, and similar items with manufacturer's recommended tape to create an airtight seal between penetrating objects and variable-permeance vapor retarder.
- B. Correct deficiencies in or remove variable-permeance vapor retarders that do not comply with specified requirements. Repair and reapply components, or tears or punctures in variable-permeance vapor retarders immediately prior to concealment.

### 3.9 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for additional requirements.

### 3.10 PROTECTION

- A. Do not permit installed insulation to be damaged prior to its concealment.

END OF SECTION

## SECTION 07 25 00 - WEATHER BARRIERS

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Air Barriers: Materials that form a system to stop passage of air through exterior walls, joints between exterior walls and roof, and joints around frames of openings in exterior walls.

#### 1.2 RELATED REQUIREMENTS

- A. Section 07 21 00 - Thermal Insulation: Vapor retarder installed in conjunction with batt insulation.
- B. Section 07 92 00 - Joint Sealants: Sealing building expansion joints.

#### 1.3 DEFINITIONS

- A. Weather Barrier: Assemblies that form either water-resistive barriers, air barriers, or vapor retarders.
- B. Air Barrier: Air tight barrier made of material that is relatively air impermeable but water vapor permeable, both to the degree specified, with sealed seams and with sealed joints to adjacent surfaces.  
Note: For the purposes of this specification, vapor impermeable air barriers are classified as vapor retarders.

#### 1.4 REFERENCE STANDARDS

- A. ASTM D1970/D1970M - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection 2021.
- B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2021a.
- C. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials 2016.
- D. ASTM E2178 - Standard Test Method for Determining Air Leakage Rate and Calculation of Air Permeance of Building Materials 2021a.
- E. ICC-ES AC38 - Acceptance Criteria for Water-Resistive Barriers 2016, with Editorial Revision (2019).
- F. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components 2019.

#### 1.5 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on material characteristics.
- C. Shop Drawings: Provide drawings of special joint conditions. Coordinate shop drawings with other adjoining construction.
- D. Quality Control Plan: for review by Architect.

- E. Manufacturer's Installation Instructions: Indicate preparation.
- F. ABAA Manufacturer Qualification: Submit documentation of current evaluation of proposed manufacturer and materials.
- G. Testing Agency Qualification Statement.

#### 1.6 QUALITY ASSURANCE

- A. Air Barrier Association of America (ABAA) Evaluated Materials Program (EAP); [www.airbarrier.org/#sle](http://www.airbarrier.org/#sle): Use evaluated materials from a single manufacturer regularly engaged in air barrier material manufacture, and use secondary materials approved in writing by primary material manufacturer.
- B. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of the type specified in this section.
- C. Single source responsibility for weather barrier materials, provide and install products from a single source.
- D. Conduct preinstallation conference at Project site. Review requirements for air barriers, including surface preparation specified under other Sections, substrate condition and pretreatment, minimum curing period, forecasted weather conditions, special details and sheet flashings, installation procedures, testing and inspection procedures, and protection and repairs.
- E. Require development of quality control plan, including manufacturer site visits, protection plan for installed products, adhesion tests, field inspection procedures, and work sequence plan.

#### 1.7 MOCK-UP

- A. Install air barrier materials in mock-up specified in Section 01 43 89. Test installation for air/water infiltration and penetration.

#### 1.8 FIELD CONDITIONS

- A. Maintain temperature and humidity recommended by the materials manufacturers before, during and after installation.

#### 1.9 DELIVERY, STORAGE AND HANDLING

- A. Refer to current Product MSDS for proper storage and handling.
- B. Deliver materials to the job site in undamaged and original packaging indicating the name of the manufacturer and product.
- C. Store roll materials on end in original packaging. Protect rolls from direct sunlight until ready for use.
- D. Store air barrier membranes, adhesives and primers at temperatures of 40 degrees F and rising.
- E. Keep solvent away from open flame or excessive heat.

F. Waste Management and Disposal

1. Separate and recycle waste materials in accordance with Section 01 74 19 - Waste Management and Disposal.

PART 2 PRODUCTS

2.1 WEATHER BARRIER ASSEMBLIES

A. Air Barrier:

1. On outside surface of single wythe masonry and concrete exterior walls use air barrier fluid applied coating.
  2. On outside surface of sheathing of exterior walls use air barrier fluid applied coating.
  3. At padouts and other portions of the structure outboard of the primary air barrier coating use air barrier fully adhered sheets materials.
- B. Variable Permeability Vapor Retarder: Refer to Section 07 21 00 for separate sheet vapor barrier over batt insulation.

2.2 AIR BARRIER MATERIALS (WATER VAPOR PERMEABLE AND WATER-RESISTIVE)

A. Air Barrier Sheet, Self-Adhered:

1. Air Permeance: 0.004 cfm/sq ft, maximum, when tested in accordance with ASTM E2178.
2. Water Vapor Permeance: 10 perms, minimum, when tested in accordance with ASTM E96/E96M Procedure A (Desiccant Method) at 73.4 degrees F.
3. Ultraviolet (UV) and Weathering Resistance: Approved in writing by manufacturer for up to 90 days of weather exposure.
4. Surface Burning Characteristics: Flame spread index of 25 or less, smoke developed index of 450 or less (Class A), when tested in accordance with ASTM E84.
5. Water Resistance: Comply with applicable water-resistive requirements of ICC-ES AC38.
6. Seam and Perimeter Tape: As recommended by sheet manufacturer.
7. Acceptable Manufacturers:
  - a. GCP Applied Technologies; Perm-A-Barrier VPS: [www.gcpat.com/#sle](http://www.gcpat.com/#sle).
  - b. Henry Company; Blueskin VP160: [www.henry.com/#sle](http://www.henry.com/#sle).
  - c. Substitutions: Refer to Section 01 25 00 for submittal and acceptance requirements for proposed substitutions .

- B. Air Barrier, Fluid Applied: Vapor permeable, elastomeric waterproofing.

1. Air Barrier Coating:
  - a. Material: Acrylic.
  - b. Dry Film Thickness (DFT): 10 mil, 0.010 inch, minimum.
  - c. Air Permeance: 0.004 cfm/sq ft, maximum, when tested in accordance with ASTM E2178.
  - d. Water Vapor Permeance: 18 perms, minimum, when tested in accordance with ASTM E96/E96M Procedure B (Water Method) at 73.4 degrees F.
  - e. Surface Burning Characteristics: Flame spread index of 25 or less, smoke developed index of 450 or less, when tested in accordance with ASTM E84.
  - f. Complies with NFPA 285 wall assembly requirements.
  - g. Nail Sealability: Pass, when tested in accordance with ASTM D1970/D1970M.
  - h. Sealants, Tapes and Accessories: As recommended by coating manufacturer.
  - i. Manufacturers:
    - 1) Henry Company, Air-bloc 31MR.
    - 2) Henry Company; Air-Bloc 17MR for low temperature installation.
    - 3) Substitutions: Refer to Section 01 25 00 for submittal and acceptance requirements for proposed substitutions .

## 2.3 ACCESSORIES

- A. Sealants, Tapes, and Accessories for Sealing Weather Barrier and Sealing Weather Barrier to Adjacent Substrates: As specified or as recommended by weather barrier manufacturer.
- B. Flexible Flashing: Self adhering transition membrane flashing complying with ASTM D1970/D1970M, except slip resistance requirement is waived if not installed on a roof.
  1. Composition: Modified bituminous sheet laminated to polyethylene sheet; Blueskin SA by Henry or approved equal.
  2. High temperature resistant self-adhered membrane: Blueskin PE200HT by Henry or approved equal. Provide at parapets beneath metal coping.
- C. Through-wall Flashing: Provide at wall assemblies with brick cladding; self-adhered membrane SBS rubberized asphalt compound, laminated to a cross-laminated polyethylene film; Blueskin TWF by Henry or approved equal.
- D. Lap sealant: Provide around window perimeters; Basis of Design - AirBloc LF by Henry

- E. Penetration and Termination Sealant: Provide at construction joints subject to dynamic joint movement; silyl-terminated polyether polymer (STPE) sealant; one part, low VOC, moisture cure; HE 925 BES by Henry or approved equal.
- F. Liquid Flashing: One part, fast curing, non-sag, elastomeric, gun grade, trowelable liquid flashing compatible with adjacent membrane materials.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify that surfaces and conditions are ready to accept the work of this section.

### 3.2 PREPARATION

- A. Remove projections, protruding fasteners, and loose or foreign matter that might interfere with proper installation.
- B. Clean and prime substrate surfaces to receive adhesives in accordance with manufacturer's instructions.
- C. Fill voids, gaps and spalled areas in substrate to provide an even plane, and in accordance with manufacturer's requirements. Strike masonry joints flush.

### 3.3 INSTALLATION

- A. Install materials in accordance with manufacturer's instructions.
- B. Air Barriers: Install continuous air tight barrier over surfaces indicated, with sealed seams and with sealed joints to adjacent surfaces.
- C. Coatings:
  1. Prepare substrate in manner recommended by coating manufacturer; treat joints in substrate and between dissimilar materials as recommended by manufacturer.
  2. Use flashing to seal to adjacent construction and to bridge joints.
- D. Openings and Penetrations in Exterior Weather Barriers:
  1. Install flashing over sills, covering entire sill frame member, extending at least 5 inches onto weather barrier and at least 6 inches up jambs; mechanically fasten stretched edges.
  2. At openings to be filled with frames having nailing flanges, seal head and jamb flanges using a continuous bead of sealant compressed by flange and cover flanges with sealing tape at least 4 inches wide; do not seal sill flange.
  3. At openings to be filled with non-flanged frames, seal weather barrier to each side of opening framing, using flashing at least 9 inches wide, covering entire depth of framing.

4. At head of openings, install flashing under weather barrier extending at least 2 inches beyond face of jambs; seal weather barrier to flashing.
5. At interior face of openings, seal gap between window/door frame and rough framing, using joint sealant over backer rod.
6. Service and Other Penetrations: Form flashing around penetrating item and seal to weather barrier surface.

END OF SECTION

## SECTION 07 42 13 - METAL WALL PANELS

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Manufactured metal panels for corrugated exterior wall panels and subgirt framing assembly, with related flashings and accessory components.

#### 1.2 RELATED REQUIREMENTS

- A. Section 07 25 00 - Weather Barriers: Water-resistive barrier under wall panels.
- B. Section 07 27 00 - Air Barriers: Air barrier under wall panels.
- C. Section 07 92 00 - Joint Sealants: Sealing joints between metal wall panel system and adjacent construction.

#### 1.3 REFERENCE STANDARDS

- A. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix) 2017a.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2020.

#### 1.4 SUBMITTALS

- A. See Section 01 33 00 for submittal procedures.
- B. Product Data - Wall System: Manufacturer's data sheets on each product to be used, including:
  - 1. Physical characteristics of components shown on shop drawings.
  - 2. Storage and handling requirements and recommendations.
  - 3. Installation instructions and recommendations.
- C. Shop Drawings: Indicate dimensions, layout, joints, construction details, support clips, [\_\_\_\_\_], and methods of anchorage.
- D. Samples: Submit two samples of wall panel and soffit panel, 12 inches by 12 inches in size illustrating finish color, sheen, and texture.
- E. Warranty Documentation for Installation of Building Rainscreen Assembly: Submit installer warranty and ensure that forms have been completed in Owner's name and registered with installer.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. See Section 01 74 19 - Construction Waste Management and Disposal for packaging waste requirements.

- B. Protect panels from accelerated weathering by removing or venting sheet plastic shipping wrap.
- C. Store prefinished material off the ground and protected from weather; prevent twisting, bending, or abrasion; provide ventilation; slope metal sheets to ensure proper drainage.
- D. Prevent contact with materials that may cause discoloration or staining of products.

## PART 2 PRODUCTS

### 2.1 METAL WALL PANEL MATERIALS

- A. Corrugated Wall Panel System: Factory fabricated prefinished metal panel system, site assembled.
  - 1. Provide exterior wall panels and subgirt framing assembly.
  - 2. Design and size components to support assembly dead loads, and to withstand live loads caused by positive and negative wind pressure acting normal to plane of wall.
  - 3. Maximum Allowable Deflection of Panel: L/180 for length(L) of span.
  - 4. Movement: Accommodate movement within system without damage to components or deterioration of seals, movement between system and perimeter components when subject to seasonal temperature cycling; dynamic loading and release of loads; and deflection of structural support framing.
  - 5. Drainage: Provide positive drainage to exterior for moisture entering or condensation occurring within panel system.
  - 6. Fabrication: Formed true to shape, accurate in size, square, and free from distortion or defects; pieces of longest practical lengths.
  - 7. Corners: Factory-fabricated in one continuous piece with minimum 2 inch returns.
- B. Exterior Wall Panels:
  - 1. Profile: Horizontal; Belvedere series - 6 inch Short Rib Panels as manufactured by ATAS .
  - 2. Side Seams: Lapped, sealed with continuous gaskets.
  - 3. Material: Precoated steel sheet, 22 gauge, 0.0299 inch minimum thickness.
  - 4. Panel Width: 36 inches.
  - 5. Color: Custom color to match RAL 7921 Black Grey.
- C. Subgirt Framing Assembly:
- D. Internal and External Corners: Same material, thickness, and finish as exterior sheets; profile to suit system; shop cut and factory mitered to required angles.

- E. Expansion Joints: Same material, thickness and finish as exterior sheets; manufacturer's standard brake formed type, of profile to suit system.
- F. Trim: Same material, thickness and finish as exterior sheets; brake formed to required profiles.
- G. Anchors: Galvanized steel.

## 2.2 MATERIALS

- A. Precoated Steel Sheet: Hot-dipped galvanized steel sheet, ASTM A653/A653M, Structural Steel (SS) or Forming Steel (FS), with G90/Z275 coating; continuous coil-coated on exposed surfaces with specified finish coating and on panel back with specified panel back coating.
- B. Select materials with surface flatness, smoothness, and lack of surface blemishes where exposed to view in finished system.

## 2.3 FINISHES

- A. Fluoropolymer Coil Coating System: Manufacturer's standard multi-coat aluminum coil coating system complying with AAMA 2605, including at least 70 percent polyvinylidene fluoride (PVDF) resin, and at least 80 percent of coil coated aluminum surfaces having minimum total dry film thickness (DFT) of 0.9 mil, 0.0009 inch; color and gloss as scheduled.

## 2.4 ACCESSORIES

- A. Cladding Support Clips: Thermally-broken, thermal spacer clips for support of cladding z-girts, angles, channels, and other framing.
  - 1. Thermal Spacer Clip: Pultruded glass fiber and thermoset polyester resin clip; 3/16 inch thick at top, base, and web.
  - 2. Clip Depth: As indicated on drawings.
- B. Gaskets: Manufacturer's standard type suitable for use with system, permanently resilient; ultraviolet and ozone resistant.
- C. Fasteners: Manufacturer's standard type to suit application; with soft neoprene washers, steel, hot dip galvanized. Fastener cap same color as exterior panel.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify that building framing members are ready to receive panels.
- B. Verify that air barrier has been installed over substrate completely and correctly; see Section 07 27 00.

### 3.2 PREPARATION

- A. Install subgirts perpendicular to panel length, securely fastened to substrates and shimmed and leveled to uniform plane. Space at intervals indicated.

### 3.3 INSTALLATION

- A. Install panels on walls in accordance with manufacturer's instructions.
- B. Fasten panels to structural supports; aligned, level, and plumb.
- C. Locate joints over supports.
- D. Lap panel ends minimum 2 inches.
- E. Provide expansion joints where indicated.
- F. Seal and place gaskets to prevent weather penetration. Maintain neat appearance.

### 3.4 TOLERANCES

- A. Maximum Offset From True Alignment Between Adjacent Members Butting or In Line: 1/16 inch.
- B. Maximum Variation from Plane or Location Indicated on Drawings: 1/4 inch.

### 3.5 CLEANING

- A. See Section 01 70 00 - Execution and Closeout Requirements for additional requirements.
- B. Remove site cuttings from finish surfaces.
- C. Remove protective material from wall panel surfaces.
- D. Clean and wash prefinished surfaces with mild soap and water; rinse with clean water.

END OF SECTION

## SECTION 07 42 64 - METAL COMPOSITE MATERIAL WALL PANELS

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Rain Screen panel system; integrated with window system.
- B. Exterior cladding and soffits consisting of formed metal composite material (MCM) sheet, and anchors to structure, attached to solid backup.
- C. Matching flashing and trim.

#### 1.2 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Installation of anchors.
- B. Section 04 20 00 - Unit Masonry: Installation of anchors.
- C. Section 07 21 00 - Thermal Insulation: Rigid insulation board and variable-permeance vapor retarder.
- D. Section 07 25 00 - Weather Barriers: Air barrier behind rainscreen wall system.
- E. Section 08 44 13 - Glazed Aluminum Curtain Walls:

#### 1.3 REFERENCE STANDARDS

- A. ASTM A276/A276M - Standard Specification for Stainless Steel Bars and Shapes; 2015.
- B. ASTM A480/A480M - Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip; 2014a.
- C. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2010.
- D. ASTM D523 - Standard Test Method for Specular Gloss; 2008.
- E. ASTM D1781 - Standard Test Method for Climbing Drum Peel for Adhesives; 1998 (Reapproved 2012).
- F. ASTM D1929 - Standard Test Method for Determining Ignition Temperature of Plastics; 2013a.
- G. ASTM D2244 - Standard Practice for Calculation of Color Differences from Instrumentally Measured Color Coordinates; 2011.
- H. ASTM D4145 - Standard Test Method for Coating Flexibility of Preprinted Sheet; 2010.
- I. ASTM D4214 - Standard Test Methods for Evaluating the Degree of Chalking of Exterior Paint Films; 2007.
- J. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2014.

- K. ASTM E283 - Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls and Doors Under Specified Pressure Differences Across the Specimen; 2004 (Reapproved 2012).
- L. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014.
- M. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Curtain Walls and Doors By Uniform Static Air Pressure Difference; 2000 (Reapproved 2009).
- N. NFPA 285 - Standard Fire Test Method for evaluation of Fire Propagation Characteristics of Exterior Non-load-Bearing Wall Assemblies Containing Combustible Components; 2012.

#### 1.4 ADMINISTRATIVE REQUIREMENTS

- A. Pre-Installation Meeting: Convene one week before starting work of this section to verify project requirements, co-ordinate with installers of other work, establish condition and completeness of building substrate, and review manufacturers' installation instructions and warranty requirements.
  - 1. Require attendance by the installer and relevant sub-contractors.
  - 2. Include MCM sheet manufacturer's representative and wall system manufacturer's representative to review storage and handling procedures.
  - 3. Review in detail truck transportation, parking, vertical transportation, schedule, personnel, installation of adjacent materials and substrate.
  - 4. Review procedures for protection of work and other construction.
  - 5. Review safety precautions.

#### 1.5 SUBMITTALS

- A. See Section 01 33 00 for general submittal procedures.
- B. Product Data - MCM Sheets: Manufacturer's data sheets on each product to be used, including thickness, physical characteristics, and finish, and:
  - 1. Finish manufacturer's data sheet showing physical and performance characteristics.
  - 2. Storage and handling requirements and recommendations.
  - 3. Fabrication instructions and recommendations.
  - 4. Specimen warranty for finish, as specified herein.
- C. Product Data - Wall System: Manufacturer's data sheets on each product to be used, including:
  - 1. Physical characteristics of components shown on shop drawings.

2. Storage and handling requirements and recommendations.
  3. Installation instructions and recommendations.
  4. Specimen warranty for wall system, as specified herein.
- D. Shop Drawings: Show layout and elevations, dimensions and thickness of panels, connections, details and location of joints, sealants and gaskets, method of anchorage, number of anchors, supports, reinforcement, trim, flashings, and accessories.
1. Indicate panel numbering system.
  2. Differentiate between shop and field fabrication.
  3. Indicate substrates and adjacent work with which the wall system must be coordinated.
  4. Include details of project specific conditions.
  5. Include large-scale details of anchorages and connecting elements.
  6. Include large-scale details or schematic, exploded or isometric diagrams to fully explain flashing at a scale of not less than 1-1/2 inches per 12 inches.
  7. Include design engineer's stamp or seal on shop drawings for attachments and anchors.
- E. Design Data: Submit structural calculations stamped by design engineer, for Architect's information and project record.
- F. Verification Samples: For each finish product specified, minimum size 12 inches square, representing actual product in color and texture.
- G. Test Report: Submit report of full-size mock-up tests for air infiltration, water penetration, and wind performance.
- H. Wall System Manufacturer Qualifications.
- I. Installer's Qualifications.
- J. Certificate: Certify that the work results of this section meet or exceed specified requirements.
- K. Manufacturer's Field Reports: Provide within 48 hours of field review. State what was observed and what changes, if any, were requested or required.
- L. Maintenance Data: Care of finishes and warranty requirements.
- M. Executed Warranty: Submit warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

## 1.6 QUALITY ASSURANCE

- A. Field Measurements: Verify actual dimensions by field measurement before fabrication; show recorded measurements on shop drawings.
- B. Design Engineer's Qualifications: Design structural supports and anchorages under direct supervision of a Structural Engineer experienced in design of this type of Work and licensed in Maryland.
- C. Wall System Manufacturer Qualifications: Company specializing in manufacturing products specified in this section.
  - 1. With not less than three years of documented experience.
  - 2. Can provide a technical representative to review substrate conditions and conduct performance testing of installation and mockup.
  - 3. Approved by MCM sheet manufacturer.
- D. Installer Qualifications: Company specializing in performing work of the type specified in this section.
  - 1. With minimum 3 years of documented experience.
  - 2. Approved by wall system manufacturer.
- E. Testing Agency Qualifications: Independent agency experienced in testing assemblies of the type required for this project and having the necessary facilities for full-size mock-up testing of the type specified.
- F. Mock-Up: Provide materials for a mock-up for evaluation of fabrication workmanship. Refer to Section 01 43 89 for additional information regarding the Exterior Technical Wall Mockup construction.

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products in manufacturer's original, unopened, undamaged containers with identification labels intact.
  - 1. Protect finishes by applying heavy duty removable plastic film during production.
  - 2. Package for protection against transportation damage.
  - 3. Provide markings to identify components consistently with drawings.
  - 4. Exercise care in unloading, storing and installing panels to prevent bending, warping, twisting and surface damage.
- B. Store products protected from exposure to harmful weather conditions and at temperature conditions recommended by manufacturer.
  - 1. Store in well ventilated space out of direct sunlight.

2. Protect from moisture and condensation with tarpaulins or other suitable weather tight covering installed to provide ventilation.
3. Store at a slope to ensure positive drainage of any accumulated water.
4. Do not store in any enclosed space where ambient temperature can exceed 120 degrees F.
5. Avoid contact with any other materials that might cause staining, denting, or other surface damage.

## 1.8 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Wall System Warranty: Provide joint written warranty by manufacturer and installer, agreeing to correct defects in manufacturing or installation within a two year period after Date of Substantial Completion.
- C. MCM Sheet Manufacturer's Finish Warranty: Provide manufacturer's written warranty stating that the finish will perform as follows for minimum of 20 years:
  1. Chalking: No more than that represented by a No.8 rating based on ASTM D4214.
  2. Color Retention: No fading or color change in excess of 5 Hunter color difference units, calculated in accordance with ASTM D2244.
  3. Gloss Retention: Minimum of 30 percent gloss retention, when tested in accordance with ASTM D523.

# PART 2 PRODUCTS

## 2.1 WALL PANEL SYSTEM

- A. Wall Panel System: Metal panels, fasteners, and anchors designed to be supported by framing or other substrate provided by others; provide installed panel system capable of maintaining specified performance without defects, damage or failure.
  1. Provide structural design by or under direct supervision of a Structural Engineer licensed in Commonwealth of Virginia.
  2. Provide panel jointing and weatherseal using reveal joints and gaskets but no sealant.
  3. Anchor panels to supporting framing without exposed fasteners.
- B. Performance Requirements:
  1. Thermal Movement: Provide for free and noiseless vertical and horizontal thermal movement due to expansion and contraction under material temperature range of minus 20 degrees F to 180 degrees F without buckling, opening of joints, undue stress on fasteners, or other detrimental effects; allow for ambient temperature at time of fabrication, assembly, and erection procedures.

2. Wind Performance: Provide system tested in accordance with ASTM E330/E330M without permanent deformation or failures of structural members under the following conditions:
  - a. Design Wind Pressure: As specified on the Structural drawings.
  - b. Maximum deflection of perimeter framing member of L/175 normal to plane of the wall; maximum deflection of individual panels of L/60.
  - c. Maximum anchor deflection in any direction of 1/16 inch at connection points of framing members to anchors.
3. In conjunction with the total wall assembly, wall panel shall resist the following:
  - a. Air Infiltration: 0.06 cfm/sq ft of wall area, maximum, when tested at 1.57 psf in accordance with ASTM E283.
  - b. Water Penetration: No water penetration under static pressure when tested in accordance with ASTM E331 at a differential of 10 percent of inward acting design load, 6.24 psf minimum, after 15 minutes.
    - 1) Water penetration is defined as the appearance of uncontrolled water on the interior face of the wall.
    - 2) Design to drain leakage and condensation to the exterior face of the wall.
- C. Panels: Formed pans of metal composite material sheet by routing back edges of sheet, removing corners, and folding edges. Depth and dimensions as indicated.
  1. Reinforce corners with riveted aluminum angles.
  2. Provide concealed attachment to supporting structure by adhering attachment members to back of panel; attachment members may also function as stiffeners.
  3. Maintain maximum panel bow of 0.8 percent of panel dimension in width and length; provide stiffeners of sufficient size and strength to maintain panel flatness without showing local stresses or read-through on panel face.
  4. Secure members to back face of panels using structural silicone sealant approved by MCM sheet manufacturer.
  5. Fabricate panels under controlled shop conditions.
  6. Where final dimensions cannot be established by field measurement before commencement of manufacturing, make allowance for field adjustments without requiring field fabrication of panels.
  7. Fabricate as indicated on drawings and as recommended by MCM sheet manufacturer.
    - a. Make panel lines, breaks, curves and angles sharp and true.
    - b. Keep plane surfaces free from warp or buckle.

- c. Keep panel surfaces free of scratches or marks caused during fabrication.
- 8. Dry Joint system for Rain Screen: Provide secure extrusions to returned panel edges with stainless steel rivets, providing a means of concealed drainage with baffles and weeps to remove water that might accumulate in members of the system.

## 2.2 MATERIALS

- A. Metal Composite Material (MCM) Sheet: Two sheets of aluminum sandwiching a solid core of extruded thermoplastic material formed in a continuous process with no glues or adhesives between dissimilar materials; core material free of voids and spaces; no foamed insulation material content.
  - 1. Acceptable Manufacturers:
    - a. Basis of Design: AlucoBond Plus; 3A Composites USA, Inc.
    - b. VitraBond Aluminum Composite Panel; Fairview Architectural
    - c. Substitutions: Refer to Section 01 25 00 for requirements regarding submittal and approval procedures for substitutions..
  - 2. Overall Sheet Thickness: 4 mm, minimum.
  - 3. Face Sheet Thickness: Aluminum; 0.019 inch minimum.
    - a. Alloy: Manufacturer's standard, selected for best appearance and finish durability.
  - 4. Core: Fire resistant solid core of extruded thermoplastic material formed in a continuous process with no glues or adhesives between dissimilar materials. Panel materials shall meet requirements for systems tested with the specified air and water barrier according to NFPA 285 in combination with the project-specific wall assembly components.
  - 5. Bond and Peel Strength: No adhesive failure of the bond between the core and the skin nor cohesive failure of the core itself below 22.4 inch-pound/inch with no degradation in bond performance, when tested in accordance with ASTM D1781, simulating resistance to panel delamination, after 8 hours of submersion in boiling water and after 21 days of immersion in water at 70 degrees F.
  - 6. Surface Burning Characteristics: Flame spread index of 25, maximum; smoke developed index of 450, maximum; when tested in accordance with ASTM E84.
  - 7. Flammability: Self-ignition temperature of 650 degrees F or greater, when tested in accordance with ASTM D1929.
  - 8. Factory Finish: One coat fluoropolymer resin coating, approved by the coating manufacturer for the length of warranty specified for the project, and applied by coil manufacturing facility that specializes in coil applied finishes.
    - a. Coating Flexibility: Pass ASTM D4145 minimum 1T-bend, at time of manufacturing.
    - b. Long-Term Performance: Not less than that specified under WARRANTY in PART 1.

9. Color: RAL 7021 Black Grey.
  - a. Proposed alternate manufacturer colors matching the identified colors are subject to the approval of the architect. Refer to Section 01 25 00 for submittal and acceptance requirements.
- B. Flashing: Sheet aluminum; 0.040 inch thick, minimum; finish and color to match MCM sheet.
- C. Anchors, Clips and Accessories: Use one of the following:
  1. Stainless steel complying with ASTM A276/A276M, ASTM A480/A480M, or ASTM A666.
- D. Fasteners:
  1. Exposed fasteners: Stainless steel; permitted only where absolutely unavoidable and subject to prior approval of the Architect.
  2. Screws: Self-drilling or self-tapping Type 410 stainless steel or zinc-alloy steel hex washer head, with EPDM or PVC washer under heads of fasteners bearing on weather side of metal wall panels.
  3. Bolts: Stainless steel.
  4. Fasteners for Flashing and Trim: Blind fasteners of high-strength aluminum or stainless steel.

### 2.3 ACCESSORIES

- A. Metal subframing and furring: ASTM A792/A792M, Class AZ50 aluminum-zinc-alloy coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal composite material panel system.
- B. Bituminous Coating: Cold-applied asphalt mastic, noncorrosive compound free of asbestos, sulfur, and other deleterious impurities; 15 mil dry film thickness per coat.
- C. Joint Sealer: Clear silicone sealant approved by MCM sheet manufacturer.
- D. Provide panel system manufacturer's and installer's standard corrosion resistant accessories, including fasteners, clips, anchorage devices and attachments.
- E. Air/water barrier: Self-adhered system. Coordinate with Section 07 25 00.
- F. Insulation: non-combustible, mineral wood insulation board. Coordinate with Section 07 21 00.
- G. Penetration and termination sealant: as recommended by air/water barrier manufacturer for sealant laps, transitions and penetrations in membrane.
- H. Exterior joint sealant: low modulus, neutral curing silicone weather sealant compatible with the air/water barrier system for use at transitions to fenestration and other compatible substrates. Coordinate with Section 07 92 00.
- I. Variable-permeance vapor retarder: MemBRAIN by CertainTEED. Coordinate with Section 07 21 00.

## 2.4 FABRICATION

- A. Fabricate and finish metal panel and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by lab testing. Comply with indicated profiles and with dimensional and structural requirements
- B. Fabricate flashing and trim to comply with Section 07 62 00 sheet metal flashing and trim.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify dimensions, tolerances, and interfaces with other work.
- B. Verify substrate on-site to determine that conditions are acceptable for product installation in accordance with manufacturers written instructions.
- C. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- D. Notify Architect in writing of conditions detrimental to proper and timely completion of work. Do not proceed with erection until unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Protect adjacent work areas and finish surfaces from damage during installation.
- B. Deliver anchorage items to be cast into concrete or built into masonry to appropriate installer(s) together with setting templates.
- C. Install subframing, furring, and other miscellaneous panel support members and anchorages according to metal-composite-material panel manufacturer's written recommendations

### 3.3 INSTALLATION

- A. Do not install products that are defective, including warped, bowed, dented, and broken members, and members with damaged finishes.
- B. Comply with instructions and recommendations of MCM sheet manufacturer and wall system manufacturer, as well as with approved shop drawings.
- C. Install panels into curtain wall system securely allowing for necessary thermal and structural movement; comply with wall system manufacturer's instructions for installation of concealed fasteners.
- D. Do not handle or tool products during erection in manner that damages finish, decreases strength, or results in visual imperfection or failure in performance. Return component parts that require alteration to shop for refabrication, if possible, or for replacement with new parts.
- E. Do not form panels in field unless required by wall system manufacturer and approved by the Architect; comply with MCM sheet manufacturer's instructions and recommendations for field forming.

- F. Separate dissimilar metals; use gasket fasteners, isolation shims, or isolation tape where needed to eliminate possibility of electrolytic action between metals.
- G. Install flashings as indicated on shop drawings At flashing butt joints, provide a lap strap under flashing and seal lapped surfaces with a full bed of non-hardening sealant.
- H. Install square, plumb, straight, and true, accurately fitted, with tight joints and intersections maintaining the following installation tolerances:
  - 1. Variation From Plane or Location: 1/2 inch in 30 feet of length and up to 3/4 inch in 300 feet, maximum.
  - 2. Deviation of Vertical Member From True Line: 0.1 inch in 25 feet run, maximum.
  - 3. Deviation of Horizontal Member From True Line: 0.1 inch in 25 feet run, maximum.
  - 4. Offset From True Alignment Between Two Adjacent Members Abutting End To End, In Line: 0.03 inch, maximum.
- I. Replace damaged products.

### 3.4 FIELD QUALITY CONTROL

- A. Wall System Manufacturer's Field Services: Provide field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with instructions.
- B. Site Visits: Schedule two site visits during execution of installation.

### 3.5 CLEANING

- A. Ensure weep holes and drainage channels are unobstructed and free of dirt and sealants.
- B. Remove protective film after installation of joint sealers, after cleaning of adjacent materials, and immediately prior to completion of work.
- C. Remove temporary coverings and protection of adjacent work areas.
- D. Clean installed products in accordance with manufacturer's instructions.

### 3.6 PROTECTION

- A. Protect installed panel system from damage during construction.

## END OF SECTION

## SECTION 07 46 46 - FIBER-CEMENT SIDING

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Fiber-cement siding mounted using the back ventilated rainscreen design.
- B. Panel fasteners and accessories.
- C. Metal vertical panel supports and fasteners.

#### 1.2 RELATED REQUIREMENTS

- A. Section 05 40 00 - Cold-Formed Metal Framing: Siding substrate.
- B. Section 07 25 00 - Weather Barriers: Air barrier under siding.
- C. Section 07 92 00 - Joint Sealants: Sealing joints between siding and adjacent construction and fixtures.

#### 1.3 REFERENCE STANDARDS

- A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2020.
- B. ASTM C1186 - Standard Specification for Flat Fiber-Cement Sheets 2008 (Reapproved 2016).

#### 1.4 SUBMITTALS

- A. See Section 01 33 00 for general submittal procedures.
- B. Product Data: Submit manufacturer's data sheets on each product to be used, including:
  1. Manufacturer's requirements for related materials to be installed by others.
  2. Preparation instructions and recommendations.
  3. Storage and handling requirements and recommendations.
  4. Installation methods for rainscreen installation with concealed fasteners.
- C. Shop Drawings - Submit detailed drawings showing:
  1. Location, layout and dimensions of panels.
  2. Locations of fasteners.
  3. Locations of panel fixed fastening points for metal sub frame.
  4. Cladding details at top, bottom, corner, windows, doors and all penetrations of the system.

- D. Delegated Design: Design cementitious panel assembly; submit comprehensive engineering analysis by a qualified professional engineer, using design requirements indicated.
- E. Test Report: Applicable model code authority evaluation report (e.g. ICC-ES).
- F. Installer's Qualification Statement.
- G. Maintenance Instructions: Periodic inspection recommendations and maintenance procedures.
- H. Warranty: Submit copy of manufacturer's warranty, made out in Owner's name, showing that it has been registered with manufacturer.
- I. Warranty Documentation for Installation of Building Rainscreen Assembly: Submit installer warranty and ensure that forms have been completed in Owner's name and registered with installer.

#### 1.5 QUALITY ASSURANCE

- A. Pre-installation meeting: Conduct a pre-installation meeting at the job site attended by Owner, Architect, manufacturer's technical representative, panel installer, and contractors of related trades.
- B. Designer Qualifications: Design Cementitious panel assembly and its structural support framing components under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed at Washington DC.
- C. Installer Qualifications: Company specializing in performing work of the type specified in this section with minimum three years of experience.
- D. Mockup: Refer to Section 01 43 89; Incorporate panel assembly in the technical mockup of the exterior wall including wall assembly fasteners, flashing, and other related accessories all in accordance with manufacturer's Design and Installation Manual.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store products under waterproof cover and elevated above grade, on a flat surface.

#### 1.7 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective work within a ten year period after Date of Substantial Completion.
- C. Installation Warranty for Building Rainscreen Assembly: Installer of exterior rainscreen assembly (including air/vapor barrier and attachments, framing, and exterior panels) to provide 10-year warranty that includes coverage for defective materials and/or workmanship. This warranty will also clearly include materials, labor, necessary activity to access these areas, and removal of any materials to effect repairs and restore to watertight conditions.

## PART 2 PRODUCTS

### 2.1 PERFORMANCE CRITERIA

- A. Delegated Design: Engage a qualified professional engineer to design the vertical panel supports to support the cementitious panels.
- B. Provide panels and panel fasteners from a single source.
- C. Provide panels and vertical panel supports capable of the following:
  - 1. Wind Loads: As indicated on the structural drawings.
  - 2. Deflection Limits: Withstand deflection L/300, maximum.
- D. Panel Performance:
  - 1. Minimum strength and bending characteristics in accordance with ASTM C120 and ASTM C1185.
    - a. Modulus of rupture: 0.024 kilonewton per square millimeter (average cross/length)
    - b. Modulus of elasticity: 16 gigapascal per kilonewton per square millimeter
  - 2. Density: 1.8 grams per cubic centimeter according to ASTM C1186.
- E. Panel Weight: 4.5 pounds per square foot
  - 1. Moisture properties per ASTM C1185, by mass
    - a. Normal: 6 percent
    - b. Maximum: 20 percent
  - 2. Water tightness per ASTM C1185: No visible droplets or surface wetting.
  - 3. Fire resistance per ASTM E84 and NFPA 285:
    - a. Noncombustible
    - b. Flame spread index: 0
    - c. Smoke developed index: Less than or equal to 15
    - d. NFPA Class A.
    - e. No flaming after 30 seconds; weight loss less than or equal to 50 percent; final center temperature less than or equal to 30 deg. C.

## 2.2 FIBER-CEMENT SIDING

- A. Panel Siding: Vertically oriented panels made of portland cement, ground lime stone, polyvinyl alcohol fibers and cellulose fibers air cured for a minimum of 4 weeks with integral surface texture, complying to ASTM C1186, Type A, Grade II; with machined edges, for nail attachment.
  - 1. Texture: Smooth.
  - 2. Length (Height): 96 inches, nominal.
  - 3. Width: 48 inches.
  - 4. Thickness: 5/16 inch, nominal.
  - 5. Finish: Factory applied stain.
  - 6. Color: As indicated on drawings.
  - 7. Warranty: 50 year limited; transferable.
  - 8. Manufacturers: Basis of design, Equitone Natura
    - a. Alternate Manufacturer's:
      - 1) Cembrit Patina
      - 2) Swiss Pearl Carat; .
      - 3) Substitutions: Refer to Section 01 25 00 for submittal and acceptance requirements for proposed substitutions.
- B. Soffit Panels: Smooth panels of same material and finish.
- C. Factory Finish: Monochromic topcoat.

## 2.3 ACCESSORIES

- A. Cladding Support Clips: Thermally-broken, galvanized steel clips for support of cladding z-girts, angles, channels and other framing.
  - 1. Galvanized Steel Sheet: ASTM A653/A653M, with G90/Z275 galvanized coating.
- B. Furring Strips: Galvanized metal channels.
- C. Trim: Refer to Section 07 62 00 for aluminum flashing and trim.
- D. Fiber-Cement Siding Metal Trim: Extruded aluminum alloy 6063-T5 temper.
  - 1. Dimension and Layout: As indicated on drawings.
  - 2. Finish: Clear anodized.

- E. Fasteners: Galvanized or corrosion resistant; length as required to penetrate minimum 1-1/4 inch.
- F. Sealant: Elastomeric, polyurethane or silyl-terminated polyether/polyurethane, and capable of being painted.

## 2.4 FABRICATION

- A. Fabricate panels at the factory to greatest extent possible
- B. Field dimension: Field verify overall dimensions prior to panel fabrication
- C. Dimensional tolerances
  - 1. Overall panel dimensions within 1 millimeter of panel width and height
  - 2. Squareness within 0.5 millimeter per meter
- D. Labeling. Apply identification label to back side of each fabricated panel
- E. Factory cut cementitious panels
- F. Panel Fastening: Concealed
  - 1. SIGMA concealed fastening system.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Examine substrate, clean and repair as required to eliminate conditions that would be detrimental to proper installation.
- B. Verify that water-resistive barrier has been installed over substrate completely and correctly.
- C. Do not begin until unacceptable conditions have been corrected.
- D. If substrate preparation is responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

### 3.2 PREPARATION

- A. Coordinate panel installation with rain drainage work, flashing, trim, soffit, roofing, parapet, wall and other adjoining work to provide a leak-proof, secure and non corrosive installation.
- B. Install Sheet Metal Flashing:
  - 1. Above door and window trim and casings.
  - 2. Above horizontal trim in field of siding.

### 3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions and recommendations.
  1. Read warranty and comply with terms necessary to maintain warranty coverage.
  2. Install in accordance with conditions stated in model code evaluation report applicable to location of project.
  3. Use trim details indicated on drawings.
  4. Touch up field cut edges before installing.
  5. Pre-drill nail holes if necessary to prevent breakage.
- B. Over Steel Studs: Use hot-dipped galvanized self-tapping screws, with the points of at least three screws penetrating each stud the panel crosses and at panel ends.
- C. Shim and align vertical panel supports. Install shims between substrate and panel supports; no shims between panel and panel supports.
- D. Install shims to the following tolerances:
  1. 1/4 inch in 20 feet on level, plumb and panel joint lines
  2. Joint widths – plus or minus 1/16 inch of indicated width.
  3. Sub frame profile face alignment maximum L/300 between supports.
- E. Joints in Vertical Siding: Install Z-flashing in horizontal joints between successive courses of vertical siding.
- F. Exterior Soffit Vents: Install according to manufacturer's written instructions and in locations indicated on drawings, and provide vent area specified.

### 3.4 FIELD QUALITY CONTROL

- A. Perform daily inspections of panel installation to maintain and confirm that tolerances are being met and that panel manufacturer's design and installation manual is being complied with.
- B. Coordinate with Owner engaged third party inspection agency to verify that installed panels meet performance requirements and tolerances.

### 3.5 ADJUSTING AND CLEANING

- A. Remove damaged, improperly installed or otherwise defective panels and replace with new panels. Damage requiring replacement includes, but is not limited to, chips and scratches to panel surfaces.
- B. Clean finished surfaces according to manufacturer's instructions.

### 3.6 PROTECTION

- A. Protect installed products until Date of Substantial Completion.
- B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION

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## SECTION 07 55 52 - MODIFIED BITUMINOUS PROTECTED MEMBRANE ROOFING

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Rubberized asphalt sheet membrane roofing, base flashings, roof insulation.
- B. Paver tiles with mounting pedestals
- C. Synthetic lawn finish with porous fill.

#### 1.2 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry: Wood nailers and curbs.
- B. Section 07 14 00 - Fluid-Applied Waterproofing: Foundation and plaza waterproofing systems.
- C. Section 07 62 00 - Sheet Metal Flashing and Trim: Weather protection to base flashings.
- D. Section 07 55 63 - Vegetated Roof Components: Overburden items specific to vegetated roofing system.
- E. Section 07 92 00 - Joint Sealers
- F. Section 32 14 00 - Unit Paving: Roofing pavers with pedestal mount
- G. Section 32 18 13 - Synthetic Grass Surfacing: Artificial Grass for Dog Run.

#### 1.3 REFERENCE STANDARDS

- A. ANSI/SPRI RP-14 - Wind Design Standard for Vegetative Roofing Systems 2010.
- B. ASTM A276/A276M - Standard Specification for Stainless Steel Bars and Shapes 2017.
- C. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation 2019.
- D. ASTM D4263 - Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method 1983 (Reapproved 2018).
- E. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes 2019a.

#### 1.4 SYSTEM DESCRIPTION

- A. Rubberized Asphalt Bitumen Protected Membrane Roofing System: A protected roof membrane assembly including surface conditioner, a monolithic, reinforced, rubberized asphalt membrane, extruded polystyrene insulation, filter fabric, flashings, pavers, drainage course and synthetic lawn finish as indicated. .

## 1.5 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate with installation of associated flashings installed under other sections.
- B. Preinstallation Meeting: Convene one week prior to commencing work of this section.
  - 1. Refer to Section 01 70 00 for general requirements for Preinstallation meetings.
  - 2. Review installation procedures and coordination required with related work.
  - 3. Review and coordinate all transitions with other building enclosure systems with relevant trade contractors.

## 1.6 SUBMITTALS

- A. See Section 01 33 00 for general submittal procedures.
- B. Product Data: Provide membrane materials, base flashing materials, insulation, and overburden materials such as the paver system and artificial turf materials.
- C. Shop Drawings: Indicate setting plan for insulation, layout of seams, direction of laps, base flashing details.
  - 1. Include size and outline of roof, indicate roof sloping strategy, and project-specific conditions keyed in on plan drawings. Coordinate shop drawings with adjacent construction.
- D. Samples: Submit two sample roof pavers.
- E. Samples: Submit two samples of artificial turf materials.
- F. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- G. Manufacturer's Installation Instructions: Indicate special precautions required for seaming the membrane.
- H. Manufacturer's Field Reports: Submit inspection reports.
- I. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

## 1.7 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified and with not less than ten years of documented experience.
- B. Installer Qualifications: Company specializing in performing the work specified and with at least ten years of documented experience.
- C. Single Source: Waterproofing and insulation components from one manufacturer or approved by the waterproofing manufacturer.

## 1.8 MOCK-UP

- A. Construct mock-up, 10 by 10 feet, including insulation, water-pervious fabric, ballast, and typical base and counter flashings specified in Section 07 62 00.
  - 1. Mock-up shall represent finished work including surface prep, crack and joint treatment, thickness, internal and external corners, drainage composite, base flashings, control joints, and protection layer to establish quality of work.
- B. Locate where directed.
- C. Mock-up may remain as part of the work.

## 1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in manufacturer's original containers, dry and undamaged, with seals and labels intact.
- B. Store materials in weather protected environment, clear of ground and moisture, and stand roll material on end only a single roll high with selvage edge up.
- C. Ensure storage and staging of materials does not exceed static and dynamic load-bearing capacities of roof decking.
- D. Protect foam insulation from direct exposure to sunlight.

## 1.10 FIELD CONDITIONS

- A. Do not apply roofing membrane during inclement weather, or at ambient temperatures below 40 degrees F.
- B. Do not apply roofing membrane to damp or frozen deck surface.
- C. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed during same day.
- D. Schedule applications so that no partially completed sections of roof are left exposed at end of workday.
- E. Do not allow waste products (petroleum, grease, oil, solvents, vegetable or mineral oil, animal fat, etc.) to come in contact with the roof membrane. Any exposure to foreign materials or chemical discharges must be evaluated by membrane manufacturer to determine any impact on the roof membrane assembly performance.

## 1.11 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective Work within a one year period after Date of Substantial Completion.
- C. Provide 20 year manufacturer warranty for watertightness including membrane, flashing, insulation and pavers.

1. Include in warranty coverage cost of repairing damage to building resulting from failure to prevent penetration of water.
- D. Provide a 15 year manufacturer's warranty against excessive wear on the synthetic lawn finish.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Rubberized Asphalt Roofing:
  1. Basis of Design: Hydrotech Monolithic Membrane MM6125-FR.
  2. Other acceptable manufacturer includes Henry Company, 790-11EV system.
  3. Substitutions: Refer to Section 01 25 00 for Substitution submittal and acceptance requirements.

### 2.2 REGULATORY REQUIREMENTS

- A. Comply with applicable building codes for fire resistance rating of roofing system.

### 2.3 MEMBRANE MATERIALS

- A. Membrane: Hot, fluid applied, rubberized asphalt membrane meeting following standards and other pertinent physical properties:

Property	Test Method	Result
Flash Point	ASTM D-92	502 F
Penetration	ASTM D 5329	98 mm @ 77F / 187mm@ 122F
Flow	ASTM D 5329	1.00 mm @ 140F
Water Vapor Permeability	ASTM E 96, Procedure E	0.3 ng.Pa(s)m <sup>2</sup>
Softening Point	ASTM D 36	180F
Elongation	ASTM D 5329	1000% minimum
Resiliency	ASTM D 5329	40% minimum
Bond to Concrete	ASTM D 5329	Pass @0F
Acid Resistance	ASTM D 896 Procedure 7.1	Pass 50% Nitric Acid 50% Sulfuric Acid
Resistance to Hydrostatic Pressure	ASTM D 5385	100 psi = 231 foot head of water
Resistance to Salt Water	ASTM D896 similar 20% sodium chloride sodium carbonate calcium chloride	No delamination, blistering, emulsification or deterioration
Resistance to Animal Waste	3 year exposure	No deterioration
Solids content		100%

- B. Surface Conditioner: A surface conditioner for concrete surfaces recommended by membrane manufacturer.
- C. Reinforcing: Spunbonded polyester fabric reinforcing sheet recommended by membrane manufacturer.

## 2.4 INSULATION

- A. Insulation: ASTM C578, Type VII, extruded polystyrene (XPS) insulation board with skin surface on one face; with the following characteristics:

1. Board Density: 60 psi minimum
2. Board Size: 24 by 48 inch.
3. Board Thickness: as indicated.
4. Board Edges: Square.

## 2.5 FLASHINGS

- A. Flexible Flashing: Flexible sheet flashing, 60-mil (1.5 mm) thick, uncured neoprene sheet., type to suit membrane sheeting.
- B. Pipe and Penetration Flashing: Base of flexible sheet flashing, compatible with membrane roof systems, and capable of accomodating pipes sized between 3/8 inch and 12 inch. Provide with clamping rings to seal around pipe and vent penetrations.
- C. Control or Expansion Joint Flashing: Sheet rubberized asphalt counter flashings and wood materials, as detailed.

## 2.6 BALLAST

- A. Aggregate: Sound, hard, washed, stone, 3/4 inch minimum to 1-1/2 inch maximum size. Fines (aggregate not less than 1/2 inch), dirt, or organic material is not acceptable.
- B. Precast Concrete Roof Pavers and Pedestals: Refer to Section 32 14 00 - Unit Paving for product information.
- C. Synthetic Lawn Finish: Basis of Design - SYNLawn Pet Premium (SR251);
1. Face Weight: 56 oz.
  2. Total Weight: 84 oz.
  3. Yarn: Texturized Polypropylene with Heat Block technology.
  4. Color: Field Green + Lime / Turf tan.
  5. Pile Height: 1.5 inches
  6. Drainage rate: > 60 inches per hour.

- D. Vegetated Roofing Assembly: 6 inches or more of growth medium and protective layers installed over fluid-applied waterproofing membrane with additional insulation above membrane. Refer to Section 07 55 50 - Vegetated Roof Components. Refer to Section 32 97 00 and 32 93 00 for growth medium and plantings.

## 2.7 ACCESSORIES

- A. Nailers: Wood, pressure preservative treated.
- B. Stainless Steel Termination Bar: ASTM A276/A276M; 1 inch by 0.125 inch thick; provide stainless steel fasteners.
- C. Porous Fill: 1/2 inch nominal diameter, rounded, water-worn gravel conforming to ASTM D448.
- D. Roofing Nails: Galvanized or nonferrous type, size as required to suit application.
- E. Seaming adhesive and seaming tape: As required by the Synthetic Lawn Finish manufacturer.
- F. Sealant to seal flashing seam edge: American Hydrotech, Inc., Lap Sealant
- G. Protection Board: 0.090 inch minimum thickness, glass-fiber, modified-bitumen mat with SBS rubber and asphalt blend.
- H. Water-Pervious Fabric: Black open weave polyolefin.
- I. Insulation Perimeter Restraint: Metal edge device configured to restrain insulation boards in position and provide top flashing over ballast to system.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify that surfaces and site conditions are ready to receive work.
- B. Verify deck is supported and secured.
- C. Verify deck is clean and smooth, free of depressions, waves, or projections, properly sloped to drains.
- D. Verify deck surfaces are dry and free of snow or ice.
- E. Confirm dry deck by moisture meter with 12 percent moisture maximum.
- F. Verify roof openings, curbs, pipes, conduit, sleeves, ducts, and vents through roof are solidly set, and wood nailing strips are in place.
- G. Verify roof drain is set to achieve weep drainage at membrane level and top grating of drain at finish deck level.

### 3.2 PREPARATION - CONCRETE DECK

- A. Fill surface honeycomb and variations with latex filler.  
Modified Bituminous Protected  
Membrane Roofing  
07 55 52 - 6

B. Do not begin work until elevated concrete substrate has cured at least 28 days and moisture content is five percent or less.

1. Test as Follows:

a. Concrete Moisture Content: No beading water under plastic after 16 hours when tested in accordance with ASTM D4263.

b. Relative Humidity in Concrete: Not greater than 75 percent when tested in accordance with ASTM F2170.

C. Spray or roller apply surface conditioner and allow to thoroughly dry.

### 3.3 INSTALLATION - FLASHINGS AND ACCESSORIES

A. Install membrane base flashings to seal membrane to vertical elements.

B. Install prefabricated roofing control joints in accordance with manufacturer's instructions.

C. Coordinate installation of roof drains and related flashings.

D. Seal flashings and flanges of items penetrating or protruding through the membrane.

### 3.4 INSTALLATION - INSULATION

A. Place insulation boards, and butt edges together in close contact.

B. Place water-permeable fabric over insulation boards in accordance with insulation manufacturer's instructions.

### 3.5 INSTALLATION - BALLAST

A. Install precast concrete pavers directly on insulation covered by water permeable fabric. Provide approximately 1/4 inch space between pavers to permit surface water drainage, using paver leveling pads. Refer to Section 32 14 00 for additional installation requirements for pavers.

### 3.6 SYNTHETIC LAWN FINISH

A. Place porous fill to depth indicated over insulation covered by the water permeable fabric. Install wood nailers at perimeter of lawn finish area. Hand tamp fill until smooth

B. Position lawn finish material, seaming as per manufacturer's instructions, and trimming to the area to be covered.

C. Secure lawn finish material to nailers with roofing nails at the perimeter spacing fasteners no more than 12 inches oc.

D. Refer to Section 31 18 13 for additional installation requirements.

### 3.7 FIELD QUALITY CONTROL

- A. Owner will provide testing services in accordance with Section 01 40 00 - Quality Requirements. Contractor shall provide temporary construction and materials for testing.
- B. Upon completion of horizontal membrane installation and before installation of protective layers, dam installation area in preparation for flood testing.
  1. Flood to minimum depth of 2 inch with clean water, and after 48 hours inspect for leaks.
  2. If leaking is found, remove water, repair leaking areas with new waterproofing materials as directed by Architect; repeat flood test, and repair damage to building.
  3. When area is proven watertight, drain water and remove dam.
- C. If required to achieve manufacturer's warranty, include electronic leak detection (ELD) testing in addition to flood testing to accurately locate micro-breaches present in field of membrane that is not as prevalent during flood testing.
- D. Engage manufacturer representative or third-party inspector to inspect substrate conditions; surface prep; and application of membrane, flashings, protection, and drainage components; furnish daily reports to Architect.
- E. Perform pull-adhesion test for every 1000 sq-ft of HRA membrane installed to verify workmanship and ensure consistency during installation. Provide photo documentation.
  1. Cohesive failure in the membrane is a pass; Adhesive failure between membrane and substrate is a fail.
  - F. Repair damage caused by test areas and areas of leak found during leak detection testing then retest for leaks zoned at the area of failure at no additional cost to Owner.
  - G. Correct deficiencies in or remove roofing system that does not comply with manufacturer's requirements, repair substrate, and repair or reinstall roofing to condition free of damage.

### 3.8 FIELD QUALITY CONTROL

- A. Correct identified defects or irregularities.
- B. Require attendance on-site of roofing and insulation materials manufacturers during installation of this work.

### 3.9 CLEANING

- A. Remove bituminous markings from finished surfaces.
- B. In areas where finished surfaces are soiled caused by work of this section, consult manufacturer of surfaces for cleaning advice and complying with their documented instructions.
- C. Repair or replace defaced or disfigured finishes caused by work of this section.

### 3.10 PROTECTION

- A. Protect building surfaces against damage from roofing work.
- B. Where traffic must continue over finished roof membrane, protect roofing surfaces from mechanical damage.

END OF SECTION

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## SECTION 07 55 63 - VEGETATED ROOF COMPONENTS

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Vegetated roof components that occur above waterproof membrane, including:
  - 1. Vegetated roofing system with less than 6 inches of soil/growth medium ("extensive").
  - 2. Vegetated roofing system with 6 inches or more of soil/growth medium ("intensive").
  - 3. Roof pavers systems.
  - 4. Plants.

#### 1.2 RELATED REQUIREMENTS

- A. Section 07 55 52 - Modified Bituminous Protected Membrane Roofing: Membrane below vegetated roof covering and other associated roof overburden.
- B. Section 32 14 00 - Unit Pavers: Roof pavers on pedestals.
- C. Section 32 91 00 - Soils.
- D. Section 32 93 00 - Plants.

#### 1.3 REFERENCE STANDARDS

- A. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures Most Recent Edition Cited by Referring Code or Reference Standard.
- B. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation 2019.
- C. ASTM D448 - Standard Classification for Sizes of Aggregate for Road and Bridge Construction 2012 (Reapproved 2017).
- D. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft<sup>3</sup> (2,700 kN·m/m<sup>3</sup>)) 2012 (Reapproved 2021).
- E. ASTM D1929 - Standard Test Method for Determining Ignition Temperature of Plastics 2020.
- F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2021a.
- G. ASTM E303 - Standard Test Method for Measuring Surface Frictional Properties Using the British Pendulum Tester 1993 (Reapproved 2013).
- H. SPRI RP-4 - Wind Design Standard for Ballasted Single-Ply Roofing Systems 2019.

#### 1.4 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to start of this work; attendance required by each affected installer.

#### 1.5 SUBMITTALS

- A. See Section 01 33 00 for submittal procedures.
- B. Product Data: Provide product data on components of vegetated roof.
- C. Shop Drawings: Indicate size and outline of roof, location and type of materials, and details of accessories and edge treatments.
- D. Manufacturer Certification: Submit written approval by membrane manufacturer of the proposed vegetated roof assembly and its components.
- E. Manufacturer's Instructions: Submit copies of manufacturer's written installation instructions and other recommendations.
- F. Preinstallation Field Report: Provide documentation that membrane installation has been approved by manufacturer and has passed specified testing.
- G. Manufacturer's Qualification Statement.
- H. Installer's Qualification Statement.
- I. Project Record Documents: Record actual locations of planted areas, hardscape features, existing concealed drains, and irrigation system (if provided).
- J. Maintenance Data: Submit manufacturer recommendations for maintenance of materials and plants.
- K. Warranty Documentation:
  - 1. Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
  - 2. Submit installer's certification that installation complies with warranty conditions for waterproof membrane.

#### 1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.
- B. Installer Qualifications: Company specializing in performing the work specified in this section, with not less than three years of documented experience.
- C. Single Source Responsibility: Provide and install products from single source.

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to project site in original, unopened containers or wrappings.
- B. Store materials under cover and elevated above grade.
- C. Store roll material lying down and on pallets fully protected from moisture.
- D. Remove damaged materials from job site, and replace damaged materials.

## 1.8 FIELD CONDITIONS

- A. Ambient Conditions: Install garden roof between April 1st and October 15th, unless otherwise indicated, or recommended in writing by manufacturer.
- B. Roof Slope: Do not install vegetated roofing over substrate with slope of less than 2 percent.

## 1.9 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective Work within a one year period after Date of Substantial Completion.
- C. Provide manufacturer's twenty year, single-source "full system" warranty.

# PART 2 PRODUCTS

## 2.1 VEGETATED ROOFING OVER RUBBERIZED ASPHALT ROOFING MEMBRANE

- A. Waterproofing System: Specified in Section 07 55 52.
- B. Vegetated Roofing Assembly: 6 inches or more of growth medium and protective layers installed over fluid-applied waterproofing membrane with additional insulation above membrane.
  - 1. Protection Layers, In Order from Bottom Up:
    - a. Protection board.
    - b. Root barrier.
    - c. Drain board.
    - d. Rigid board insulation.
    - e. Filter fabric/water retention mat.
  - 2. Number and type of protective materials may be reduced provided equivalent protection and functionality is achieved and is approved by manufacturer.
- C. Protection Board: 0.25 minimum thickness, glass-fiber, modified-bitumen mat with SBS rubber and asphalt blend.

- D. Drain Board: 7/16 inch minimum thickness, 9,000 psf minimum compressive strength, molded-polystyrene board with woven filter fabric with minimum flow capacity of 21 gpm/ft per unit.
- E. Rigid Board Insulation Above Membrane: Extruded polystyrene (XPS) board insulation.
- F. Protection Fabric/Water Retention Mat: 0.150 inch minimum thickness, and 16 oz/sq ft minimum weight, non-woven polypropylene.

## 2.2 INSULATION

- A. Extruded Polystyrene (XPS) Board Insulation: Complies with ASTM C578, Type XII; natural skin surfaces, with drainage channels on one face; and following characteristics:
  - 1. Board Size: 48 by 96 inch.
  - 2. Board Thickness: 1-1/2 inches.
  - 3. Board Edges: Square.
  - 4. Compressive Resistance: 40 psi. min. Provide 60 psi minimum compressive strength XPS insulation below pavers.
  - 5. Board Density: 1.2 lb/cu ft.

## 2.3 FIELD-INSTALLED SOIL/GROWTH MEDIUM

- A. Provide manufacturer's custom growing media mix capable of supporting vigorous growth of specified vegetation. Refer to Section 32 91 00 for additional soil requirements.

## 2.4 FIELD-INSTALLED PLANTS

- A. See Section 32 93 00 and Landscape drawings for plants required.

## 2.5 ROOF PAVERS SYSTEMS

- A. Wood Roof Pavers: Ipe (Ironwood) or Black Locust wood tile plank decking, constructed from wood face slats, at least 13/16 inch thick, and secured to wood battens with stainless steel screws.
  - 1. Comply with local wind load resistance requirements of ASCE 7.
  - 2. Surface Burning Characteristics: Comply with flame spread index (FSI) of 0 to 25, Class A, and smoke developed index (SDI) of 450 or less; when tested in accordance with ASTM E84.
  - 3. Texture: As selected by Architect from manufacturer's standard line.
  - 4. Surface Finish: None, allow to weather naturally.
  - 5. Length and Width: 6 inch width by random length, 5/4 inch thick, nominal.
  - 6. Wood Hardness: 3680 lb, Janka Hardness Scale.

7. Slip Resistance: Provide walking surfaces of exterior pavers with pendulum test values of at least 55 in accordance with ASTM E303 test method.
- B. Pedestals: Polypropylene components, providing anti-slip, noise reducing rubber head with built-in spacer tabs, UV resistant, and configured to permit adjustment to height.
- C. Precast Concrete Paver and Pedestal System with Wind Uplift Resistance: Precast concrete pavers with average compressive strength greater than 8000 psi. Coordinate with requirements of Section 32 14 00 for paver specifications in addition to the following requirements.
  1. Comply with local wind load resistance requirements of ASCE 7.
  2. Self-Ignition Temperature: Provide plastic pedestal components with self-ignition temperature greater than 650 degrees F in accordance with ASTM D1929 test method.
  3. Texture: As selected by Architect from manufacturer's standard line.
  4. Paver Length and Width: 23-13/16 inch by 23-13/16 inch, nominal.
  5. Thickness: 2 inch, nominal.
  6. Pedestal: Adjustable stand of high impact copolymer polypropylene to level and adjust height of pavers, with maximum static load of 3000 pounds per pedestal.
  7. Shim Plates: Styrene-butadiene rubber (SBR), of various thicknesses.
  8. Lock Down Device: Anchored to pedestal, consisting of high impact copolymer polypropylene, 7 inch by 7 inch, and located at corners of pavers in grid pattern.

## 2.6 ACCESSORIES

- A. Stone Ballast: No.4 size, 1-1/2 inch nominal diameter, rounded, water-worn gravel complying with ASTM D448 and applied at a minimum of 10 lbs/sq ft.
- B. Paver Edge Restraints: Provide closure to underside of pavers at perimeter edge of pavers or areas that change elevation or step-down; restraint system shall fully contain pavers and tie back into building wall or parapet.
  1. Vegetated Roof: Provide galvanized metal L-channel with drain holes to close off underside of pavers and covered with filter fabric on vegetated roofing soil side.
- C. Edge Treatment: Provide dividers and edge elements to separate vegetated portion of roof from other areas as indicated on drawings.
  1. Plastic: High density polyethylene (HDPE); manufacturer's standard profiles and sizes.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify that roofing membrane work is complete.
- B. Verify that surface of membrane is ready to accept vegetated roofing components.
- C. Inspections and Testing Prior to Installation of Vegetated Roof Components:
  1. Verify that installed membrane roofing system has been inspected by manufacturer's representative.
  2. Verify that installed membrane roofing system has been tested by controlled flooding, electronic testing or other leak detection method approved by manufacturer.
  3. Provide documentation that membrane installation has been approved by manufacturer and passed specified testing.

### 3.2 PREPARATION

- A. Clean membrane surfaces of ponded water, snow, ice, dirt, debris, and foreign materials.

### 3.3 INSTALLATION, GENERAL

- A. Install in accordance with membrane manufacturer's instructions and warranty restrictions, if any.
- B. Dry surfaces thoroughly before vegetated roofing work begins.
- C. Protect waterproofing or roof membrane as necessary to prevent damage during application of vegetated roof system.
- D. Provide temporary ballast in partially completed sections of vegetated roof to protect overburden from wind effects during installation; ensure ballast has no sharp edges, protrusions, chemical contaminants, or other composition that could damage waterproof membrane.

### 3.4 INSTALLATION - PROTECTION BOARD OVER WATERPROOFING

- A. Embed protection board in fluid-waterproofing while waterproofing is still hot and overlap edges 2 to 3 inches.
- B. Seal laps with additional fluid waterproofing.

### 3.5 INSTALLATION - DRAIN BOARDS

- A. Horizontal Surfaces: Install boards by method required or recommended by membrane manufacturer.
  1. Attached Boards: Attach drain boards to waterproof membrane with manufacturer's recommended adhesive or seam tape.
- B. Corners:

1. Bend panels to make inside corners.
  2. Cut panel flush with corner but leave 3 inches of additional fabric, and wrap fabric around edge of drain board and secure with tape to back of board, as required.
- C. Penetrations: Cut drain board to fit tightly around penetrations.
- D. Inspect completed drain board installation, and repair holes and tears by lapping each hole or tear at least 6 inches with new, undamaged filter fabric and sealing with manufacturer-approved tape.

### 3.6 INSTALLATION - INSULATION

- A. Install root barrier prior to insulation, lapping sheets in accordance with manufacturer's written instructions. Extend root barrier a minimum of 24 in. beyond extent of vegetative roof areas, including up adjacent walls and penetrations to cover base flashing conditions.
- B. Handle insulation carefully, and avoid damaging or rupturing facer or finished surface.
- C. Install insulation with staggered end joints.
- D. Abut edges tightly together, with gap of 1/4 inch or less.
- E. Inspect completed insulation installation; cut out broken corners or other damaged areas of insulation, and replace with undamaged insulation custom cut to fit damaged or broken area removed.

### 3.7 INSTALLATION - PROTECTION FABRIC/WATER RETENTION MAT

- A. Loose-lay protection fabric/water retention mat, draw tight without folds or wrinkles, and overlap edges 3 inches.
- B. Temporarily attach protection fabric to substrate during installation, as required, with manufacturer's recommended construction adhesive.
- C. Inspect completed protection fabric/water retention mat installation; repair any holes or tears by lapping each hole or tear at least 6 inches with new, undamaged material and sealing with manufacturer-approved tape.

### 3.8 ACCESSORIES INSTALLATION

- A. Edge Treatment: Install dividers and edging where indicated.
  1. Provide intermittent spacing between dividers to allow water to flow between areas.
  2. Extend protection layers up vertical surfaces of dividers and edging to retain overburden.
- B. Install pavers on pedestals, fully support each edge, and shim and/or adjust pavers to provide level surface.
  1. Fully support edges; shim and adjust pavers to provide level surface.

2. Provide approximately 1/8 inch space between pavers to permit surface water drainage.
- C. Paver Edge Restraints: Install exposed paver edge restraints in accordance with roof paver manufacturer's instructions.
- D. Ballast: Install ballast in accordance with SPRI RP-4.

### 3.9 INSTALLATION - SOIL/GROWTH MEDIUM

- A. General: Place soil/growth medium carefully to avoid damaging or displacing other materials and accessories. Coordinate with Section 32 91 00 for specific requirements
- B. Placement, Depth Greater than 8 inches:
  1. Place soil/growth medium in lifts of 6 inches or less, except final lift.
  2. Compact each lift as described below.
  3. Place final lift of 6 inches or less and 1 inch greater than proposed finish grade prior to compaction.
  4. Compact final lift until top of soil is within 1 inch of proposed finish grade.
- C. Placement, Soil Depth Less than 8 inches:
  1. Place soil/growth medium in single lift of 8 inches or less and to 1 inch greater than proposed finish grade.
  2. Compact lift until top of soil is within 1 inch of proposed finish grade
- D. Compaction:
  1. Use landscape rollers or handheld mechanical compactors.
  2. Compact soil/growth medium to between 50 and 60 percent compaction as measured by ASTM D1557.
- E. Install and maintain erosion control devices as recommended by manufacturer until plant installation is complete.

### 3.10 INSTALLATION - PLANTS

- A. Install plants in accordance with good horticultural practice and Section 32 93 00.
- B. Maintain plants in a live and healthy condition until Date of Substantial Completion.

### 3.11 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for additional requirements.

- B. Engage full-time manufacturer's technical representative or third-party inspector to inspect substrate conditions, surface preparation, application of membrane, base flashings, protection, insulation, pavers, and veggie assembly, and to prepare daily reports.
- C. Test roofing membrane prior to installation of vegetated roofing elements using one of the following:
  - 1. Perform flood testing in accordance to ASTM D5957. Install temporary containment assemblies, plug or dam drains and flood with water. Flood test prior to installing protection layers.
  - 2. Perform Electronic Leak Detection survey over entire roofing area.
- D. Have completed garden roof inspected by manufacturer's field representative.
- E. Obtain waterproof membrane manufacturer's written approval of completed garden roof installation.

### 3.12 CLEANING

- A. See Section 01 70 00 - Execution and Closeout Requirements for additional requirements.
- B. In areas where finished surfaces are soiled by work of this section, consult manufacturers of surfaces for cleaning advice and comply with their documented instructions.
- C. Repair or replace defaced or damaged finishes caused by work of this section.

### 3.13 PROTECTION

- A. Protect installed vegetated roof system from construction traffic and subsequent construction operations.
- B. Provide substantial barricades or other barriers where necessary to prevent traffic across vegetation.

### 3.14 MAINTENANCE

- A. See Section 01 70 00 - Execution and Closeout Requirements, for additional requirements relating to maintenance service.
- B. Maintain plants in vegetated roof for a period of one year after Date of Substantial Completion.
- C. Maintenance shall include but not be limited to including pruning, cultivating, watering, weeding, fertilizing, mulching, restoring planting saucers, adjusting and repairing devices, resetting plants to proper elevations or vertical position, and performing other operations as required to establish viable plantings.
- D. Replace growing medium that becomes displaced or eroded because of settling or other processes.
- E. Apply treatments as required to keep vegetated assembly free of pests and disease. Use only products and methods acceptable to vegetated roof and membrane roofing manufacturer.

END OF SECTION

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## SECTION 07 62 00 - SHEET METAL FLASHING AND TRIM

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Fabricated sheet metal items, including flashings, counterflashings, canopy cladding, and other items indicated in Schedule.
- B. Sealants for joints within sheet metal fabrications.

#### 1.2 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry: Field fabricated roof curbs.
- B. Section 07 92 00 - Joint Sealants: Sealing non-lap joints between sheet metal fabrications and adjacent construction.
- C. Section 08 62 00 - Unit Skylights: Integral metal curbs.

#### 1.3 REFERENCE STANDARDS

- A. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix) 2017a.
- B. ANSI/SPRI/FM 4435/ES-1 - Test Standard for Edge Systems Used with Low Slope Roofing Systems 2017.
- C. ASTM B32 - Standard Specification for Solder Metal 2020.
- D. ASTM C920 - Standard Specification for Elastomeric Joint Sealants 2018.
- E. ASTM D4586/D4586M - Standard Specification for Asphalt Roof Cement, Asbestos-Free 2007 (Reapproved 2018).
- F. SMACNA (ASMM) - Architectural Sheet Metal Manual 2012.

#### 1.4 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene one week before starting work of this section.

#### 1.5 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures for general submittal procedures.
- B. Shop Drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details.
- C. Samples: Submit two samples 6 by 6 inch in size illustrating metal finish color.

## 1.6 QUALITY ASSURANCE

- A. Perform work in accordance with SMACNA (ASMM) requirements and standard details, except as otherwise indicated.
- B. Fabricator and Installer Qualifications: Company specializing in sheet metal work with 5 years of documented experience.

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. See Section 01 74 19 - Construction Waste Management and Disposal for packaging waste requirements.
- B. Stack material to prevent twisting, bending, and abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.
- C. Prevent contact with materials that could cause discoloration or staining.

# PART 2 PRODUCTS

## 2.1 SHEET MATERIALS

- A. Aluminum: ASTM B209 (ASTM B209M), 3005 alloy, H12 or H14 temper; 20 gauge, 0.032 inch thick; mill finish at concealed locations.
- B. Pre-Finished Aluminum: ASTM B209 (ASTM B209M), 3005 alloy, H12 or H14 temper; 20 gauge, 0.032 inch thick; plain finish shop pre-coated with fluoropolymercoating.
  - 1. Fluoropolymer Coating: High performance organic powder coating, AAMA 2604; multiple coat, thermally cured fluoropolymer finish system. Provide for custom colors to match adjacent metal panel colors.
- C. Stainless Steel: ASTM A666, Type 304 alloy, soft temper, 24 gauge, thick; smooth No. 4 - Brushed finish, Use stainless steel for all flashing and trim items at masonry veneer locations.

## 2.2 MANUFACTURED TRIMS

- A. Coping: Provide pre-fabricated snap-on coping with spring support, and clips; Permasnap 2 plus as manufactured by Hickman.
  - 1. Comply with requirements of ANSI/SPRI/FM 4435/ES-1 for project specific conditions.
  - 2. Prefinished Aluminum as specified above; provide 0.018 inch thick material at coping indicated as wider than 24 inches.
  - 3. Springs: 26 ga stainless steel, 8 inches wide at clip locations.
  - 4. Clips: 16 ga stainless steel, 12 inches wide; spacing as recommended by manufacturer.
  - 5. Support Channels: 24 ga galvanized channel; provide at copings 24 inches wide or greater.

6. Finish as indicated for aluminum sheet materials above.

## 2.3 FABRICATION

- A. Form sections true to shape, accurate in size, square, and free from distortion or defects.
- B. Fabricate cleats and attachment devices from same material and equal thickness as accessory being anchored or from compatible, noncorrosive metal.
- C. Form pieces in longest possible lengths.
- D. Hem exposed edges on underside 1/2 inch; miter and seam corners.
- E. Form material with flat lock seams, except where otherwise indicated; at moving joints, use sealed lapped, bayonet-type or interlocking hooked seams.
- F. Fabricate corners from one piece with minimum 18-inch long legs; seam for rigidity, seal with sealant.
- G. Fabricate flashings to allow toe to extend 2 inches over roofing overburden. Return and brake edges.

## 2.4 EXTERIOR PENETRATION FLASHING PANELS

- A. Flashing Panels for Exterior Wall Penetrations: Premanufactured components and accessories as required to preserve integrity of building envelope; suitable for conduits and facade materials to be installed.

## 2.5 ACCESSORIES

- A. Fasteners: Stainless steel, with soft neoprene washers.
- B. Primer: Zinc chromate type.
- C. Protective Backing Paint: Zinc molybdate alkyd.
- D. Concealed Sealants: Non-curing butyl sealant.
- E. Exposed Sealants: ASTM C920; elastomeric sealant, with minimum movement capability as recommended by manufacturer for substrates to be sealed; color to match adjacent material.
- F. Fenestration Perimeter Flashing Attachments: Two-piece flashing receiver and clip of extruded aluminum, at least 0.045 inch thick, for attaching flashing at perimeter of exterior wall fenestration openings.
  - 1. Provide flashing receiver profile appropriate for flashing applications.
- G. Underlayment: Coordinate with Section 07 27 00 and include Self-adhering, high-temperature sheet flashing; minimum 30 mils thick, designed to withstand high metal temperatures beneath metal roofing. Provide primer as recommended by manufacturer. Basis of Design - Blueskin PE200HT by Henry, Grace Ice and Water Shield HT by GCP Technologies or approved equal.

- H. Asphalt Roof Cement: ASTM D4586/D4586M, Type I, asbestos-free.
- I. Reglets: Surface-mounted type, Stainless steel; face and ends covered with plastic tape.
- J. Solder for Stainless Steel: ASTM B32; Grade Sn60 with acid flux type.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify roof openings, curbs, pipes, sleeves, ducts, and vents through roof are solidly set, reglets in place, and nailing strips located.
- B. Verify roofing termination and base flashings are in place, sealed, and secure.

### 3.2 PREPARATION

- A. Install starter and edge strips, and cleats before starting installation.
- B. Install surface mounted reglets true to lines and levels, and seal top of reglets with sealant.
- C. Back paint concealed metal surfaces with protective backing paint to a minimum dry film thickness of 15 mil, 0.015 inch.

### 3.3 INSTALLATION

- A. Secure flashings in place using concealed fasteners, and use exposed fasteners only where permitted..
- B. Apply plastic cement compound between metal flashings and felt flashings.
- C. Fit flashings tight in place; make corners square, surfaces true and straight in planes, and lines accurate to profiles.
- D. Exterior Flashing Receivers: Install in accordance with manufacturer's recommendations, and in proper relationship with adjacent construction, and as follows:
  1. Secure receiver at perimeter of wall opening with adhesives or fasteners.
- E. Seal joints at aluminum or stainless steel flashings and trim with sealant watertight unless otherwise indicated.
- F. Solder metal joints for full metal surface contact, and after soldering wash metal clean with neutralizing solution and rinse with water.
- G. Protect against galvanic reaction or corrosion by painting contacting surfaces where dissimilar metals contact each other.
- H. Install self-adhering sheet underlayment where installing sheet metal flashing and trim directly on cementitious substrates and in locations shown on drawing.

- I. Coordinate installation of scupper and copings with hot rubberized asphalt roofing membrane, Section 07 55 52 and exterior wall finish.
- J. Provide for thermal expansion of exposed flashing and trim. Space movement joints at maximum of 10 feet with no joints within 24 in. of corner or intersection.
- K. Use soldered joints at stainless steel flashings and trim unless otherwise indicated on Drawings. Do not solder aluminum sheet.
- L. Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Seal and clamp flashing to pipes that penetrate roof.
- M. At expansion joints, provide sheet metal trim only fastened on one side or with two pieces with an interlocking hook sized to accomodate the expected movement of expansion/contraction joints.

### 3.4 FLAT COPPER ROOFING

- A. Install in accordance with SMACNA guidelines for copper roofing and the following.
- B. Before applying roofing, cover deck with underlayment. Lap 2 inch at joints and secure in place with roofing nails. Using solder of equal parts tin and lead, solder slowly with well-heated irons to thoroughly heat sheet and completely sweat solder through full width of seam. Tin edges of copper to be soldered at least 3/4 inch before sheets are locked.; in copper, use solid copper or bronze roofing nails. Where roof decks abut vertical surfaces, turn metal roofing up vertical surfaces about 8 inch where practicable; where vertical surfaces are covered with applied materials, turn up roofing behind applied materials. Use flat-seam method. Walking not permitted directly on metal roofs; provide approved walkways.
- C. Standing-seam Method: Make standing seams parallel with slope of roof. Fabricate sheets into long lengths at shop by locking short dimensions together and thoroughly soldering joints thus formed. In applying metal, turn up one edge of course at each side seam at right angles 1.5 inch. Then install 2 by 3 inch cleats spaced 12 inches apart by fastening one end of each cleat to roof with two one inch long nails and folding roof end back over nail heads. Turn end adjoining turned-up side seam up over upstanding edge of course. Turn up adjoining edge of next course 1.75 inches and abutting upstanding edges locked, turned over, and flattened against one side of standing seam. Make standing seams straight, rounded neatly at the top edges, and stand about one inch above roof deck. All sheets must be same length, except as required to complete run or maintain pattern. Locate transverse joints of each panel half way between joints in adjacent sheets. Align joints of alternate sheets horizontally to produce uniform pattern, as shown in SMACNA 1793.

- D. Flat-Seam Method: Lay metal so short dimension is parallel to gutter or eave lines and so water will flow over and not into seams. Make seams by turning edges of sheet 3/4 inch and lock and solder together. If sheets are laid one at a time, secure to roof deck with cleats, using three cleats to each sheet, two on long side and one on short side. Use cleats 2 inches wide, hooked over 3/4 inch upturned edges of sheets, and nail to roof deck with two one inch long nails. Turn back roof end of cleat over nail heads before next sheet is applied. If desired, sheets may be made into long lengths at shop by locking short dimensions together and soldering seams thus formed. Turn long lengths 3/4 inch, and secure each length to roof deck by cleats spaced 12 inches apart. Mallet and solder seams after pans are in place. All sheets to be same length, except as required to complete run or maintain pattern. Locate transverse joints of each panel half way between joints in adjacent sheets. Align joints of alternate sheets horizontally to produce uniform pattern, as shown in SMACNA 1793.

### 3.5 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements for field inspection requirements.
- B. Inspection will involve surveillance of work during installation to ascertain compliance with specified requirements.
- C. Provide repair and reinstallation, at no additional cost to Owner, of sheet metal components related to window or doors that are determined to be the cause of quality control field testing failure of window or door testing.

### 3.6 SCHEDULE

- A. Through-Wall Flashing in Masonry: Refer to Section 04 20 00.
- B. Scuppers: Prefinished Aluminum; color to match adjacent metal panels
- C. Coping, Cap, Parapet, Sill and Ledge Flashings: Metal Composite Material, coordinate with Wall Panel system, Section 07 42 64.
- D. Residential Lobby Canopy: Copper roof as indicated.
- E. Counterflashings at Curb-Mounted Roof Items, including skylights and roof hatches:
- F. Roofing Penetration Flashings, for Pipes, Structural Steel, and Equipment Supports: Aluminum sheet or Stainless steel.

END OF SECTION

## SECTION 07 84 00 - FIRESTOPPING

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Firestopping systems.
- B. Firestopping of joints and penetrations in fire-resistance-rated and smoke-resistant assemblies, whether indicated on drawings or not, and other openings indicated.

#### 1.2 DEFINITIONS

- A. Firestopping (Through-Penetration Protection System): Sealing or stuffing material or assembly placed in spaces between and penetrations through building materials to arrest movement of fire, smoke, heat, and hot gases through fire rated construction.

#### 1.3 REFERENCE STANDARDS

- A. ASTM E2174 - Standard Practice for On-Site Inspection of Installed Firestop Systems 2020a.
- B. ASTM E2393 - Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers 2020a.
- C. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi 2015 (Reapproved 2021)e1.
- D. ITS (DIR) - Directory of Listed Products current edition.
- E. FM 4991 - Approval Standard for Firestop Contractors 2013.
- F. FM (AG) - FM Approval Guide current edition.
- G. SCAQMD 1168 - Adhesive and Sealant Applications 1989 (Amended 2017).
- H. UL (FRD) - Fire Resistance Directory Current Edition.

#### 1.4 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures for submittal requirements.
- B. Schedule of Firestopping: List each type of penetration, fire rating of the penetrated assembly, and firestopping test or UL listed design number required to maintain fire resistance rating of adjacent assemblies.
- C. Product Data: Provide data on product characteristics, performance ratings, and limitations.
- D. Sustainable Design Submittal: Submit VOC content documentation for nonpreformed materials.
- E. Manufacturer's Installation Instructions: Indicate preparation and installation instructions.

- F. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- G. Certificate from authority having jurisdiction indicating approval of materials used.
- H. Manufacturer's qualification statement.
- I. Engineering Judgements: For conditions not covered by UL or WH listed designs, submit judgements by licensed professional engineer suitable for presentation to authority having jurisdiction for acceptance as meeting code fire protection requirements.
- J. Installer's qualification statement.

## 1.5 QUALITY ASSURANCE

- A. Fire Testing: Provide firestopping assemblies of designs that provide the scheduled fire ratings when tested in accordance with methods indicated.
  - 1. Listing in UL (FRD), FM (AG), or ITS (DIR) will be considered as constituting an acceptable test report.
  - 2. Valid evaluation report published by ICC Evaluation Service, Inc. (ICC-ES) at [www.icc-es.org](http://www.icc-es.org) will be considered as constituting an acceptable test report.
  - 3. Submission of actual test reports is required for assemblies for which none of the above substantiation exists.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- C. Installer Qualifications: Company specializing in performing the work of this section and:
  - 1. Approved by Factory Mutual Research Corporation under FM 4991, or meeting any two of the following requirements:
  - 2. Verification of minimum three years documented experience installing work of this type.
  - 3. Verification of at least five satisfactorily completed projects of comparable size and type.
  - 4. Licensed by local authorities having jurisdiction (AHJ).

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store products until ready for installation in manufacturer's original unopened packaging, legibly marked with manufacturer's name and product identification, date of manufacture, lot number, listing agency's classification marking, curing/dry time, mixing instructions (if applicable) and MSDS reference number.
- B. Store and handle in such a manner as to prevent deterioration or damage due to moisture, temperature changes, contaminants, and other causes; follow manufacturer's instructions.

- C. Store and dispose of hazardous materials, and materials contaminated by hazardous materials, in accordance with requirements of local Authority Having Jurisdiction.

#### 1.7 FIELD CONDITIONS

- A. Comply with firestopping manufacturer's recommendations for temperature and conditions during and after installation; maintain minimum temperature before, during, and for three days after installation of materials.
- B. Provide ventilation in areas where solvent-cured materials are being installed.
- C. Coordinate firestopping of dynamic and static construction joints (top-of-wall, bottom-of-wall, floor-to-floor, floor-to-wall), wall-to-wall, perimeter so that each particular system may be installed in accordance with its listing, including assembly rating, sizing, movement capabilities and manufacturer's published STC rating.
- D. Coordinate construction and cutting of openings so that each particular firestop system may be installed in accordance with its listing, including assembly rating, L rating, sizing, sleeves, manufacturer's published STC rating and penetrating items.

#### 1.8 WARRANTY

- A. At project closeout, provide to Owner or Owners Representative an executed copy of the manufacturer's standard limited warranty against manufacturing defect, outlining its terms, conditions, and exclusions from coverage.

### PART 2 PRODUCTS

#### 2.1 FIRESTOPPING - GENERAL REQUIREMENTS

- A. Basis of design includes systems as indicated on the Drawings. Provide systems indicated or approved equal.
  - 1. Substitution: See Section 01 25 00 - Substitution Procedures.
- B. Provide firestopping products that are compatible with one another, with the substrates forming openings, and with the items, if any, penetrating through-penetration firestop systems, under conditions of service and application, as demonstrated by firestopping products manufacturer based on testings and field experience.
- C. Firestopping Materials with Volatile Content: Provide only products having lower volatile organic compound (VOC) content than required by SCAQMD 1168.
- D. Primers, Sleeves, Forms, Insulation, Packing, Stuffing, and Accessories: Type required for tested assembly design.
- E. Color: In concealed locations, manufacturer's standard color that will stand out; in exposed locations provide color similar to adjacent materials as approved by Architect.

- F. Fire Ratings: See Drawings for required systems and ratings. Fire stop rating shall meet or exceed the rating of the surrounding wall or opening in which it occurs.

## 2.2 ACCEPTABLE MANUFACTURERS

- A. Firestopping Manufacturers: Subject to compliance with through-penetration firestop systems (XHEZ) and or wall opening protective materials (CLIV) and/or joint systems (XHBN) and/or perimeter fire containment systems (XHDG) and /or continuity head of wall joint systems (XHBO) listed in Volume 2 of the UL Fire Resistance Directory, the following manufacturer's are acceptable:
1. 3M Fire Protection Products: [www.3m.com/firestop/#sle](http://www.3m.com/firestop/#sle).
  2. A/D Fire Protection Systems Inc: [www.adfire.com/#sle](http://www.adfire.com/#sle).
  3. Hilti, Inc: [www.us.hilti.com/#sle](http://www.us.hilti.com/#sle).
  4. HoldRite, a Brand of Reliance Worldwide Corporation: [www.holdrite.com/#sle](http://www.holdrite.com/#sle).
  5. Specified Technologies Inc: [www.stifirestop.com/#sle](http://www.stifirestop.com/#sle).
  6. Tremco Commercial Sealants & Waterproofing: [www.tremcosealants.com/#sle](http://www.tremcosealants.com/#sle).
  7. Substitutions: Refer to Section 01 25 00 for submittal and acceptance requirements for proposed substitution of acceptable manufacturers.

## 2.3 MATERIALS

- A. Firestopping Materials: Any materials meeting requirements.
- B. Volatile Organic Compound (VOC) Content: Provide products having VOC content lower than that required by SCAQMD 1168.
- C. Mold and Mildew Resistance: Provide firestopping materials with mold and mildew resistance rating of zero(0) in accordance with ASTM G21.
- D. Primers, Sleeves, Forms, Insulation, Packing, Stuffing, and Accessories: Provide type of materials as required for tested firestopping assembly.
- E. Color: In concealed locations, manufacturer's standard color that will stand out; .In exposed locations provide color similar to adjacent materials as approved by Architect.
- F. Fire Ratings: Refer to drawings for required systems and ratings.

## 2.4 PRODUCT DESCRIPTION

- A. Provide installed firestop products that limit the spread of fire, heat, smoke, and gasses through otherwise unprotected openings in rated assemblies, including walls, partitions, floors, roof/ceilings, and similar locations, restoring the integrity of the fire rated construction to its original fire rating. Different types of products by multiple manufacturers are acceptable as required to meet specified system descriptions and performance requirements; provide only one type for each similar application.

1. Silicone Firestopping Elastomeric Firestopping: Single component silicone elastomeric compound and compatible silicone sealant.
2. Foam Firestopping Compounds: Multiple component silicone based liquid elastomer, when mixed, expand and cure in place to produce a flexible, non-shrinking foam compound.
3. Endothermic Sealants: Single component latex formulations that upon cure do not re-emulsify during exposure to moisture
4. Elastomeric Sealants: Single component latex formulations that upon cure do not re-emulsify during exposure to moisture and can accommodate minimum +/- 25 percent movement.
5. Formulated Firestopping Compound of Incombustible Fibers: Formulated compound mixed with incombustible non-asbestos fibers.
6. Fiber Stuffing and Sealant Firestopping: Composite of mineral fiber stuffing insulation with silicone elastomer for smoke stopping.
7. Firesafe Insulation: Non-combustible, lightweight, semi-rigid stone wool batt insulation to ASTM C612 that provides fire resistance to ASTM E136 and sound control to ASTM C423. Acceptable Material: Rockwool Safe or approve equal.
8. Mechanical Firestopping Device with Fillers: Mechanical device with incombustible fillers and silicone elastomer, covered with sheet stainless steel jacket, joined with collars, penetration sealed with flanged stops.
9. Intumescent Firestopping: Intumescent putty compound which expands on exposure to surface heat gain.
10. Firestop Pillows: Re-enterable, non-curing, mineral fiber core encapsulated with an intumescent coating on all six sides contained in a flame retardant poly bag.
11. Wall Opening Protective Materials: Intumescent, non-curing pads or inserts for protection of electrical switch and receptacle boxes to reduce horizontal separation to less than 24 inches.
12. Fire Rated Cable Grommet: Molded two-piece grommet made from plenum grade polymer with a foam inner core for sealing cable penetrations up to 0.53 inches (14mm).

## 2.5 PERFORMANCE REQUIREMENTS

- A. Conform to applicable code for fire resistance ratings and surface burning characteristics.
- B. Provide firestop products that are flexible enough to allow for pipe vibration, water hammer, thermal expansion and other normal building movement in a through penetration application without damage to the seal.
- C. Provide fire resistive sealants and sprays for construction joint applications that are flexible enough to satisfy the movement criteria per the test standards ASTM E 1399, ASTM E 1966 or ANSI/UL 2079.

- D. Provide products that upon curing do not re-emulsify, dissolve, leach, breakdown, or otherwise deteriorate over time from exposure to atmospheric moisture, sweating pipes, ponding water or other forms of moisture characteristic during and after construction.
- E. When intumescent products are used, provide products that do not contain sodium silicate or any other water soluble intumescent ingredient in the formulation.
- F. Provide firestop products that do not contain ethylene glycol.
- G. Provide products with the appropriate flame spread index and smoke develop index, when tested in accordance with ASTM E 84.
- H. Fire rated pathway devices shall be the preferred product and shall be installed in all locations where frequent cable moves, add-ons and changes will occur. Such devices include the following attributes:
  - 1. Capable of retrofit around existing cables;
  - 2. Designed such that two or more devices can be ganged together;
  - 3. Maintenance free such that no action is required to activate the smoke and fire sealing mechanism.
- I. When mechanical cable pathways are not practical, openings within walls and floors designed to accommodate voice, data, and video cabling shall be provided with re-enterable products specifically designed for retrofit.
- J. Provide a fire-rated grommet for all individual or small grouped cable applications up to 0.53 inch, (14 mm).
- K. Provide moisture-curing products where inclement weather or greater than transient water exposure is expected.
- L. Provide products that meet the intent of the L rating classification for the movement of smoke per ANSI/UL 1479 for through penetrations and ANSI/UL 2079 for construction joints.
- M. Provide products that meet the intent of the L rating classification for the movement of smoke per ANSI/UL 1479 for through penetrations and ANSI/UL 2079 for construction joints.
- N. Provide products identical to those tested and listed for classification by UL, Intertek or any other qualified independent testing agency.
- O. Firestopping materials must meet and be acceptable for use by all building codes and NFPA codes cited in this section.
- P. Provide products that meet the intent of the state or local guidelines on volatile organic compounds (VOC).
- Q. Where applicable provide products that meet the intent of the F rating classification for passage of flame per ANSI/UL 1479 for through penetrations.

- R. Provide products that meet the intent of the L rating classification for the movement of smoke per ANSI/UL 1479 for through penetrations and ANSI/UL 2079 for construction joints.

## 2.6 FIRE WALL STENCILING AND IDENTIFICATION

- A. At each fire rated barrier in concealed floor, ceiling or attic spaces, provide stenciling or Identification labels on both sides of barrier in location where notice will be visible to anyone seeking to install or remove penetrating items or firestopping.
- B. Provide stencil lettering in a highly visible color contrasting with substrate, not less than 3 inches in height.
  - 1. Suggested wording: "FIRE AND/OR SMOKE BARRIER - PROTECT ALL OPENINGS".
- C. Provide Identification Labels at each concealed penetration of a fire-rated barrier: Pressure sensitive self-adhesive vinyl labels, preprinted with the following information:
  - 1. The applicable words "Warning - Through Penetration Firestop System - Do not Disturb. Notify Building Management of Any Damage." or "Warning - Construction Gap Fire Resistive System - Do not Disturb. Notify Building Management of Any Damage."
  - 2. Listing agency's system number or designation.
  - 3. System manufacturer's name, address, and phone number.
  - 4. Installer's name, address, and phone number.
  - 5. General contractor's name, address, and phone number (if applicable).
  - 6. Date of installation.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify openings are ready to receive the work of this section.

### 3.2 PREPARATION

- A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other materials that could adversely affect bond of firestopping material.
- B. Remove incompatible materials that could adversely affect bond.
- C. Install backing materials to prevent liquid material from leakage.
- D. Install masking and temporary coverings as required to prevent contamination or defacement of adjacent surfaces due to firestopping installation.

### 3.3 INSTALLATION

- A. Install materials in manner described in fire test report and in accordance with manufacturer's instructions, completely closing openings.
- B. Install material at fire rated construction perimeters and openings containing penetrating sleeves, piping, ductwork, conduit and other items, requiring firestopping.
- C. Apply primer where recommended by manufacturer for type of firestopping material and substrate involved, and as required for compliance with required fire ratings.
- D. Install so that openings are completely filled and material is securely adhered.
- E. Where firestopping surface will be exposed to view, finish to a smooth, uniform surface flush with adjacent surfaces.
- F. After installation is complete, remove combustible forming materials and accessories that are not part of the listed system.
- G. Repair or replace defective installations in accordance with manufacturer's recommendations, listed systems details and applicable code requirements.
- H. At each through penetration or fire-resistive joint system, attach identification labels on both sides in location where label will be visible to anyone seeking to remove penetrating items or firestopping.
- I. Clean firestop materials off surfaces adjacent to openings as work progresses, using methods and cleaning materials approved in writing by firestop system manufacturer and which will not damage the surfaces being cleaned.
- J. Notify Authority Having Jurisdiction when firestopping installation is ready for inspection; obtain advance approval of anticipated inspection dates and phasing, if any, required to allow subsequent construction to proceed.
- K. Do not cover installed firestopping until inspected by authorities having jurisdiction.

### 3.4 FIELD QUALITY CONTROL

- A. Independent Testing Agency: Inspection agency employed and paid by Owner, will examine penetration firestopping in accordance with ASTM E2174 and ASTM E2393.
- B. Schedule installation of firestopping after completion of penetrating item installation but prior to covering or concealing of openings.
- C. Repair or replace penetration firestopping and joints at locations where inspection results indicate firestopping or joints do not meet specified requirements.

### 3.5 CLEANING AND PROTECTION

- A. Remove left over material and debris from Work area. Use necessary means to protect fire protection product(s) before, during, and after installation.

- B. Touch-up, repair or replace damaged products before Substantial Completion.
- C. Install Identification labels for through penetration and construction joint systems in concealed floor, ceiling or attic spaces in location where notice will be visible to anyone seeking to install or remove penetrating items or firestopping.

### 3.6 CLEANING

- A. Clean adjacent surfaces of firestopping materials.
- B. Remove left over material and debris from Work area. Use necessary means to protect fire protection product(s) before, during, and after installation.
- C. Touch-up, repair or replace damaged products before Substantial Completion.

### 3.7 PROTECTION

- A. Protect adjacent surfaces from damage by material installation.

END OF SECTION

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## SECTION 07 92 00 - JOINT SEALERS

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Sealants and joint backing.

#### 1.2 REFERENCE STANDARDS

- A. ASTM C834 - Standard Specification for Latex Sealants; 2010.
- B. ASTM C919 - Standard Practice for Use of Sealants in Acoustical Applications; 2012.
- C. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2014.
- D. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2013.

#### 1.3 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate the work with other sections referencing this section.

#### 1.4 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures for general submittal requirements
- B. Product Data: Provide data indicating sealant chemical characteristics.
- C. Samples: Submit two samples, of the manufacturer's standard and custom palette of colors illustrating sealant colors for selection.
  1. When selections have been made, submit samples of cured sealants, in colors selected, approximately 4 inches in length.
  2. Submit samples of materials in contact with sealants for adhesion and compatibility testing by the sealant manufacturer. Provide results of testing along with manufacturer's acceptance and recommendations of their use.
  3. Coordinate with work of other sections in preparing mock-ups or field samples in advance of actual construction.
- D. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.
- E. Sustainable Design Submittals: Refer to Section 01 81 13 for requirements for sustainable design submittals.
  1. Manufacturer's Certificate: Certify products meet or exceed specified sustainable design requirements.

## 1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- B. Applicator Qualifications: Company specializing in performing the work of this section with minimum three years documented experience and approved by manufacturer.
- C. Testing agency: Refer to Section 01 40 00 for requirements to procure a qualified testing agency.

## 1.6 FIELD CONDITIONS

- A. Maintain temperature and humidity recommended by the sealant manufacturer during and after installation.
- B. Perform field-adhesion testing before installing sealants in accordance with Method A, Field-applied Sealant Joint Hand Pull Tab in ASTM C1193.

## 1.7 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective work within a five year period after Date of Substantial Completion.
- C. Warranty: Include coverage for installed sealants and accessories which fail to achieve airtight seal, exhibit loss of adhesion or cohesion, or do not cure.

# PART 2 PRODUCTS

## 2.1 MANUFACTURERS

- A. Gunnable and Pourable Sealants:
  - 1. BASF Construction Chemicals-Building Systems: [www.buildingsystems.bASF.com](http://www.buildingsystems.bASF.com).
  - 2. Dow Corning Corporation: [www.dowcorning.com](http://www.dowcorning.com).
  - 3. Hilti, Inc: [www.us.hilti.com](http://www.us.hilti.com).
  - 4. Pecora Corporation: [www.pecora.com](http://www.pecora.com).
- B. Preformed Compressible Foam Sealers:
  - 1. EMSEAL Joint systems, Ltd.

## 2.2 SEALANTS

- A. General Requirements: Coordinate selection of sealants with:
  - 1. Ability to bond to polyethylene facer of the air/water barrier flashing

2. Required modulus of elasticity to meet expansion and contraction requirements.
  3. Coordinate with bituminous seals across window perimeter flashing laps.
  4. Color range in standard and custom pallate to match adjacent surfaces.
  5. Sustainability Requirements: Refer to Section 01 81 13 for VOC limits for all sealant materials.
- B. General Purpose Exterior Sealant: Silicone; ASTM C920, Grade NS, Class 50 minimum; Non-staining, neutral-curing; Uses M, G, and A; single component.
1. Color: Match adjacent finished surfaces.
  2. Applications: Use for:
    - a. Control, expansion, and soft joints in masonry.
    - b. Joints between concrete and other materials.
    - c. Joints between metal frames and other materials.
    - d. Other exterior joints for which no other sealant is indicated.
- C. General Purpose Traffic Bearing Sealant: Single-component, nonsag, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 100/50, for Use T.
1. Color: Colors as selected
  2. Applications: Use for exterior and interior pedestrian and vehicular traffic bearing joints.
- D. Non-Sag "Traffic-Grade" Polyurethane Sealant: ASTM C920, Grade NS, Uses M and A; single or multi-component; explicitly approved by manufacturer for continuous water immersion and traffic without the necessity to recess sealant below traffic surface.
1. Movement Capability: Plus and minus 25 percent, minimum.
  2. Hardness Range: 40 to 50, Shore A, when tested in accordance with ASTM C661.
  3. Color: Match adjacent finished surfaces.
  4. Service Temperature Range: Minus 40 to 180 degrees F.
- E. Exterior Metal Lap Joint Sealant: Butyl or polyisobutylene, non-drying, non-skinning, non-curing.
1. Applications: Use for concealed sealant bead in sheet metal work.
- F. General Purpose Interior Sealant: Acrylic emulsion latex; ASTM C834, Type OP, Grade NF single component, paintable.
1. Color: Match adjacent finished surfaces.

2. Applications: Use for:

- a. Interior wall and ceiling control joints.
- b. Joints between door and window frames and wall surfaces.
- c. Other interior joints for which no other type of sealant is indicated.

G. Bathtub/Tile Sealant: White silicone; ASTM C920, Class 25, Uses M and A; single component, mildew resistant.

1. Applications: Use for:

- a. Joints between plumbing fixtures and floor and wall surfaces.
- b. Joints between kitchen and bath countertops and wall surfaces; provide clear or matching color at dark colored countertops.

H. Acoustical Sealant for Concealed Locations:

1. Composition: Acrylic latex emulsion sealant; ASTM C920, Grade NS, Class 12-1/2, Uses M and A; single component, non-skimming.

2. Applications: Use for concealed locations only:

- a. Sealant bead between top stud runner and structure and between bottom plate and floor.

I. Concrete Paving Joint Sealant: Polyurethane, self-leveling; ASTM C920, Class 25, Uses T, I, M and A; single component.

1. Color: Gray.

2. Applications: Use for:

- a. Joints in sidewalks and vehicular paving.

J. Precompressed Foam Seal: Comprised of urethane or modified-acrylic impregnated foam impregnated with water-repellent, and with self-adhesive faces protected prior to installation by release paper.

1. Color: As selected by Architect.

2. Size as required to provide water-tight seal when installed.

3. Calculate size according to manufacturer's recommendations.

4. Measure size of existing joints before selecting seal width.

5. Provide product recommended by manufacturer for traffic-bearing use.

## 2.3 ACCESSORIES

- A. Primer: Non-staining type, recommended by sealant manufacturer to suit application.
- B. Joint Cleaner: Non-corrosive and non-staining type, recommended by sealant manufacturer; compatible with joint forming materials.
- C. Joint Backing: Round foam rod compatible with sealant; ASTM D 1667, closed cell PVC; oversized 30 to 50 percent larger than joint width.
- D. Bond Breaker: Pressure sensitive tape recommended by sealant manufacturer to suit application.
- E. Cavity Vent: Refer to Section 04 20 00 for cavity vents.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify that substrate surfaces are ready to receive work.
- B. Verify that joint backing and release tapes are compatible with sealant.

### 3.2 PREPARATION

- A. Remove loose materials and foreign matter that could impair adhesion of sealant.
- B. Clean and prime joints in accordance with manufacturer's instructions.
- C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.
- D. Protect elements surrounding the work of this section from damage or disfigurement.

### 3.3 INSTALLATION

- A. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.
- B. Perform installation in accordance with ASTM C1193.
- C. Perform acoustical sealant application work in accordance with ASTM C919.
- D. Measure joint dimensions and size joint backers to achieve width-to-depth ratio, neck dimension, and surface bond area as recommended by manufacturer, except where specific dimensions are indicated.
- E. Install bond breaker where joint backing is not used.
- F. Install sealant free of air pockets, foreign embedded matter, ridges, and sags.
- G. Apply sealant within recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.

- H. Tool joints concave.
- I. Concrete Floor Joint Filler: Install concrete floor joint filler per manufacturer's written instructions. After floor joint filler is fully cured, shave joint filler flush with top of concrete slab.

### 3.4 FIELD QUALITY CONTROL

- A. Refer to Section 01 40 00 for requirements to procure a qualified testing agency.
- B. Field test joint-sealant adhesion to joint substrates according to Method A, Field-applied Sealant Joint Hand Pull Tab of ASTM C1193; or Method A, Tail Procedure of ASTM C1521. Provide written report of test results.
- C. Remove and replace failed portions of sealants using same materials and procedures as indicated for original installation.

### 3.5 CLEANING

- A. Clean adjacent soiled surfaces.

### 3.6 PROTECTION

- A. Protect sealants until cured from contaminating substances and from damage resulting from construction operations. Remove and damaged or deteriorated joint sealants from damage resulting from construction operation and reinstall.

### 3.7 POST-OCCUPANCY

- A. Post-Occupancy Inspection: Perform visual inspection of entire length of project sealant joints at a time that joints have opened to their greatest width; i.e. at the low temperature in the thermal cycle. Report failures immediately and repair.

END OF SECTION

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## SECTION 07 95 00 - EXPANSION CONTROL

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes: Elastomeric assemblies includes roof horizontal expansion control systems, above-grade exterior wall expansion control systems, fire-rated expansion control systems, and joint covers.
- B. Related Sections:
  - 1. Section 01 74 19 - Construction and Demolition Waste Management
  - 2. Section 07 14 13 Hot Fluid Applied Rubberized Asphalt Waterproofing.
  - 3. Section 07 17 00 - Bentonite Waterproofing.
  - 4. Section 07 55 56 Fluid Applied Protected Membrane Roofing (Hot Rubberized Asphalt).
  - 5. Section 07 92 00 - Joint Sealants.

#### 1.2 SYSTEM DESCRIPTION

- A. Design Requirements: Design, fabricate and install expansion control systems, including anchorage, capable of withstanding specified loads, building movements, thermally induced movement, and moisture movements, including all fabrication and erection tolerances of building materials and systems without failure, excessive deflection, infiltration of air and water into building interior beyond specified limits, or exceeding specified performance criteria.
- B. Manufacturer: Responsible for designing units, including anchorage to structural system, transitions, direction changes, and necessary modifications to meet specified requirements and maintain visual design concepts.
- C. Performance Requirements: Permit unrestrained movement of joint without disengagement of cover.
  - 1. Provide seal assembly for joint width and expansion dimensions.
  - 2. Provide units to accommodate joints size, variations in adjacent surfaces, and dynamic movement without material degradation or fatigue when tested in accordance with ASTM E1399.
  - 3. Air Infiltration / Exfiltration: Provide expansion control systems with maximum air leakage of 0.06 cfm/sq ft of fixed wall area when tested according to ASTM E283 at a minimum static-air-pressure differential of 6.24 lbf/sq ft.
  - 4. Water Penetration under Static Pressure: Provide expansion control systems that do not evidence water penetration when tested according to ASTM E331 for one 15 minute cycle at a minimum differential static pressure of 20 percent of the peak positive wind load design pressure, but not less than 15 psf.

- D. Fire Resistance Requirements: Test fire rated cover assemblies or fire-rated barrier component of joint cover assembly at maximum joint width with field splice in accordance with ASTM E119 or E814, UBC 43-1.
  - 1. Classify by UL, Warnock Hersey, or other fire testing agency acceptable to authority having jurisdiction.
  - 2. Fire Rating: Not less than rating of adjacent construction.
  - 3. Flame Spread Index: 25 or less, ASTM E84.
  - 4. Smoke Generated Index: 0 to 450, ASTM E84.
- E. Interface with Adjacent Systems: Design watertight transition with adjacent waterproofing systems.

### 1.3 ADMINISTRATIVE REQUIREMENTS

- A. Sequencing: Coordinate formed blockouts and recesses in concrete to receive joint cover assemblies with Section 03 30 00.

### 1.4 SUBMITTALS

- A. General: Submit in accordance with Section 01 33 00.
- B. Product Data: Submit for expansion joints.
  - 1. Include data to indicate nominal joint size, joint movement range, percentage of movement from nominal joint size, and quantity of axial dimensions through which joint can move.
  - 2. Include information for factory finishes, sealants, and other required components.
  - 3. Include color charts for color-finished items indicating manufacturer's full range of colors available for selection.
- C. Shop Drawings: Indicate layout including locations, dimensions, profiles, fabrication details, interface with adjacent construction, anchorage, frequency of attachment, finishes, splices, joints, miters, and accessories.
- D. LEED Building Submittal Requirements: Submit the following LEED Building certification items:
  - 1. A completed LEED Building Materials Certification Form, Information to be supplied includes:
    - a. The percentage by weight of recycled content in the product(s). Identify post-consumer and/or pre-consumer recycled content.
    - b. The manufacturing location for the product(s); and the location (source) of the raw materials used to manufacture the product(s).

- c. Provide material costs for the materials included in the contractor's or subcontractor's work.  
Material cost does not include costs associated with labor and equipment.
  - 2. Letters of Certification, provided from the product manufacturer on the manufacturer's letterhead, to verify the amount of recycled content.
  - 3. Product Cut Sheets for all materials that meet the LEED Building Performance Requirements this Section.
  - 4. Material Safety Data Sheets (MSDS), for all applicable products. Applicable products include, but are not limited to adhesives, sealants, carpets, paints and coatings applied on the interior of the building. MSDS shall indicate the Volatile Organic Compound (VOC) limits of products submitted (If an MSDS does not include a product's VOC content, then product data sheets, manufacturer literature, or a letter of certification from the manufacturer can be submitted in addition to the MSDS to indicate the VOC content).
- E. Informational Submittals: Submit following packaged separately from other submittals:
- 1. Manufacturer's instructions.

## 1.5 QUALITY ASSURANCE

- A. Regulatory Requirements: Ensure flammable components comply with applicable portions of local, state, and federal codes, laws, and ordinances for flame spread and smoke developed indices.
- B. Single Source Responsibility: Furnish each product from one manufacturer for entire Project, unless otherwise acceptable to Architect.
  - 1. Provide each joint cover assembly as complete unit, including fire and moisture barriers, resilient inserts, anchors, and accessory items necessary for proper operation.
  - 2. Manufacturer Qualifications: Company specializing in manufacturing Products specified in this Section with minimum five years experience.
- C. LEED Building Performance Requirements
  - 1. Adhesives or sealants used for work in this section for interior applications shall meet the requirements of Section 018113: "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints and Coatings", where applicable.
  - 2. Materials manufactured within a radius of 500 miles from the project site where all or a portion of the raw resources also originate within a radius of 500 miles shall be documented in accordance with the LEED Building Submittal Requirements of this Section.
  - 3. Steel materials used for work in this section shall contain a minimum of 35% (combined) pre-consumer/post-consumer recycled content (the percentage of recycled content is based on the weight of the component materials). Certification of recycled content shall be in accordance with the LEED Building Submittal Requirements of this Section.

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4. Materials that contain recycled content shall be documented in accordance with the LEED Building Submittal Requirements of this Section.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

A. Acceptable Manufacturers:

1. EMSEAL Joint Systems, Ltd. Westborough, MA.
2. Accepted Substitute in accordance with Section 01 25 00.

### 2.2 MANUFACTURED UNITS

A. Expansion Joint Cover Assemblies - General: Factory-fabricated and assembled; designed to completely fill joint openings, sealed to prevent passage of air, dust, water, smoke; suitable for traffic expected.

1. Joint Dimensions and Configurations: As indicated on drawings.
2. Joint Cover Sizes: Selected to suit joint width and configuration, based on manufacturer's published recommendations and limitations.
3. Joint Cover Styles: As indicated on drawings.
4. Joint Movement Capability: If not indicated, provide minimum plus/minus 25 percent joint movement capability.
5. Lengths: Provide covers in full lengths required; avoid splicing wherever possible.
6. Anchors, Fasteners, and Fittings: Provided by cover manufacturer.

B. Floor Joint Covers: Coordinate with indicated floor coverings.

1. If floor covering is not indicated, obtain instructions from Architect before proceeding.
2. If style is not indicated, provide extruded aluminum frame both sides, resilient seals, and minimize exposed metal.

C. Resilient Seal Type Covers: Having flat exposed surface without crevices that could collect dirt; designed to withstand expected movement without extrusion of seal from joint assembly; for floors, provide style that is flush with top of floor covering; for exterior joints, weathertight.

- D. Sliding Cover Plate Type Covers: Provide plate with beveled edges and neat fit that does not collect dirt.
- E. Covers In Gypsum Board Assemblies: Provide style with anchoring wings that can be completely covered by joint compound.
- F. Covers In Fire Rated Assemblies: Provide cover assembly having fire rating equivalent to that of assembly into which it is installed.

1. Acceptable Evaluation Agencies: UL, ULC, and Intertek.

G. Roof Joint:

1. Nominal Joint Width: As indicated.
2. Joint Movement Range Across Nominal Joint Width: maximum 5 inches.
3. Description: Double flanged extruded PVC system.
  - a. Color: Black.
4. Acceptable Product: Emseal RJ-0400 Roof Joint or Accepted Substitute in accordance with Section 01 25 00.

H. Below Grade Expansion Joint:

1. Joint Width: As indicated.
2. Description: Heavy-duty double-celled extruded heat-weldable rubber gland flanked by integral side flashing sheets.
3. Acceptable Product: Emseal BG System or Accepted Substitute in accordance with Section 01 25 00

I. Topping Slab Expansion Joint:

1. Joint Width: As indicated.
2. Joint Movement Range Across Nominal Joint Width: +/- 25 percent.
3. Description: Fire-rated trafficable waterproof joint system.
4. Acceptable Product: Emshield DFR-FP or Accepted Substitute in accordance with Section 01 25 00.
  - a. 01 25 00.

J. Fire Rated Expansion Joint:

1. Joint Width: As indicated.
2. Joint Movement Range Across Nominal Joint Width: +/- 50 percent.
3. Description: Fire-rated traffic durable high movement and watertight expansion joint.
4. Acceptable Product: Emshield DFR2 or Accepted Substitute in accordance with Section 01 25 00

K. Mat Foundation Expansion Joint:

1. Joint Width: As indicated.
2. Joint Movement Range Across Nominal Joint Width: +30 - 25 percent.

3. Description: Double-sided joint-face adhered precompressed primary waterproofing seal.
4. Acceptable Product: Emseal DSM-DS or Accepted Substitute in accordance with Section 01 25 00

L. Exterior Wall Expansion Joint:

1. Nominal Joint Width: As indicated.
2. Joint Movement Range Across Nominal Joint Width: +/-25 percent.
3. Description: Factory-applied and cured silicone bellows with microsphere-modified acrylic-impregnated expanding foam sealant backing.
4. Acceptable Product: Provide as indicated or Accepted Substitute in accordance with Section 01 25 00
  - a. Where joint is exposed: Emseal Colorseal
  - b. Where back (hidden)seal occurs in double expansion joint conditions: Emseal Backerseal.

M. Exterior Vehicle Grade Expansion Joint

1. Joint Width: 1/2 inch to 4 inch.
2. Joint Movement Range Across Nominal Joint Width: +50 - 50 percent.
3. Description: Water tight waterproofing seal for horizontal-plane deck applications; traffic durable, joint face adhered and precompressed.
4. Acceptable Product: Emseal DSM or Accepted Substitute in accordance with Section 01 25 00

2.3 ACCESSORIES

- A. Provide parts, devices, anchors, fasteners, spacers, and other accessories required for complete, watertight installations.
- B. Sealants: Refer to Section 07 92 00.

2.4 FABRICATION

- A. Expansion Joints: Prior to fabrication, field measure actual existing conditions to ensure proper fit.
  1. Fabricate and provide anchors for installation in formed blockouts or recesses without need for cast-in-place or pre-installed anchors.
  2. Provide in longest units in longest practical lengths to minimize quantity of intermediate joints and field splicing.
  3. Fabricate with mitered and welded corners where joint changes direction or abuts other materials.

4. Fabricate with end closures, transitions, tee-joints, corners, cross-connections, and other pieces by expansion joint manufacturer to provide continuous assembly.
- B. Shop assemble components and package with anchors and fittings.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine conditions and proceed with work in accordance with Section 01 40 00.
  1. Verify that deck, framing assemblies, and other items affecting work of this Section are in place and positioned correctly.
  2. Verify that field measurements and formed recess dimensions are as shown on shop drawings.
  3. Verify that joint preparation and affected dimensions are acceptable.

### 3.2 PREPARATION

- A. Provide anchoring devices for installation.
- B. Provide templates and rough-in measurements.

### 3.3 INSTALLATION

- A. Expansion Joints: Comply with manufacturer's recommendations.
  1. Install units plumb, level, square, and free from warp or twist while maintaining dimensional tolerances, and alignment with surrounding construction.
  2. Install floor joints with top surface flush with finish floor surface.
  3. Install wall joints flush with adjacent finish surfaces.
  4. Secure to substrate. Make allowances for change in joint size due to difference between installation and building operating temperatures.
  5. Install with minimum quantity of intermediate joints and splices.
  6. Install flexible filler materials to substrate with adhesive as recommended by manufacturer.
  7. Set joint systems to proper width for ambient temperature at time of setting.
  8. Provide termination bars at exposed ends of flanged joint expansion control systems.
- B. Fire-Rated Expansion Joints: Install to comply with fire rating design requirements.
  1. Provide a continuous, uninterrupted fire resistance throughout the length of the joint, including at transitions and field splices.

C. Covers with Elastomeric Components:

1. Install elastomeric seal to form one continuous piece.
2. Splicing Field Cuts/Miters of Assembly Components: Elastomeric Components: Use manufacturer's vulcanizing or welding procedures to provide watertight joints.

D. Joints with Extruded Preformed Seals: Install joints to comply with manufacturer's recommendations and with minimum number of end joints.

1. For straight sections, provide preformed seals in continuous lengths.
2. Vulcanize or heat-weld field splice joints in preformed seal material to provide watertight joints using procedures recommended by manufacturer.
3. Apply adhesive, epoxy, or lubricant adhesive approved by manufacturer to both frame interfaces before installing preformed seals.
4. Seal transitions according to manufacturer's recommendations.
5. Install foam seals with adhesive recommended by manufacturer and heat seal splices.

### 3.4 ADJUSTING, CLEANING AND PROTECTION

A. Adjusting: Adjust parts for smooth, uniform operation.

1. Adjust joint cover to freely accommodate joint movement.

B. Cleaning: In accordance with Section 01 70 00 and as recommended by manufacturer. Do not use materials or methods which may damage finish or surrounding construction.

1. Clean excess primer, adhesives, sealants, and other products from components and adjacent surfaces for proper operation of assembly.

C. Protection: Protect finished work in accordance with Section 01 50 00.

1. Protect installation from damage by work of other trades.
2. Do not permit traffic over unprotected floor joint surfaces.

END OF SECTION

## SECTION 08 06 71 - DOOR HARDWARE SCHEDULE

### PART 1 GENERAL

#### 1.1 SUMMARY

- A. This Section references specification sections relating to commercial door hardware for the following:
  - 1. Swinging doors.
  - 2. Sliding Doors.
  - 3. Other doors to the extent indicated.
- B. Commercial door hardware includes, but is not necessarily limited to, the following:
  - 1. Mechanical door hardware.
  - 2. Electromechanical and access control door hardware.
  - 3. Electromechanical and access control door hardware power supplies, back-ups and surge protection.
  - 4. Automatic operators.
  - 5. Cylinders specified for doors in other sections.

#### 1.2 RELATED SECTIONS:

- A. Section – 08 71 00 - Door Hardware”.
- B. Section 28 15 10 - Multi-Family Data on Credential Access Control Devices.

#### 1.3 CODES AND REFERENCES:

- A. Comply with the version year adopted by the Authority Having Jurisdiction.
  - 1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
  - 2. ICC/IBC - International Building Code.
  - 3. NFPA 70 - National Electrical Code.
  - 4. NFPA 80 - Fire Doors and Windows.
  - 5. NFPA 101 - Life Safety Code.
  - 6. NFPA 105 - Installation of Smoke Door Assemblies.
  - 7. State Building Codes, Local Amendments.
  - 8. Standards: Reference Related Sections for requirements regarding compliance with applicable industry standards.

#### 1.4 SUBMITTALS

- A. Refer to Section 01 33 00 for general submittal procedures.
- B. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.
- C. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
  1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."
  2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.
  3. Content: Include the following information:
    - a. Type, style, function, size, label, hand, and finish of each door hardware item.
    - b. Manufacturer of each item.
    - c. Fastenings and other pertinent information.
    - d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
    - e. Explanation of abbreviations, symbols, and codes contained in schedule.
    - f. Mounting locations for door hardware.
    - g. Door and frame sizes and materials.
  4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.
  - D. Keying Schedule: Prepared under the supervision of the Owner, separate schedule detailing final keying instructions for locksets and cylinders in writing. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner to approve submitted keying schedule prior to the ordering of permanent cylinders.

- E. Product Test Reports: Indicating compliance with cycle testing requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified independent testing agency.
- F. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Division 01, Closeout Submittals. The manual to include the name, address, and contact information of the manufacturers providing the hardware and their nearest service representatives. The final copies delivered after completion of the installation test to include "as built" modifications made during installation, checkout, and acceptance.
- G. Warranties and Maintenance: Special warranties and maintenance agreements specified in the Related Sections.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.
- B. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.
- C. Deliver, as applicable, permanent keys, cylinders, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner shall be established at the "Keying Conference".

#### 1.6 WARRANTY

- A. General Warranty: Reference Section 01 78 00 - Closeout Submittals. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

#### 1.7 MAINTENANCE SERVICE

- A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

### PART 2 PRODUCTS

#### 2.1 SCHEDULED DOOR HARDWARE

- A. Refer to "PART 3 – EXECUTION" for required Hardware Product specifications.

## PART 3 EXECUTION

### 3.1 DOOR HARDWARE SETS

- A. The door hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.
  - 1. Quantities listed are for each pair of doors, or for each single door.
  - 2. The supplier is responsible for handing and sizing all products.
  - 3. Where multiple options for a piece of hardware are given in a single line item, the supplier shall provide the appropriate application for the opening.
  - 4. At existing openings with new hardware the supplier shall field inspect existing conditions prior to the submittal stage to verify the specified hardware will work as required. Provide alternate solutions and proposals as needed.
- B. Products listed in the hardware sets shall be supplied by and in accordance with the requirements described in the specification section as noted for each item.
  - 1. Section 08 71 00 – Door Hardware.
  - 2. Section 28 15 10 – Multi-Family Access Control.
- C. Manufacturer's Abbreviations:
  - 1. MK - McKinney
  - 2. PE - Pemko
  - 3. SU - Securitron
  - 4. RO - Rockwood
  - 5. YA - Yale
  - 6. EM - Emtek
  - 7. AD - Adams Rite
  - 8. RF - Rixson
  - 9. NO - Norton

### 3.2 HARDWARE SETS

END OF SECTION

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## SECTION 08 11 13 - HOLLOW METAL DOORS AND FRAMES

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Non-fire-rated steel doors and frames.
- B. Steel frames for wood doors
- C. Fire-rated steel doors and frames.
- D. Thermally insulated steel doors with frames.

#### 1.2 RELATED REQUIREMENTS

- A. Section 08 71 00 - Door Hardware.
- B. Section 08 80 00 - Glazing: Glass for doors and borrowed lites.
- C. Section 28 15 10 - Multi-Family Data-on-Credential Access Control Devices

#### 1.3 REFERENCE STANDARDS

- A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design 2010.
- B. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100) 2017.
- C. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames 2020.
- D. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2020.
- E. BHMA A156.115 - Hardware Preparation In Steel Doors And Steel Frames 2016.
- F. ICC A117.1 - Accessible and Usable Buildings and Facilities 2017.
- G. NAAMM HMMA 840 - Guide Specifications For Receipt, Storage and Installation of Hollow Metal Doors and Frames 2007.
- H. NAAMM HMMA 850 - Fire-Protection and Smoke Control Rated Hollow Metal Door and Frame Products 2014.
- I. NAAMM HMMA 860 - Guide Specifications for Hollow Metal Doors and Frames 2018.
- J. NFPA 80 - Standard for Fire Doors and Other Opening Protectives 2019.
- K. UL (DIR) - Online Certifications Directory Current Edition.

- L. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies Current Edition, Including All Revisions.
- M. UL 1784 - Standard for Air Leakage Tests of Door Assemblies Current Edition, Including All Revisions.

#### 1.4 SYSTEM DESCRIPTION

- A. General: Meet or exceed SDI 100 and more stringent requirements specified in this Section.
  - 1. Fire Rated Assemblies: Fabricate assemblies as tested and approved by UL or other nationally recognized testing agency acceptable to authorities having jurisdiction.
    - a. Comply with NFPA 80.
    - b. Tested in accordance with NFPA 252 or UL 10B.
    - c. Identified with factory applied label indicating applicable fire rating.
  - 2. Smoke Rated Assemblies: Fabricate assemblies as tested and approved by UL or other national acceptable to authorities having jurisdiction.
    - a. tested in accordance with UL 10C.
  - 3. Hardware Preparation: ANSI A115 Series and SDI 107, except for hardware locations.
    - a. Hardware Locations: Comply with Section 08 71 00.
    - b. Mortise, reinforce, drill, and tap frames and doors at factory to receive mortised and concealed hardware in accordance with templates and approved hardware schedules.

#### 1.5 SUBMITTALS

- A. See Section 01 33 00 for submittal procedures.
- B. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes; and one copy of referenced standards/guidelines.
- C. Door hardware supplier is to furnish templates, template reference number and/or physical hardware to the steel door and frame supplier in order to prepare the doors and frames to receive the finish hardware items.
- D. Shop Drawings: Include the following:
  - 1. Elevations of each door design.
  - 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.
  - 4. Locations of reinforcement and preparations for hardware.

5. Details of anchorages, joints, field splices, and connections.
6. Details of accessories.
7. Details of moldings, removable stops, and glazing.
8. Details of conduit and preparations for power, signal, and control systems.

## 1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years documented experience.
- B. Source Limitations: Obtain hollow metal doors and frames through one source from a single manufacturer wherever possible.
- C. Quality Standard: In addition to requirements specified, furnish SDI-Certified manufacturer products that comply with ANSI/SDI A250.8, latest edition, "Recommended Specifications for Standard Steel Doors and Frames".
- D. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to UL10C (neutral pressure at 40" above sill) or UL 10C.
  1. Oversize Fire-Rated Door Assemblies Construction: For units exceeding sizes of tested assemblies, attach construction label certifying doors are built to standard construction requirements for tested and labeled fire rated door assemblies except for size.
  2. Temperature-Rise Limit: Where indicated and at vertical exit enclosures (stairwell openings) and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F (250 deg C) above ambient after 30 minutes of standard fire-test exposure.
- E. Smoke Control Door Assemblies: Comply with NFPA 105.
  1. Smoke "S" Label: Doors to bear "S" label, and include smoke and draft control gasketing applied to frame and on meeting stiles of pair doors.
- F. Fire-Rated, Borrowed-Light Frame Assemblies: Assemblies complying with NFPA 80 that are listed and labeled, by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 257. Provide labeled glazing material.
- G. Pre-Submittal Conference: Conduct conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier, Installer, and Contractor to review proper methods and procedures for installing hollow metal doors and frames and to verify installation of electrical knockout boxes and conduit at frames with electrified or access control hardware.

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Comply with NAAMM HMMA 840 or ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.
- B. Protect with resilient packaging; avoid humidity build-up under coverings; prevent corrosion and adverse effects on factory applied painted finish.
- C. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
  1. Store hollow metal work under cover at Project site. Place in stacks of five units maximum in a vertical position with heads up, spaced by blocking, on minimum 4-inch high wood blocking. Do not store in a manner that traps excess humidity.
  2. Provide minimum 1/4-inch space between each stacked door to permit air circulation. Door and frames to be stacked in a vertical upright position.

## 1.8 PROJECT CONDITIONS

- A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

## 1.9 COORDINATION

- A. Coordinate installation of anchorages for hollow metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.
- B. Building Information Modeling (BIM) Support: Utilize designated BIM software tools and obtain training needed to successfully participate in the Project BIM processes. All technical disciplines are responsible for the product data integration and data reliability of their Work into the coordinated BIM applications.

## 1.10 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.
- B. Warranty includes installation and finishing that may be required due to repair or replacement of defective doors.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Hollow Metal Doors and Frames:
  1. Ceco Door, an Assa Abloy Group company: [www.assaabloydss.com/#sle](http://www.assaabloydss.com/#sle).
  2. Curries, an Assa Abloy Group company: [www.assaabloydss.com/#sle](http://www.assaabloydss.com/#sle).

3. Substitutions: Refer to Section 01 25 00 for alternate material proposals.

## 2.2 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.
- C. Frame Anchors: ASTM A653/A653M, Commercial Steel (CS), Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.

## 2.3 DOORS AND FRAMES

### A. Requirements for all Doors and Frames:

- 1. Accessibility: Comply with ICC A117.1 and ADA Standards.
- 2. Top and Bottom Edges: Reinforce tops and bottoms of doors with a continuous steel channel not less than 16 gauge, extending the full width of the door and welded to the face sheet. Doors with an inverted top channel to include a steel closure channel, screw attached, with the web of the channel flush with the face sheets of the door. Plastic or composite channel fillers are not acceptable.
- 3. Door Edge Profile: Beveled, both sides.
- 4. Typical Door Face Sheets: Flush.
- 5. Light Openings and Glazing
  - a. Stops and Moldings: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints at fabricator's shop. Fixed and removable stops to allow multiple glazed lites each to be removed independently. Coordinate frame rabbet widths between fixed and removable stops with the type of glazing and installation indicated.
  - b. Moldings for Glazed Lites in Doors and Loose Stops for Glazed Lites in Frames: Minimum 20 gauge thick, fabricated from same material as door face sheet in which they are installed.
  - c. Fixed Frame Moldings: Formed integral with hollow metal frames, a minimum of 5/8 inch (16 mm) high unless otherwise indicated. Provide fixed frame moldings and stops on outside of exterior and on secure side of interior doors and frames.
  - d. Preformed Metal Frames for Light Openings: Manufacturer's standard frame formed of 0.048-inch-thick, cold rolled steel sheet; with baked enamel or powder coated finish; and approved for use in doors of fire protection rating indicated. Match pre-finished door paint color where applicable.

6. Hardware Preparation: In accordance with BHMA A156.115, with reinforcement welded in place, in addition to other requirements specified in door grade standard.
    - a. Hinge Reinforcement: Minimum 7 gauge (3/16") plate 1-1/4" x 9" or minimum 14 gauge continuous channel with pierced holes, drilled and tapped.
    - b. Hardware Reinforcements: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.
  7. Zinc Coating for Typical Interior and/or Exterior Locations: Provide metal components zinc-coated (galvanized) by the hot-dip process in accordance with ASTM A653/A653M, with Coating Designation A60, unless noted otherwise for specific hollow metal doors and frames.
- B. Finish: Factory Primed for field finishing.
- C. Edge Clearances:
1. Between Bottom Edge of Door and Finish Floor at Non-Label Assemblies: In accordance with SDI 100 except where larger undercuts are scheduled.
    - a. Undercuts: Not exceed those permitted by NFPA 80 (1999), Section 1-11.4. Finish floor is defined as top surface of substrate. Where carpet or other applied surface materials are placed over floor substrate and greater than 1/2 inch thickness, provide 1/4 inch clearance.
  2. Between Bottom Edge of Door and Threshold: 1/4 inch.
- D. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with the specified requirements for each type; for instance, an exterior door that is also indicated as being sound-rated must comply with the requirements specified for exterior doors and for sound-rated doors; where two requirements conflict, comply with the most stringent.

## 2.4 STEEL DOORS

- A. Exterior Doors:
1. Grade: ANSI A250.8 - SDI-100; Level 3 - Extra Heavy-Duty, Physical Performance Level A, Model 1 - Full Flush.
    - a. Core: Polyurethane.
    - b. Thickness: 1-3/4 inch.
    - c. Galvanizing: Components hot-dipped zinc-iron alloy-coated (galvannealed) in accordance with ASTM A653/A653M, with Coating Designation A60.
    - d. Insulating Value: U-value of 0.50, when tested in accordance with ASTM C1363.
    - e. Air leakage: Refer to Section 01 81 13 for sustainability requirements.
- B. Interior Doors, Non-Fire-Rated:

1. Grade: ANSI A250.8 - SDI-100; Level 2 - Heavy-Duty, Physical Performance Level B, Model 1 - Full Flush.
  2. Thickness: 1-3/4 inch.
- C. Interior Doors, Fire-Rated:
1. Grade: ANSI A250.8 - SDI-100; Level 2 - Heavy-Duty, Physical Performance Level C, Model 1 - Full Flush.
  2. Fire Rating: As indicated on Door and Frame Schedule, tested in accordance with UL 10C ("positive pressure").
    - a. Provide units listed and labeled by UL (Underwriters Laboratories) - UL (BMD).
    - b. Attach fire rating label to each fire rated unit.
  3. Core: Mineral board.
  4. Thickness: 1-3/4 inch.
- D. Interior Smoke and Draft Control Doors: Same fire rated construction as the fire-rated doors, and the following;
1. Maximum Air Leakage: 3.0 cfm/sq ft of door opening at 0.10 inch w.g. pressure, when tested in accordance with UL 1784 at both ambient and elevated temperatures.
  2. Gasketing: No added eals allowed.
  3. Label: UL "S" label.

## 2.5 STEEL FRAMES

- A. General:
1. Comply with the requirements of grade specified for corresponding door.
    - a. ANSI A250.8 - SDI-100, Level 1 Door Frames: 16 gage, 0.053 inch, minimum thickness.
    - b. ANSI A250.8 - SDI-100, Level 2 and 3 Door Frames: 14 gage, 0.067 inch, minimum thickness.
    - c. Frames for Wood Doors: Comply with frame requirements specified in ANSI A250.8 - SDI-100, Level 1, 18 gage, 0.042 inch
  2. Finish: Factory primed, for field finishing.
  3. Provide mortar guard boxes for hardware cut-outs in frames to be installed in masonry or to be grouted. Formed from same material as frames, not less than 0.016 inches thick.
  4. Floor Anchor Clips: Provide at each jamb, formed from A60 metallic coated material, not less than 0.042 inches thick..

5. Jamb Anchors:
    - a. Masonry Walls: 3/16 inch diameter crimped galvanized wire or corrugated steel T- strap design formed from A60 metallic coated material, not less than 0.042 inch thick. Locate near bottom of frame, near top of frame, and 32 inch centers maximum intermittently, minimum three per jamb.
    - b. Metal Stud Wall Systems: Steel clips welded to frame, type or design compatible with stud system. Locate at top of frame, 12 inch from top, and 24 inch centers maximum intermittently, minimum four per jamb.
    - c. Fire Rated Frames: Comply with fire testing agency label and listing requirements.
  6. Frames in Masonry Walls: Size to suit masonry coursing with head member 4 inches high to fill opening without cutting masonry units.
- B. Exterior Door Frames: Fully welded.
1. Galvanizing: Components hot-dipped zinc-iron alloy-coated (galvannealed) in accordance with ASTM A653/A653M, with manufacturer's standard coating thickness.
  2. Weatherstripping: Integral, recessed into door edge or frame.
- C. Interior Door Frames, Non-Fire-Rated: Fully welded type.
- D. Interior Door Frames, Fire-Rated: Fully welded type.
1. Fire Rating: Same as door, labeled.
- E. Frames for Interior Glazing or Borrowed Lights: Construction and face dimensions to match door frames, and as indicated on drawings.

## 2.6 FIRE RATED DOORS AND FRAMES

- A. System Description: Steel fire-rated glazed wall and door system.
1. Basis of Design: "Fireframes® Designer Series" fire-rated frame system as manufactured and supplied by Technical Glass Products, or approved equal. Refer to Section 01 25 00 regarding submittal and approval requirements for substitutions.
- B. Design Requirements:
1. Construction: Narrow-profile, roll-formed steel architectural grade specialty fire doors.
    - a. Knock down frames are not permitted.
  2. Dimensions – Door and Framing:
    - a. Door framing face dimension: 1 15/16-inch.

- b. Depth of door framing: 1 15/16-inch.
  - c. Door style face dimension: 3 1/8-inch.
  - d. Door cross rail (if applicable) face: 3 9/16-inch
  - e. Depth of stile, header, sill and cross rail: 1 15/16-inch
- 3. Fire Rated Glazing: ASTM C 1036 and ASTM C 1048; composed of laminated ceramic glazing material; clear; 5/16 inch thick;
    - a. Impact safety rated, ANSI Z97.1;
    - b. Logo: Label each piece of fire-rated glazing with a permanent logo including name of product, manufacturer, testing laboratory (UL® only), fire rating period, safety glazing standards, and date of manufacture.
    - c. FireLite plus as manufactured by Technical Glass Products or approved equal.
  - 4. Glazing Gasket: Supplied with the steel framing members. Nom. 3/4 inch by 3/16 inch black applied to the steel framing members to cushion and seal the glazing material when installed.

## 2.7 ACCESSORY MATERIALS

- A. Glazing: As specified in Section 08 80 00, factory installed.
- B. Mechanical Fasteners for Concealed Metal-to-Metal Connections: Self-drilling, self-tapping, steel with electroplated zinc finish.
- C. Astragals:
  - 1. Pairs of Interior Labeled Doors: Full height overlapping design, applied on in-active leaf as necessary to meet label requirements, minimum 20 gage steel.
  - 2. Pairs of Exterior Doors: Full height overlapping design welded on active leaf, 1-3/4 inch by 12 gage steel.
- D. Grout for Frames: Portland cement grout of maximum 4-inch slump for hand troweling; thinner pumpable grout is prohibited.
- E. Silencers: Resilient rubber, fitted into drilled hole; 3 on strike side of single door, 3 on center mullion of pairs, and 2 on head of pairs without center mullions.
  - 1. Temporary Frame Spreaders: Provide for all factory- or shop-assembled frames.

## 2.8 FABRICATION

- A. Fabricate hollow metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. When shipping limitations so dictate, frames for large openings are to be fabricated in sections for splicing or splining in the field by others.
- B. Tolerances: Fabricate hollow metal work to tolerances indicated in ANSI/SDI A250.8.
- C. Hollow Metal Doors:
  - 1. Exterior Doors: Provide optional weep-hole openings in bottom of exterior doors to permit moisture to escape where specified.
  - 2. Glazed Lites: Factory cut openings in doors with applied trim or kits to fit. Factory install glazing where indicated.
  - 3. Astragals: Provide overlapping astragals as noted in door hardware sets in Division 08 Section "Door Hardware" 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.
  - 4. Continuous Hinge Reinforcement: Provide welded continuous 12 gauge strap for continuous hinges specified in hardware sets in Division 08 Section "Door Hardware".
  - 5. Electrical Raceways: Provide hollow metal doors to receive electrified hardware with concealed wiring harness and standardized Molex™ plug connectors on both ends to accommodate up to twelve wires. Coordinate connectors on end of the wiring harness to plug directly into the electrified hardware and the through-wire transfer hardware or wiring harness specified in hardware sets in Division 08 Sections "Door Hardware" and "Access Control Hardware". Wire nut connections are not acceptable.
- D. Hollow Metal Frames:
  - 1. Shipping Limitations: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
  - 2. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.
    - a. Welded frames are to be provided with two steel spreaders temporarily attached to the bottom of both jambs to serve as a brace during shipping and handling. Spreader bars are for bracing only and are not to be used to size the frame opening.
  - 3. Sidelight 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 butt welding.

4. Continuous Hinge Reinforcement: Provide welded continuous 12 gauge straps for continuous hinges specified in hardware sets in Division 08 Section "Door Hardware".
5. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated for removable stops, provide security screws at exterior locations.
6. Mortar Guards: Provide guard boxes at back of hardware mortises in frames at all hinges and strike preps regardless of grouting requirements.
7. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
8. Jamb Anchors: Provide number and spacing of anchors as follows:
  - a. Masonry Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
    - 1) Two anchors per jamb up to 60 inches high.
    - 2) Three anchors per jamb from 60 to 90 inches high.
    - 3) Four anchors per jamb from 90 to 120 inches high.
    - 4) Four anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 120 inches high.
9. Stud Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
  - a. Three anchors per jamb up to 60 inches high.
  - b. Four anchors per jamb from 60 to 90 inches high.
  - c. Five anchors per jamb from 90 to 96 inches high.
  - d. Five anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 96 inches high.
  - e. Two anchors per head for frames above 42 inches wide and mounted in metal stud partitions.
10. Door Silencers: Except on weatherstripped or gasketed doors, drill stops to receive door silencers. Silencers to be supplied by frame manufacturer regardless if specified in Division 08 Section "Door Hardware".
11. Bituminous Coating: Where frames are fully grouted with an approved Portland Cement based grout or mortar, coat inside of frame throat with a water based bituminous or asphaltic emulsion coating to a minimum thickness of 3 mils DFT, tested in accordance with UL 10C and applied to the frame under a 3rd party independent follow-up service procedure.

- E. Hardware Preparation: Factory prepare hollow metal work to receive template mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to the Door Hardware Schedule and templates furnished as specified in Division 08 Section "Door Hardware."
1. Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8.
  2. Reinforce doors and frames to receive non-template, mortised and surface mounted door hardware.
  3. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.
  4. Coordinate locations of conduit and wiring boxes for electrical connections with Division 26 Sections.

## 2.9 FINISH MATERIALS

- A. Primer: Rust-inhibiting, complying with ANSI A250.10, door manufacturer's standard.
- B. Color-Coated Finish: Apply manufacturer's standard powder coating finish system complying with AAMA 2603 applied to factory-assembled frames before shipping, complying with manufacturer's written instructions for surface preparation including pretreatment, application, and minimum dry film thickness.
  1. Color and Gloss: As selected by Architect from manufacturer's full range

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that opening sizes and tolerances are acceptable.
- C. Verify that finished walls are in plane to ensure proper door alignment.

### 3.2 PREPARATION

- A. Remove welded in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.
- B. Prior to installation, adjust and securely brace welded hollow metal frames for square, level, twist, and plumb condition.
- C. Tolerances shall comply with SDI-117 "Manufacturing Tolerances Standard Steel Doors and Frames."
- D. Drill and tap doors and frames to receive non-template, mortised, and surface-mounted door hardware.

### 3.3 INSTALLATION

- A. Install doors and frames in accordance with manufacturer's instructions and related requirements of specified door and frame standards and NAAMM HMMA 840.
- B. Install fire rated units in accordance with NFPA 80.
- C. Coordinate frame anchor placement with wall construction.
  - 1. Set frames accurately in position, plumbed, leveled, aligned, and braced securely until permanent anchors are set. After wall construction is complete and frames properly set and secured, remove temporary braces, leaving surfaces smooth and undamaged. Shim as necessary to comply with installation tolerances.
  - 2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with post-installed expansion anchors.
  - 3. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with mortar.
  - 4. Grout Requirements: Do not grout head of frames unless reinforcing has been installed in head of frame. Do not grout vertical or horizontal closed mullion members.
- D. Coordinate and install door hardware as specified in Section 08 71 00.
- E. Field Glazing: Comply with installation requirements in Section 08 80 00 - Glazing and with hollow metal manufacturer's written instructions.
- F. Coordinate installation of electrical connections to electrical hardware items.
- G. Touch up damaged factory finishes to like new condition.

### 3.4 TOLERANCES

- A. Clearances between Door and Frame: As specified in ANSI A250.8-SDI-100.
- B. Maximum Diagonal Distortion: 1/16 inch measured with straight edge, corner to corner.

### 3.5 ADJUSTING

- A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow metal work that is warped, bowed, or otherwise unacceptable.
- B. Remove grout and other bonding material from hollow metal work immediately after installation.
- C. Prime-Coat and Painted Finish Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat, or painted finishes, and apply touchup of compatible air drying, rust-inhibitive primer, zinc rich primer (exterior and galvanized openings) or finish paint.

### 3.6 SCHEDEULE

A. Refer to Door and Frame Schedule on the drawings.

END OF SECTION

## SECTION 08 14 16 - FLUSH WOOD DOORS

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Flush wood doors; flush and flush glazed configuration; fire-rated, non-rated, acoustical, and special function.

#### 1.2 RELATED REQUIREMENTS

- A. Section 06 20 00 - Finish Carpentry: Wood door frames.
- B. Section 08 11 13 - Hollow Metal Doors and Frames.
- C. Section 08 71 00 - Door Hardware.
- D. Section 08 80 00 - Glazing.
- E. Section 09 91 23 - Interior Painting: Field finishing of doors.
- F. Section 09 93 00 - Staining and Transparent Finishing: Field finishing of doors.

#### 1.3 REFERENCE STANDARDS

- A. ANSI A135.4 - Basic Hardboard 2012 (R2020).
- B. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass 2018.
- C. ASTM C1172 - Standard Specification for Laminated Architectural Flat Glass 2019.
- D. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition 2014, with Errata (2016).
- E. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies Current Edition, Including All Revisions.

#### 1.4 SUBMITTALS

- A. See Section 01 33 00 for submittal procedures.
- B. Product Data: Indicate door core materials and construction; veneer species, type and characteristics.
- C. Shop Drawings: Show doors and frames, elevations, sizes, types, swings, undercuts, beveling, blocking for hardware, factory machining, factory finishing, cutouts for glazing and other details.
  - 1. Provide information as required by AWI/AWMAC/WI (AWS).
- D. Certificate: Submit labels and certificates required by quality assurance and quality control programs.
- E. Manufacturer's Installation Instructions: Indicate special installation instructions.
- F. Warranty, executed in Owner's name.

## 1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section, with not less than three years of documented experience.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Package, deliver and store doors in accordance with specified quality standard.
- B. Accept doors on site in manufacturer's packaging, and inspect for damage.
- C. Protect doors with resilient packaging sealed with heat shrunk plastic; do not store in damp or wet areas or areas where sunlight might bleach veneer; seal top and bottom edges with tinted sealer if stored more than one week, and break seal on site to permit ventilation.

## 1.7 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.
- B. Interior Doors: Provide manufacturer's warranty for the life of the installation.
- C. Include coverage for delamination of veneer, warping beyond specified installation tolerances, defective materials, and telegraphing core construction.

# PART 2 PRODUCTS

## 2.1 DOORS AND PANELS

- A. Doors: See drawings for locations and additional requirements.
  - 1. Quality Standard: Custom Grade, Standard Duty performance, in accordance with AWI/AWMAC/WI (AWS), unless noted otherwise.
- B. Interior Doors: 1-3/8 inches thick unless otherwise indicated; solid core, flush or embossed construction as indicated.
  - 1. Fire Rated Doors: Tested to ratings indicated on drawings in accordance with UL 10C - Positive Pressure; Underwriters Laboratories Inc (UL) or Intertek/Warnock Hersey (WHI) labeled without any visible seals when door is open.
  - 2. Wood veneer facing for field transparent finish as indicated on drawings.
  - 3. Hardboard facing with factory opaque finish as indicated on drawings.

## 2.2 DOOR AND PANEL CORES

- A. Non-Rated Solid Core and 20 Minute Rated Doors: Type particleboard core (PC), plies and faces as indicated.

- B. Fire-Rated Doors: Mineral core type, with fire resistant composite core (FD), plies and faces as indicated above; with core blocking as required to provide adequate anchorage of hardware without through-bolting.

## 2.3 DOOR FACINGS

- A. Veneer Facing for Transparent Finish: Natural birch, veneer grade in accordance with quality standard indicated, plain sliced (flat cut), with book match between leaves of veneer, running match of spliced veneer leaves assembled on door or panel face.
1. Vertical Edges: Same species as face veneer.
- B. Hardboard Facing for Opaque Finish: ANSI A135.4, Class 1 - Tempered, S2S (smooth two sides) hardboard, 1/8 inch thick.
- C. Facing Adhesive: Type I - waterproof.

## 2.4 DOOR CONSTRUCTION

- A. Fabricate doors in accordance with door quality standard specified.
- B. Cores Constructed with stiles and rails:
1. Provide solid blocks at lock edge for hardware reinforcement.
  2. Provide solid blocking for other throughbolted hardware.
- C. Glazed Openings: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings.
- D. Factory machine doors for hardware other than surface-mounted hardware, in accordance with hardware requirements and dimensions.
- E. Factory fit doors for frame opening dimensions identified on shop drawings, with edge clearances in accordance with specified quality standard.
1. Exception: Doors to be field finished.
- F. Provide edge clearances in accordance with the quality standard specified.

## 2.5 ACCESSORIES

- A. Wood Door Frames: See Section 06 20 00.
- B. Hollow Metal Door Frames: See Section 08 11 13.
- C. Wood Louvers:
1. Material and Finish: to match door facing
  2. Louver Blade: Stock louver.

3. Louver Free Area: 50 percent.
- D. Glazed Openings:
  1. Heat-Strengthened and Fully Tempered Glass: ASTM C1048.
  2. Laminated Glass: Float glass laminated in accordance with ASTM C1172. Translucent
- E. Glazing Stops: Wood, of same species as door facing, butted corners; prepared for countersink style tamper proof screws.
- F. Door Hardware: See Section 08 71 00.

### PART 3 EXECUTION

#### 3.1 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that opening sizes and tolerances are acceptable.
- C. Do not install doors in frame openings that are not plumb or are out-of-tolerance for size or alignment.

#### 3.2 INSTALLATION

- A. Install doors in accordance with manufacturer's instructions and specified quality standard.
- B. Field-Finished Doors: Trimming to fit is acceptable.
  1. Adjust width of non-rated doors by cutting equally on both jamb edges.
  2. Trim maximum of 3/4 inch off bottom edges.
  3. Trim fire-rated doors in strict compliance with fire rating limitations.
- C. Use machine tools to cut or drill for hardware.
- D. Coordinate installation of doors with installation of frames and hardware.
- E. Coordinate installation of glazing.
- F. Install door louvers plumb and level.

#### 3.3 TOLERANCES

- A. Comply with specified quality standard for fit and clearance tolerances.
- B. Comply with specified quality standard for telegraphing, warp, and squareness.

#### 3.4 ADJUSTING

- A. Adjust doors for smooth and balanced door movement.

B. Adjust closers for full closure.

### 3.5 SCHEDULE

A. Refer to Unit Door and Frame Schedule on the Drawings.

END OF SECTION

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## SECTION 08 31 00 - ACCESS DOORS AND PANELS

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Wall access door and frame units.
- B. Ceiling access door and frame units.

#### 1.2 RELATED REQUIREMENTS

- A. Section 08 71 00 - Door Hardware: Keyed cylinders.
- B. Section 09 21 16 - Gypsum Wallboard Assemblies.
- C. Section 09 90 00 - Paints and Coatings: Field paint finish.
- D. Divisions 21, 22, 23, 26, 27, and 28: Coordination of access panel locations.

#### 1.3 REFERENCE STANDARDS

- A. ASTM International: ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
- B. National Fire Protection Association: NFPA 80 - Standard for Fire Doors, Fire Windows.
- C. ITS (DIR) - Directory of Listed Products; Intertek Testing Services NA, Inc.; current edition.
- D. UL (FRD) - Fire Resistance Directory; Underwriters Laboratories Inc.; current edition.

#### 1.4 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures, for submittal procedures.
- B. Product Data: Provide sizes, types, finishes, hardware, scheduled locations, and details of adjoining work.
- C. Shop Drawings: Indicate exact position of all access door units. Include complete schedule indicating types, general locations, sizes, wall and ceiling construction details, latching and locking provisions, and other pertinent data.
- D. Sample: Submit full size for each type of access door and panel.
- E. Manufacturer's Installation Instructions: Indicate installation requirements.
- F. Project Record Documents: Record actual locations of all access units.

#### 1.5 QUALITY ASSURANCE

- A. Fire Resistance Ratings: Where indicated as fire rated provide assemblies from manufacturers listed in UL Directory or Intertek Testing Services (Warnock Hersey Listed) Directory.

- B. Fire Rated Horizontal Access Doors: Rating of ceiling or flooring as indicated on Drawings.
  - 1. Tested Rating: Determined in accordance with ASTM E119.
- C. Attach label from agency approved by authority having jurisdiction to identify each fire rated access door.

## 1.6 COORDINATION

- A. Coordinate Work with work requiring controls, mechanical VRF units, valves, traps, dampers, cleanouts, and similar items requiring operation being located behind finished surfaces.

# PART 2 PRODUCTS

## 2.1 ACCESS DOOR AND PANEL APPLICATIONS

- A. Public Area and Unit Walls and Ceilings:
  - 1. Concealed, fully hinged gypsum wallboard access panel.
  - 2. Size as indicated.
  - 3. Aluminum frame and glass fiber reinforced nylon hardware;
  - 4. Glass Fiber reinforced gypsum access panel.
  - 5. Key operated cam lock.
- B. Walls and Ceilings, in garage and maintenance space areas unless otherwise indicated:
  - 1. Glass Fiber reinforced gypsum access panel; Basis of Design - IntexForms, Inc or approved equal.
  - 2. Size: 12 x 12 inches minimum, unless otherwise indicated.
  - 3. Standard duty, hinged door, rectangular with radius corner at walls; oval, lift and shift style at ceilings.
  - 4. Tool-operated spring or cam lock with key operation; no handle.
  - 5. In Masonry: Surface mounted frame with door surface flush with frame surface.
- C. Fire Rated Walls: See drawings for wall fire ratings.
  - 1. Acceptable manufacturer: Acudor, model FW-5015 or approve equal.
  - 2. 90 minute fire rating per UL 10(b).
  - 3. Recessed steel frame and door, 22 gauge; Door fitted with 5/8 inch fire-rated drywall.
  - 4. Size: 12 x 12 inches, unless otherwise indicated.
  - 5. Insulated, double skin door panel.

6. Self-closing and self-latching door mechanism; tool-operated spring or cam lock, with key operation; no handle.

## 2.2 WALL AND CEILING UNITS

### A. Glass Fiber Reinforced Gypsum Access Doors :

1. Description: Glass fiber reinforced gypsum door, 5/8 inch deep for ceiling access.
2. Basis of Design: IntexForms Inc or approved equal.
3. Locations: Wall and ceiling in garage and maintenance space areas unless otherwise indicated.
4. Provide sizes as noted and/or indicated, minimum of 12 by 12 inches;
5. Material: Recycled glass and high density gypsum cement plaster.
6. Finish: Natural white.
7. Door: Radius Corner drop in or Radius corner hinged with cam latch, key operated.
8. Options: Neoprene gasket.

### B. Concealed Units: Basis of Design is Bauco-Plus II concealed hardware access panel for gypsum wall board locations.

1. Provide sizes as noted and/or indicated, minimum of 12 by 12 inches;
2. Aluminum extrusion frame and door with gypsum board installed, no corrosive hardware, safety devices, installation kit & bracing where needed.
3. Keyed cam lock for VRF units, Torx Cam latch for all other locations.

### C. Fire rated Access Doors: Factory fabricated door and frame units, fully assembled units with corner joints welded, filled, and ground flush; square and without rack or warp; coordinate requirements with assemblies units are to be installed in.

1. Manufacturers:
  - a. Acudor Products Inc: [www.acudor.com](http://www.acudor.com).
  - b. Babcock-Davis: [www.babcockdavis.com](http://www.babcockdavis.com).
  - c. Karp Associates, Inc: [www.karpinc.com](http://www.karpinc.com).
  - d. Milcor by Commercial Products Group of Hart & Cooley, Inc: [www.milcorinc.com](http://www.milcorinc.com).
2. Style: As indicated.
3. Recessed frame with fire rated door.

4. Frames: 22 gauge, minimum.
5. Flush door, 22 gauge; Door fitted with 5/8 inch fire-rated drywall.
6. Door Panels to Receive Wall/Ceiling Finish: Surface recessed 0.625 inch back from wall face.
7. Units in Fire Rated Assemblies: Fire rating as required by applicable code for the fire rated assembly in which they are to be installed.
  - a. Provide certificate of compliance from authority having jurisdiction indicating approval of fire rated doors.
8. Steel Finish: Primed.
9. Primed Finish: Polyester powder coat; manufacturer's standard color.
10. Size(s): As indicated.
11. Hardware:
  - a. Hardware for Fire Rated Units: As required for listing.
  - b. Locking Devices: Provide flush, screwdriver-operated cam locks of number required to hold door in flush, smooth plane when closed.

### PART 3 EXECUTION

#### 3.1 EXAMINATION

- A. Verify that rough openings are correctly sized and located.

#### 3.2 INSTALLATION

- A. Install units in accordance with manufacturer's instructions.
- B. Install frames plumb and level in openings. Secure rigidly in place.
- C. Set concealed frame type units flush with adjacent finished surfaces.
- D. Position units to provide convenient access to the concealed work requiring access.
- E. Install fire rated units in accordance with NFPA 80 and requirements for fire listing.

END OF SECTION

## SECTION 08 32 00 - SLIDING GLASS DOORS

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Factory fabricated sliding glazed barn door panels with operating hardware.

#### 1.2 RELATED REQUIREMENTS

- A. Section 08 71 00 - Door Hardware.
- B. Section 08 80 00 - Glazing: Product and execution requirements for glass type and installation.

#### 1.3 REFERENCE STANDARDS

#### 1.4 SUBMITTALS

- A. See Section 01 33 00, for submittal procedures.
- B. Product Data: Provide component dimensions.
- C. Shop Drawings: Indicate opening dimensions, elevations of different types, and framed opening tolerances.
- D. Manufacturer's Installation Instructions: Include complete preparation, installation, and cleaning requirements.
- E. Manufacturer's Qualification Statement.

#### 1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to project site and store in manufacturer's protective cartons until openings are ready for door installation.
- B. Protect finished surfaces with wrapping paper or strippable coating during installation. Do not use adhesive papers or sprayed coatings that bond to substrate when exposed to sunlight or weather.

#### 1.7 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective work within a two year period after Date of Substantial Completion.

## PART 2 PRODUCTS

### 2.1 SLIDING GLASS DOORS

- A. Interior Sliding Door Systems: Aluminum cased frame with receiving channel, adjustable top track assembly along with carriage assemblies; provide frames with integral double seal full gasketing; provide factory prepped locks and other related components in frame system.
  - 1. Configuration: As indicated on drawings.
  - 2. Finish: Powder coat paint finish.
  - 3. Color: As selected by Architect from manufacturer's standard colors.
  - 4. Door Type: As indicated on drawings.
  - 5. Door Thickness: 1-3/4 inches.
  - 6. Wall Thickness: 4-7/8 inches.
  - 7. Weight Rating: Door carriage assembly rated for 220 pounds or greater.
- B. Construction: Factory assemble door frame as one unit, including head jambs, and sill; factory assemble operating and fixed panels.
  - 1. Sizes: Allow for tolerances of rough framed openings, clearances, and shims around perimeter of assemblies.
  - 2. Joints and Connections: Flush, hairline width, and waterproof; accurately and rigidly joined corners.
  - 3. Sills: One piece, sloped to drain, with integral roller track.

### 2.2 COMPONENTS

- A. Glass and Glazing Materials: See Section 08 80 00.

### 2.3 ASSEMBLY

- A. Factory assemble door frame as one unit, including head, jambs, and sill; factory assemble operating and fixed panels.
- B. Sizes: Allow for tolerances of rough framed openings, clearances, and shims around perimeter of assemblies.
- C. Joints and Connections: Flush, hairline width, and waterproof; accurately and rigidly joined corners.
- D. Sills: One piece, sloped to drain, with integral roller track.

## 2.4 ACCESSORIES

- A. Pull Handles: Manufacturer's standard type.
- B. Sliding Panel Bottom Rollers: Stainless steel, adjustable from interior.
- C. Limit Stops: Resilient rubber.
- D. Anchors: Hot-dipped galvanized or stainless steel.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify that openings are ready to receive work and opening dimensions and clearances are as indicated on shop drawings.

### 3.2 INSTALLATION

- A. Install sliding glass door units in accordance with manufacturer's instructions.
- B. Attach frame and shims to perimeter opening to accommodate construction tolerances and other irregularities.
- C. Use anchorage devices to securely fasten sliding door assembly to wall construction without distortion or imposed stresses.
- D. Install perimeter trim.

### 3.3 TOLERANCES

- A. Maintain dimensional tolerances and alignment with adjacent work.
- B. Maximum Variation from Plumb: 1/16 inch.
- C. Maximum Variation from Level: 1/16 inch.
- D. Longitudinal or Diagonal Warp: Plus or minus 1/8 inch from 10 feet straight edge.

### 3.4 ADJUSTING

- A. Adjust hardware for smooth operation.

### 3.5 CLEANING

- A. Remove protective material from factory finished surfaces.
- B. Remove labels and visible markings.
- C. Wash surfaces by method recommended and acceptable to sealant and sliding glass door manufacturer; rinse and wipe surfaces clean.

- D. Remove excess sealant by moderate use of mineral spirits or other solvent acceptable to sealant manufacturer.

### 3.6 PROTECTION

- A. Protect installed products from damage until Date of Substantial Completion.

END OF SECTION

## SECTION 08 32 23 - SLIDING AND FOLDING GLAZED WALLS AND DOORS

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Glazed aluminum sliding wall panel systems, top supported.
- B. Support and operating hardware.

#### 1.2 REFERENCE STANDARDS

- A. AAMA 609 & 610 - Cleaning and Maintenance Guide for Architecturally Finished Aluminum (Combined Document) 2015.
- B. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix) 2017a.
- C. ASTM C864 - Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers 2005 (Reapproved 2019).
- D. ASTM D1187/D1187M - Standard Specification for Asphalt-Base Emulsions for Use as Protective Coatings for Metal 1997 (Reapproved 2018).
- E. ASTM E2112 - Standard Practice for Installation of Exterior Windows, Doors and Skylights 2019c.
- F. NFRC 100 - Procedure for Determining Fenestration Product U-factors 2017.
- G. NFRC 200 - Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence 2014, with Errata (2017).

#### 1.3 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures, for submittal procedures.
- B. Product Data: Provide information on dimensions, frame and sill construction, glazing, hardware, and storage and handling requirements.
- C. Shop Drawings: Indicate opening dimensions, elevations of different types, and framed opening tolerances.
- D. Manufacturer's Installation Instructions: Include complete preparation, installation, and cleaning requirements.
- E. Manufacturer's Certificates: Certify products meet or exceed specified requirements.
- F. Manufacturer's qualification statement.
- G. Installer's qualification statement.

- H. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

#### 1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with not less than three years of documented experience.
- B. Installer Qualifications: Company specializing in installation of products of type specified, with not less than three years of documented experience.

#### 1.5 SEQUENCING

- A. Ensure that locating templates and other information required for installation of products of this section are furnished to affected trades in time to prevent interruption of construction progress.
- B. Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to project site and store in manufacturer's protective cartons until openings are ready for installation.
- B. Protect finished surfaces with wrapping paper or strippable coating during installation. Do not use adhesive papers or sprayed coatings that bond to substrate when exposed to sunlight or weather.

#### 1.7 FIELD CONDITIONS

- A. Do not install sealants when ambient temperature is less than 40 degrees F.

#### 1.8 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.
- B. Correct defective Work within a ten year period after Date of Substantial Completion.
- C. Provide ten year manufacturer warranty against failure of glass seal on insulating glass units, including interpane dusting or misting. Include provision for replacement of failed units.
- D. Provide ten year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking.

### PART 2 PRODUCTS

#### 2.1 BASIS OF DESIGN - ALUMINUM PANEL FRAME

- A. Floor Mounted; Tested for Air, Water, and Wind Load Performance; Thermally Broken, with Insulating Glazing:

1. Concealed hinges/pivots
2. Independent sliding panels, with interlock system when closed; slide and pivot to open
3. Narrow 3 inch frame
4. Upstand track, 3/4 inch high.
5. Inswing operation.
6. Basis of Design: SunFlex SF55, Outswing Insulated Aluminum System

## 2.2 DESIGN CRITERIA - EXTERIOR SYSTEMS

- A. Comply with requirements for contractor's design-related professional design services indicated in Section 01 40 00 - Quality Requirements.
- B. Structural Design Criteria Based on Regulatory Requirements: Comply with applicable code criteria for loads, including seismic loads, except as indicated below.
- C. Structural Design Criteria: As indicated on drawings.

## 2.3 SLIDING AND FOLDING GLAZED DOORS AND WALLS

- A. Glazed Aluminum Sliding Wall Panel Systems: Extruded aluminum sliding wall panel frames, factory fabricated; complete with sill, flashings, and support and anchorage devices.
  1. Support System: Floor mounted.
  2. Weather Performance Sill: Ramp type to meet ADA requirements, with sealant, shims and fasteners at necessary locations.
    - a. Finish: To match the panel frame.
    - b. Provide weep holes in sill and drain connections to exterior in accordance with manufacturer's requirements for weather performance indicated.
  3. Panel: Thermally broken, extruded aluminum stile and rail panels with standard one lite.
    - a. Thickness 2-1/4 inches (57 mm).
    - b. Stile and Rail 2-15/16 inches (75 mm).
    - c. Bottom Rail 2-15/16 inches (75 mm).
  4. Aluminum Frames: Factory finished; manufacturer's standard corner construction; thermally broken.
  5. Drainage: Provide drainage to exterior for moisture entering joints and glazing spaces and for condensation occurring within frame construction.

6. Glass Stops: Same material and color as frame.
  7. Aluminum Frame Finish: PVDF coating in accordance with AAMA 2605.
- B. Glazing: Triple glazed, Low-E coated, argon filled, fully tempered, with glass thickness 1/4 inch, for unit total of 1-1/4 inch overall thickness.
1. Unit U-Factor: In compliance with glazing requirements indicated; NFRC 100.
  2. Solar Heat Gain Coefficient (SHGC): In compliance with glazing requirements indicated; NFRC 200.
  3. Setting Blocks: Manufacturer's standard type; complying with ASTM C864.
  4. Glazing: Silicone bedding on exterior surfaces and glazing seal on the interior of the panel.
- C. Sliding Wall Panel Hardware: Manufacturer's standard hardware including carriages with sealed ball bearing rollers, and top or bottom tracks.
1. Door Hardware: Pull handle.
  2. Locking Mechanisms: Minimum two-point deadbolt locking of each panel; manufacturer's standard type; a Schlage compatible lockset multi-point locking with dead bolt and concealed locking rods at the top and bottom of the door panel. Locking rods and mechanism shall not be edge or surface mounted.
  3. Folding Hardware: Manufacturer's standard folding hardware integrated with engineered head track, side jambs and threshold frame system. Hardware systems carrying capacity is a minimum of 220 lbs (99.79 Kg) per panel.
    - a. System operates with an upper wheel carrier that rolls on the aluminum head track. Lower track is incorporated into the threshold to guide door panels. Upper carrier and lower guide attached to door panel hinges. Jamb panels attached with top and bottom pivots. Provide handles to open and close door. Carrier pins at top pivots, and intermediate and end carriers support the full door weight and provides panel adjustment. Provide a pin locking system to lock vertical adjustment once heights are set. Pivots at jamb allow screwdriver adjustment of the system horizontally up to 3/8 inch (10 mm). All screws fully concealed for external security. Architectural grade stainless steel used for hinge pins, carrier pins and carrier bogeys.
  4. Wall Pivots: Provide wall pivots for jamb side pivot panels for taller doors or high-wind environments.
  5. Door Stops: Provide magnetic door stops for main entry swing panels and for stacking of folding panels.
  6. Exposed Hardware Finish: As selected from manufacturer's standard line.
- D. Weatherstripping: Manufacturer's standard, continuous and replaceable; provide between exterior doors, panels, frame and track.

## 2.4 FACTORY ASSEMBLY

- A. Factory assemble sliding/folding operable panel frames as single unit, including head, jambs, and bottom sections; provide concealed fasteners.
1. Sizes: Allow for tolerances of rough framed openings, clearances, and shims at perimeter of assemblies. Fabricate to sizes and configurations indicated on the Drawings. Verify opening sizes by field measurement prior to completing fabrication.
2. Joints and Corners: Flush, hairline and waterproof, accurately fitted and secured; prepared to receive anchors; fasteners and attachments concealed from view; reinforced as required for imposed loads.
3. Fabricate with manufacturer's non-integral nail fin for use in conjunction with standard flashing, weather resistant barriers and compatible sealants.
4. Glazing: Factory installed.

## 2.5 ACCESSORIES

- A. Anchors: Hot-dipped galvanized or stainless steel in accordance with project and manufacturer's installation requirements.
- B. Sealant for Setting Sills and End Dams: Elastomeric sealant acceptable to door manufacturer.
- C. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M, Type I.

# PART 3 EXECUTION

## 3.1 EXAMINATION

- A. Verify that openings are ready to receive work and opening dimensions and clearances are as indicated on approved shop drawings.
- B. Verify that the maximum deflection of the header with the live load does not exceed the lesser of L/720 of the span and 1/4 inch. Structural support for lateral loads including both wind load and when the panels are stacked open) must be provided.

## 3.2 PREPARATION

- A. Prepare opening to permit correct installation of door unit in coordination with air and vapor seal.
- B. Apply two coats of bituminous paint with minimum of 16 mils, 0.016 inch dry film thickness (DFT), or as recommended by coating manufacturer, on concealed aluminum surfaces in contact with cementitious or dissimilar materials.
  1. Allow bituminous paint to dry prior to installation of aluminum component.
  2. Dipping of aluminum into bituminous paint is not permitted.

### 3.3 INSTALLATION

- A. Install assemblies in accordance with manufacturer's instructions.
- B. Install exterior doors in accordance with ASTM E2112.
- C. Attach frame and shims to perimeter opening to accommodate construction tolerances and other irregularities.
- D. Use anchorage devices to securely fasten assembly to adjacent construction without distortion or imposed stresses. Securely fit frame in place, level, straight, plumb and square. Install frame in proper elevation, plane and location, and in proper alignment with other work. Install head section of frame with a 1/8 inch upward crown at the center of the opening.
- E. Set exterior sills in full bed of sealant, with end dams and non-blocking sill drainage openings.
- F. Install shims at exterior wall sill locations and ensure water dams are not created and sill weep openings are not blocked due to shim placement and orientation.
- G. Install perimeter trim and interior closures.

### 3.4 TOLERANCES

- A. Maintain dimensional tolerances and alignment with adjacent work.
- B. Maximum Variation from Plumb: 1/16 inch.
- C. Maximum Variation from Level: 1/16 inch.
- D. Longitudinal or Diagonal Warp: Plus or minus 1/8 inch from 10 feet straight edge.
- E. Gaps between folding panels that accommodate weather stripping and hinges to be 3/16 inch or less when panels are closed.

### 3.5 ADJUSTING

- A. Adjust doors and hardware for smooth operation.

### 3.6 CLEANING

- A. Comply with requirements of Section 01 74 19 - Construction Waste Management and Disposal
- B. Remove protective material from factory finished surfaces.
- C. Remove labels and visible markings.
- D. Wash surfaces by method recommended and acceptable to sealant and window manufacturer; rinse and wipe surfaces clean.
- E. Upon completion of installation, thoroughly clean door aluminum surfaces in accordance with AAMA 609 & 610.

- F. Remove excess sealant by moderate use of mineral spirits or other solvent acceptable to sealant manufacturer.

### 3.7 PROTECTION

- A. Protect installed products in particular the thresholds adn floor channels from damage until Date of Substantial Completion.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

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## SECTION 08 33 23 - OVERHEAD COILING DOORS

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Fire-rated coiling doors.
- B. Electric operators and control stations.
- C. Overhead coiling doors, operating hardware, exterior; electrically operated.
- D. Wiring from electric circuit disconnect to operators and control stations.

#### 1.2 RELATED REQUIREMENTS

- A. Section 26 05 33.13 - Conduit for Electrical Systems: Conduit from electric circuit to operator and from operator to control station.
- B. Section 26 05 83 - Wiring Connections: Power to disconnect.
- C. Section 28 46 00 - Fire Detection and Alarm: Fire alarm interconnection.

#### 1.3 REFERENCE STANDARDS

- A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel 2019.
- B. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products 2017.
- C. ITS (DIR) - Directory of Listed Products current edition.
- D. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum) 2020.
- E. NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts 2000, with Errata (2008).
- F. NEMA MG 1 - Motors and Generators 2018.
- G. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- H. NFPA 80 - Standard for Fire Doors and Other Opening Protectives 2019.
- I. UL (DIR) - Online Certifications Directory Current Edition.
- J. UL 325 - Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems Current Edition, Including All Revisions.

#### 1.4 SUBMITTALS

- A. See Section 01 33 00 for general submittal procedures.
- B. Product Data: Provide general construction, electrical equipment, and component connections and details.
- C. Shop Drawings: Indicate pertinent dimensioning, anchorage methods, hardware locations, and installation details.
- D. Manufacturer's Installation Instructions: Indicate installation sequence and procedures, adjustment and alignment procedures.
- E. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

#### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing work of type specified and with at least three years documented experience.
- B. Products Requiring Electrical Connection: Listed and classified by UL (DIR) or testing firm acceptable to authorities having jurisdiction as suitable for purpose specified.

#### 1.6 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Provide five year manufacturer limited warranty for mechanical components, including motor assembly.

### PART 2 PRODUCTS

#### 2.1 MANUFACTURERS

- A. Overhead Coiling Fire Doors:
  - 1. C.H.I. Overhead Fire Doors; Model 7301: [www.chiohd.com/#sle](http://www.chiohd.com/#sle).
  - 2. The Cookson Company: [www.cooksondoor.com/#sle](http://www.cooksondoor.com/#sle).
- B. Overhead Exterior High-Speed Coiling Metal Doors:
  - 1. Rytec Corporation; Spiral: [www.rytecdoors.com/#sle](http://www.rytecdoors.com/#sle).

#### 2.2 COILING DOORS

- A. Exterior Coiling Doors: Aluminum slat curtain.
  - 1. Capable of withstanding positive and negative wind loads of 20 psf without undue deflection or damage to components.

2. Sandwich slat construction with insulated core of foamed-in-place polyurethane insulation; minimum R-value of 8.1. Double-walled construction with reinforced hinge system and integral weatherseal between slats, designed to allow removal of individual slats without removal of the entire curtain.
  3. Nominal Slat Size: 6 inches wide by required length.
  4. Finish: Anodized, color as selected.
  5. Guide, Angles: Galvanized steel.
  6. Hood Enclosure: Manufacturer's standard; primed steel.
  7. Electric operation.
  8. Mounting: Surface mounted.
- B. Fire-Rated Coiling Doors: Steel slat curtain; comply with NFPA 80.
1. 1-1/2 hour fire rating.
  2. Provide products listed and labeled by UL (DIR) as suitable for purpose specified and indicated on drawings.
  3. Oversized Openings: Provide certificate of compliance from authorities having jurisdiction indicating approval of fire rated units and operating hardware assembly.
  4. Nominal Slat Size: 2-1/2 inches wide by required length.
  5. Finish: [\_\_\_\_\_].
  6. Guides, Angles: Primed steel.
  7. Hood Enclosure: Manufacturer's standard; primed steel.
  8. Coiling Door Release Mechanism: Fire alarm system activated with automatically governed closing speed.
  9. Manual hand chain lift operation.
  10. Mounting: Surface mounted.
  11. Locking Devices: Lock and latch handle on outside.

### 2.3 MATERIALS AND COMPONENTS

- A. Metal Curtain Construction: Interlocking slats.
1. Slat Ends: Alternate slats fitted with end locks to act as wearing surface in guides and to prevent lateral movement.

2. Curtain Bottom for Slat Curtains: Fitted with angles to provide reinforcement and positive contact in closed position.
  3. Weatherstripping for Exterior Doors: Moisture and rot proof, resilient type, located at jamb edges, bottom of curtain, and where curtain enters hood enclosure of exterior doors
- B. Guide Construction: Continuous, of profile to retain door in place with snap-on trim, mounting brackets of same metal.
- C. Guides - Angle: ASTM A36/A36M metal angles, size as indicated.
1. Hot-dip galvanized in compliance with ASTM A123/A123M.
  2. Prime painted.
- D. Hood Enclosure and Trim: Internally reinforced to maintain rigidity and shape.
1. Minimum thickness; 24 gauge.
  2. Prime painted.
- E. Lock Hardware:
1. For motor operated units, additional lock or latching mechanisms are not required.
  2. Latching Mechanism: Inside mounted, adjustable keeper, spring activated latch bar feature to keep in locked or retracted position.
  3. Latch Handle: Manufacturer's standard.
  4. Manual Chain Lift: Provide padlockable chain keeper on guide.
- F. Roller Shaft Counterbalance: Steel pipe and helical steel spring system, capable of producing torque sufficient to ensure smooth operation of curtain from any position and capable of holding position at mid-travel; with adjustable spring tension; requiring 25 lb nominal force to operate.

## 2.4 ELECTRIC OPERATION

- A. Operator, Controls, Actuators, and Safeties: Comply with UL 325; provide products listed by ITS (DIR), UL (DIR), or testing agency acceptable to authorities having jurisdiction.
1. Provide interlock switches on motor operated units.
- B. Electric Operators:
1. Mounting: Side mounted.
  2. Motor Enclosure:
    - a. Exterior Coiling Doors: NEMA MG 1, Type 4; open drip proof.

3. Motor Rating: 1/3 HP; continuous duty.
  4. Motor Voltage: 120 volts, single phase, 60 Hz.
  5. Motor Controller: NEMA ICS 2, full voltage, reversing magnetic motor starter.
  6. Controller Enclosure: NEMA 250, Type 4.
  7. Opening Speed: 12 inches per second.
  8. Brake: Manufacturer's standard type, activated by motor controller.
  9. Manual override in case of power failure.
  10. See Section 26 05 83 for electrical connections.
- C. Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated; enclose terminal lugs in terminal box sized to comply with NFPA 70.
- D. Control Station: Provide standard three button, 'Open-Close-Stop' momentary-contact control device for each operator complying with UL 325.
1. 24 volt circuit.
  2. Surface mounted, at interior door jamb.
  3. Programmable Inputs and Outputs: Design to accommodate special control applications such as traffic lights, horns, actuation devices, timing sequences, and others).
  4. Display Type: Self-diagnostic scrolling two-line fluorescent.
  5. Door Travel Limit Regulation: Self adjusting, not requiring use of tools.
  6. Entrapment Protection Devices: Provide sensing devices and safety mechanisms complying with UL 325.
    - a. Primary Device: Provide electric sensing edge, wireless sensing, NEMA 1 photo eye sensors, or NEMA 4X photo eye sensors as required with momentary-contact control device.
- E. Safety Edge: Located at bottom of coiling door, full width, electro-mechanical sensitized type, wired to stop and reverse door direction upon striking object, hollow neoprene covered.

### PART 3 EXECUTION

#### 3.1 EXAMINATION

- A. Verify that opening sizes, tolerances and conditions are acceptable.

#### 3.2 INSTALLATION

- A. Install units in accordance with manufacturer's instructions.

- B. Install fire-rated doors in accordance with NFPA 80.
- C. Use anchorage devices to securely fasten assembly to wall construction and building framing without distortion or stress.
- D. Securely and rigidly brace components suspended from structure. Secure guides to structural members only.
- E. Fit and align assembly including hardware; level and plumb, to provide smooth operation.
- F. Coordinate installation of electrical service with Section 26 05 83.
- G. Complete wiring from disconnect to unit components.
- H. Complete wiring from fire alarm system.
- I. Install enclosure and perimeter trim.

### 3.3 TOLERANCES

- A. Maintain dimensional tolerances and alignment with adjacent work.
- B. Maximum Variation From Plumb: 1/16 inch.
- C. Maximum Variation From Level: 1/16 inch.
- D. Longitudinal or Diagonal Warp: Plus or minus 1/8 inch per 10 feet straight edge.

### 3.4 ADJUSTING

- A. Adjust operating assemblies for smooth and noiseless operation.

### 3.5 CLEANING

- A. Clean installed components.
- B. Remove labels and visible markings.

END OF SECTION

## SECTION 08 43 16 - STOREFRONT SYSTEMS

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Aluminum-framed interior storefront systems, with vision glass.
- B. Fire rated interior storefront systems with fire rated glazing systems.
- C. All-glass entrances.
- D. Aluminum doors and frames.

#### 1.2 RELATED REQUIREMENTS

- A. Section 08 51 13 - Aluminum Windows: Operable sash within glazing system.
- B. Section 08 71 00 - Door Hardware: Hardware items other than specified in this section.
- C. Section 08 80 00 - Glazing: Glass and glazing accessories.

#### 1.3 REFERENCE STANDARDS

- A. AAMA CW-10 - Care and Handling of Architectural Aluminum from Shop to Site 2015.
- B. AAMA 503 - Voluntary Specification for Field Testing of Newly Installed Storefronts, Curtain Walls and Sloped Glazing Systems 2014.
- C. AAMA 609 & 610 - Cleaning and Maintenance Guide for Architecturally Finished Aluminum (Combined Document) 2015.
- D. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix) 2017a.
- E. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix) 2017a.
- F. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures Most Recent Edition Cited by Referring Code or Reference Standard.
- G. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable 2021a.
- H. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate 2014.
- I. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric) 2014.

- J. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes 2021.
- K. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric) 2021.
- L. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference 2014 (Reapproved 2021).
- M. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference 2000 (Reapproved 2016).
- N. ASTM E783 - Standard Test Method for Field Measurement of Air Leakage Through Installed Exterior Windows and Doors 2002 (Reapproved 2018).
- O. ASTM E1105 - Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform or Cyclic Static Air Pressure Difference 2015.
- P. ASTM E1996 - Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Windborne Debris in Hurricanes 2020.

#### 1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate with installation of other components that comprise the exterior enclosure and interior framing as applicable.
- B. Preinstallation Meeting: Conduct a preinstallation meeting one week before starting work of this section; require attendance by all affected installers.

#### 1.5 SUBMITTALS

- A. See Section 01 33 00 for submittal procedures.
- B. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, glass and infill, door hardware, and internal drainage details.
- C. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related work, expansion and contraction joint location and details, and field welding required.
  - 1. Include design engineer's stamp or seal on shop drawings for attachments and anchors.
- D. Manufacturer's Certificate: Certify that the products supplied meet or exceed the specified requirements.
- E. Design Data: Provide framing member structural and physical characteristics, engineering calculations, and dimensional limitations.
- F. Hardware Schedule: Complete itemization of each item of hardware to be provided for each door, cross-referenced to door identification numbers in Contract Documents.

- G. Field Quality Control Submittals: Report of field testing for water penetration and air leakage.
- H. Designer's Qualification Statement.
- I. Manufacturer's Qualification Statement.
- J. Installer's Qualification Statement.
- K. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

#### 1.6 QUALITY ASSURANCE

- A. Designer Qualifications: Design structural support framing components under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed in the State in which the Project is located.
- B. Manufacturer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.
- C. Installer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Handle products of this section in accordance with AAMA CW-10.
- B. Protect finished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond to aluminum when exposed to sunlight or weather.

#### 1.8 FIELD CONDITIONS

- A. Do not install sealants when ambient temperature is less than 40 degrees F. Maintain this minimum temperature during and 48 hours after installation.

#### 1.9 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective Work within a five year period after Date of Substantial Completion.
- C. Provide five year manufacturer warranty against failure of glass seal on insulating glass units, including interpane dusting or misting. Include provision for replacement of failed units.
- D. Provide five year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking.

## PART 2 PRODUCTS

### 2.1 ALUMINUM-FRAMED STOREFRONT SYSTEM

- A. Aluminum-Framed Storefront: Factory fabricated, factory finished aluminum framing members with infill, anchorage and attachment devices.
1. Glazing Rabbet: For 1 inch insulating glazing.
  2. Basis of Design: YKK YES 60XT. Provide as indicated or approved equal, refer to Section 01 25 00 for submittal and approval procedures for proposed substitutions.
  3. Glazing Position: Front-set.
  4. Doors: Narrow Stile door with pivot hinges and closer standard with the storefront system.
  5. Finish: High performance organic coatings.
    - a. Factory finish all surfaces that will be exposed in completed assemblies.
    - b. Touch-up surfaces cut during fabrication so that no natural aluminum is visible in completed assemblies, including joint edges.
  6. Fabrication: Joints and corners flush, hairline, and weatherproof, accurately fitted and secured; prepared to receive anchors and hardware; fasteners and attachments concealed from view; reinforced as required for imposed loads.
  7. Construction: Eliminate noises caused by wind and thermal movement, prevent vibration harmonics, and prevent "stack effect" in internal spaces.
  8. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
  9. Expansion/Contraction: Provide for expansion and contraction within system components caused by cycling temperature range of 170 degrees F over a 12 hour period without causing detrimental effect to system components, anchorages, and other building elements.
  10. Movement: Allow for movement between storefront and adjacent construction, without damage to components or deterioration of seals.
  11. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.

B. All-Glass Entrance Doors

1. Entrances Doors: Factory fabricated assemblies consisting of frameless glass panels fastened with metal structural fittings in configuration indicated on drawings.
  - a. Exterior Assemblies: Designed to resist the structural designated wind pressures:

- b. Operational Loads: Designed to withstand door operation under normal traffic without damage, racking, sagging, or deflection.
- c. Prepared for all specified hardware whether specified in this section or not.
- d. Finished metal surfaces protected with strippable film.
- e. Factory assembled to greatest extent practicable; may be disassembled to accommodate shipping constraints.
- f. Top and bottom pivots concealed in full width rails top and bottom.
- g. Floor Closer.
- h. Push/pulls: Ladder type push/pull, Stainless steel. .
- i. Deadbolt mounted in bottom rail.
- j. Pairs: Overhead mounted door stop.

C. Performance Requirements:

- 1. Wind Loads: Design and size components to withstand the specified load requirements without damage or permanent set, when tested in accordance with ASTM E330/E330M, using loads 1.5 times the design wind loads and 10 second duration of maximum load.
  - a. Design Wind Loads: Comply with requirements of ASCE 7.
  - b. Member Deflection: Limit member deflection to flexure limit of glass in any direction, with full recovery of glazing materials.
- 2. Wind-Borne-Debris Resistance: Identical full-size glazed assembly without auxiliary protection, tested by independent agency in accordance with ASTM E1996 for Wind Zone [ ] - Enhanced Protection for Large and Small Missile impact and pressure cycling at design wind pressure.
- 3. Water Penetration Resistance on Manufactured Assembly: No uncontrolled water on interior face, when tested in accordance with ASTM E331 at pressure differential of 8 psf.
- 4. Air Leakage Laboratory Test: Maximum of 0.06 cu ft/min sq ft of wall area, when tested in accordance with ASTM E283 at 6.27 psf pressure differential across assembly.

## 2.2 FIRE RATED INTERIOR STOREFRONT SYSTEMS

A. Basis of Design:

- 1. Frame System: "Fireframes® Designer Series by TGP" fire-rated steel frame system as manufactured and supplied by Technical Glass Products.
- 2. Glass Material: Pilkington Pyrostop® fire-rated glazing as fabricated and distributed by Technical Glass Products; 45-200 for doors, 60-101 for sidelites.

B. Fire Rating Requirements

1. Duration -- Doors: Capable of providing a fire rating for 45 minutes.
2. Duration-- Window Assembly: Capable of providing a fire rating for 60 minutes.

C. Design Requirements:

1. Dimensions – Door and Framing:
  - a. Door framing face dimension: 1 15/16-inch.
  - b. Depth of door framing: 1 15/16-inch.
  - c. Door style face dimension: 3 1/8-inch.
  - d. Door cross rail (if applicable) face: 3 9/16-inch.
  - e. Depth of stile, header, sill and cross rail: 1 15/16-inch
2. Dimensions -- Window Assembly:
  - a. Perimeter framing face dimension: 2 3/4-inch at head, sill and jamb.
  - b. Horizontal and/or vertical mullions: 3 9/16-inch on the face.
  - c. Depth of perimeter and mullion: 1 15/16-inch.

D. Construction: Narrow-profile, roll-formed steel architectural grade specialty fire doors. Conventional break-shape type hollow metal steel fire-rated doors will not be considered an acceptable substitute.

### 2.3 COMPONENTS

- A. Aluminum Framing Members: Tubular aluminum sections, drainage holes and internal weep drainage system.
  1. Framing members for interior applications need not be thermally broken.
  2. Glazing Stops: Flush.
- B. Glazing: As specified in Section 08 80 00.
- C. Steel Framing Members: Steel profiled formed tubing;
- D. Glazing: As specified in Section 08 80 00.
- E. Glazing Accessories: calcium silicate setting blocks.
- F. Glazing Compounds: As recommended by the manufacturer for the rated system.

## 2.4 MATERIALS

- A. Extruded Aluminum: ASTM B221 (ASTM B221M).
- B. Steel Tubing: ASTM A1008/A1008M CS, cold rolled,
- C. Sheet Aluminum: ASTM B209 (ASTM B209M).
- D. Fasteners: Stainless steel.
- E. Sealant for Setting Thresholds: Non-curing butyl type.
- F. Glazing Gaskets: Type to suit application to achieve weather, moisture, and air infiltration requirements.

## 2.5 FINISHES

- A. High Performance Organic Coating: AAMA 2604; multiple coats, thermally cured fluoropolymer system.
- B. Superior Performing Organic Coatings System: Manufacturer's standard multi-coat superior performing organic coatings system complying with AAMA 2605, including at least 70 percent polyvinylidene fluoride (PVDF) resin, and at least 80 percent of aluminum extrusion and panels surfaces having minimum total dry film thickness (DFT) of 1.2 mils, 0.0012 inch.
- C. Color: As indicated on drawings.
- D. Touch-Up Materials: As recommended by coating manufacturer for field application.

## 2.6 HARDWARE

- A. For each exterior door, include weatherstripping, sill sweep strip, and threshold.
- B. Other Door Hardware: As specified in Section 08 71 00.
- C. Weatherstripping: Wool pile, continuous and replaceable; provide on all exterior doors.
- D. Sill Sweep Strips: Resilient seal type, retracting, of neoprene; provide on all doors.
- E. Threshold: Extruded aluminum, one piece per door opening, ribbed surface; provide on all exterior doors.
- F. Pivots: Center type; top and bottom.

## 2.7 FABRICATION

- A. Furnish frame assemblies assembled where possible.
  - 1. When necessary, splice frames too large for shop fabrication or shipping or to fit in available building openings.
  - 2. Fit with suitable fasteners.

3. Knock-down frames are not permitted
- B. Field glaze frame assemblies.
- C. Factory prepare door assemblies and install all hardware.
- D. Fabrication Dimensions: Fabricate to field dimensions.
- E. Obtain approved shop drawings prior to fabrication.

### PART 3 EXECUTION

#### 3.1 EXAMINATION

- A. Verify dimensions, tolerances, and method of attachment with other work.
- B. Verify that wall openings and adjoining air and vapor seal materials are ready to receive work of this section.

#### 3.2 INSTALLATION

- A. Install wall system in accordance with manufacturer's instructions.
- B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.
- C. Provide alignment attachments and shims to permanently fasten system to building structure.
- D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.
- E. Provide thermal isolation where components penetrate or disrupt building insulation.
- F. Install sill flashings at exterior installations. Turn up ends and edges; seal to adjacent work to form water tight dam.
- G. Where fasteners penetrate sill flashings, make watertight by seating and sealing fastener heads to sill flashing.
- H. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of fire-rated barriers.
- I. Set thresholds in bed of sealant and secure.
- J. Install hardware using templates provided.
  1. See Section 08 71 00 for hardware installation requirements.
- K. Install glass in accordance with Section 08 80 00, using glazing method required to achieve performance criteria.

- L. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

### 3.3 TOLERANCES

- A. Maximum Variation from Plumb: 0.06 inch per 3 feet non-cumulative or 0.06 inch per 10 feet, whichever is less.
- B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch.

### 3.4 FIELD QUALITY CONTROL

- A. Provide services of storefront manufacturer's field representative to observe for proper installation of system and submit report.
- B. See Section 01 40 00 - Quality Requirements, for independent field testing and inspection requirements, and requirements for monitoring quality of specified product installations.
- C. Provide field testing of installed aluminum storefront system by independent laboratory in accordance with AAMA 503 during construction process and before installation of interior finishes.
  - 1. Perform a minimum of two tests in each designated area as indicated on drawings.
  - 2. Conduct tests in each area prior to 10 percent and 50 percent completion of this work.
  - 3. Field test for water penetration in accordance with ASTM E1105 with uniform static air pressure difference (Procedure A) not less than 4.18 psf.
    - a. Maximum allowable rate of water penetration in 15-minute test is 0.5 ounce that is not contained in an area with provisions to drain to exterior, or collected on surface of interior horizontal framing member.
  - 4. Field test for air leakage in accordance with ASTM E783 with uniform static air pressure difference of 1.57 psf.
    - a. Maximum allowable rate of air leakage is 0.09 cfm/sq ft.
- D. Repair or replace storefront components that have failed designated field testing, and retest to verify performance complies with specified requirements.

### 3.5 ADJUSTING

- A. Adjust operating hardware for smooth operation.

### 3.6 CLEANING

- A. Remove protective material from pre-finished surfaces.
- B. Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths, and take care to remove dirt from corners and to wipe surfaces clean.

- C. Protect glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels, and clean surfaces.
- D. Do not clean with astringent cleaners. Use a clean “grit free” cloth and a small amount of mild soap and water or mild detergent.
  - 1. Do not use any of the following:
    - a. Steam jets
    - b. Abrasives
    - c. Strong acidic or alkaline detergents, or surface-reactive agents
    - d. Detergents not recommended in writing by the manufacturer
    - e. Do not use any detergent above 77 degrees F
    - f. Organic solvents including but not limited to those containing ester, ketones, alcohols, aromatic compounds, glycol ether, or halogenated hydrocarbons.
    - g. Metal or hard parts of cleaning equipment must not touch the glass surface
- E. Protect glass from contact with contaminating substances resulting from construction operations, including weld splatter. If, despite such protection, contaminating substances do come into contact with glass, remove them immediately as recommended by glass manufacturer.
- F. Upon completion of installation, thoroughly clean aluminum surfaces in accordance with AAMA 609 & 610.

### 3.7 PROTECTION

- A. Protect installed products from damage until Date of Substantial Completion.

END OF SECTION

## SECTION 08 51 13.10 - ALUMINUM WINDOW SYSTEM AND DOORS

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Conventionally glazed, unitized aluminum windows system with fixed sash, operating sash, and infill panels at slab edges.
- B. Factory glazing.
- C. Terrace Door: Private entrances to residential units at balconys.
- D. Operating hardware.
- E. Insect screens.
- F. Exhaust vents.

#### 1.2 RELATED REQUIREMENTS

- A. Section 07 25 00 - Weather Barriers: Sealing frame to weather barrier installed on adjacent construction.
- B. Section 07 92 00 - Joint Sealants: Sealing joints between window frames and adjacent construction.
- C. Section 07 42 13.23 - Metal Composite Material Wall Panels: for metal wall panels installed as part of aluminum windows system.
- D. Section 07 90 05 - Joint Sealers: installation of joint sealants installed with aluminum window systems, and for sealant not specified in this Section.
- E. Section 08 44 14 - Glazed Aluminum Curtain Walls: exterior aluminum-framed curtainwall and public entrances at ground floors.

#### 1.3 REFERENCE STANDARDS

- A. AAMA/WDMA/CSA 101/I.S.2/A440 - North American Fenestration Standard/Specification for Windows, Doors, and Skylights 2017.
- B. AAMA CW-10 - Care and Handling of Architectural Aluminum from Shop to Site 2015.
- C. AAMA 450 - Voluntary Performance Rating for Mullion Window Assemblies.
- D. AAMA 502 - Voluntary Specification for Field Testing of Newly Installed Fenestration Products 2012.
- E. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix) 2017a.
- F. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes 2021.

- G. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric) 2021.
- H. ASTM E783 - Standard Test Method for Field Measurement of Air Leakage Through Installed Exterior Windows and Doors 2002 (Reapproved 2018).
- I. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic") 2002 (Ed. 2004).

#### 1.4 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene one week before starting work of this section.
- B. Coordinate with installation of other components that comprise the exterior enclosure.

#### 1.5 SUBMITTALS

- A. See Section 01 33 00 for submittal procedures.
- B. Product Data: Provide component dimensions, information on glass and glazing, internal drainage details, and descriptions of hardware and accessories.
- C. Shop Drawings: Indicate opening dimensions, elevations of different types, framed opening tolerances, method for achieving air and vapor barrier seal to adjacent construction, anchorage locations, and installation requirements.
- D. Samples: Submit two samples, 12 by 12 inch in size illustrating typical corner construction, accessories, and finishes.
- E. Submit two samples of operating hardware.
- F. Calculations: Provide signed and sealed calculations from the window manufacturer that show the mulled assemblies can withstand the design pressures in accordance with the requirements of AAMA 450.
- G. Test Reports: Prior to submitting shop drawings or starting fabrication, submit test report(s) by independent testing agency showing compliance with performance requirements in excess of those prescribed by specified grade.
- H. Design Data: Provide framing member structural and physical characteristics and engineering calculations by a Professional Engineer licensed in District of Columbia , and identify dimensional limitations.
- I. Manufacturer's Installation Instructions: Include complete preparation, installation, and cleaning requirements.
- J. Field Quality Control Submittals: Report of field testing for water penetration and air leakage.
- K. Manufacturer's Qualification Statement.
- L. Installer's Qualification Statement.

M. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

#### 1.6 QUALITY ASSURANCE

- A. Single Subcontractor Responsibility: Aluminum windows and window walls are part of the glazed fenestration systems for the building which includes aluminum-framed glass terrace doors and aluminum windows and window walls. Glazed fenestration systems, including related anchors, supports, and related metal flashings and trim, shall be furnished and installed by a single subcontractor entity solely responsible for the glazed fenestration systems.
- B. Designer Qualifications: Design structural support framing components under direct supervision of a Professional Structural Engineer with a minimum of five years experienced in design of similar structures and licensed in the Commonwealth of Virginia .
- C. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years of documented experience.
- D. Installer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.

#### 1.7 MOCKUP

- A. See Section 01 43 89, for general requirements for mock-ups.
- B. Provide mock-up as part of the exterior wall technical mockup including each component being used on the project. Assemble to illustrate component assembly including glazing materials, infill panels, weep drainage system, attachments, anchors, and perimeter sealant.
- C. Conduct air and water infiltration testing on the mockup; refer to the field-quality control requirements below for test standards. Submit test results and inspection reports prepared by testing agency and manufacturer's technical representative

#### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Comply with requirements of AAMA CW-10.
- B. Protect finished surfaces with wrapping paper or strippable coating during installation. Do not use adhesive papers or sprayed coatings that bond to substrate when exposed to sunlight or weather.

#### 1.9 FIELD CONDITIONS

- A. Do not install sealants when ambient temperature is less than 40 degrees F.
- B. Maintain this minimum temperature during and 24 hours after installation of sealants.

#### 1.10 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

- B. Correct defective Work within a five year period after Date of Substantial Completion.
- C. Provide ten year manufacturer warranty against failure of glass seal on insulating glass units, including interpane dusting or misting. Include provision for replacement of failed units.
- D. Provide twenty year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking.

## PART 2 PRODUCTS

### 2.1 WINDOWS

- A. Basis of Design: Quaker Commercial Windows and Doors; C600 fixed and projected windows; M600 Terrace Doors; Refer to Section 01 25 00 for submittal and acceptance requirements for substitutions.
- B. Design Criteria:
  - 1. Rain Screen Principle:
    - a. Provide for positive drainage of water entering window wall system to the exterior face of the building in accordance with NRC "Rain Screen Principle".
    - b. Incorporate complete heel bead about the interior of all sealed insulating units for positive drainage of the glazing cavity to exterior.
    - c. Compartmentalization seals for be air and water tight, capable of supporting design air pressure differences.
    - d. Provide positive drainage at compartment seals.
  - 2. General: In designing and engineering work, the following principles shall be followed:
    - a. Vision glass shall be replaceable from the interior;
    - b. The rain screen principle is used, including provisions for pressure equalization and compartmentalization;
    - c. Glass, panels, and framing members have a uniform appearance and color;
    - d. Shop drawings show all sealants, air/vapor seals, thermal breaks, thermal separations, drainage slots;
    - e. Insulating glass units are designed with glazing pockets to minimize the possibility of thermal breakage;
    - f. Fastenings shall be concealed except where indicated or specified otherwise;
    - g. Exterior joints in window framing and panels are bulb gasket/wet sealed.

- C. Performance Requirements: Design and size components to withstand the following load requirements without damage or permanent set.
1. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design unitized aluminum windows system.
  2. Design Wind Loads: Comply with requirements of ASCE 7, and of the Structural General Notes in the drawings.
    - a. Measure performance by testing in accordance with ASTM E 330, using test loads equal to 1.5 times the design wind loads and 10 second duration of maximum pressure.
  3. Movement: Accommodate the following movement without damage to components or deterioration of seals:
    - a. Movement of window wall relative to perimeter framing.
    - b. Deflection of structural support framing, under permanent and dynamic loads.
  4. Air Infiltration: Limit air infiltration through assembly to 0.01 cu ft/min/sq ft of wall area or less, measured at 6.24 psf differential pressure across assembly in accordance with ASTM E 283.
  5. Water Leakage: None, when measured in accordance with ASTM E 331 at a test pressure difference of 12.0 lb/sq ft for fixed windows and operable windows (field tested).
  6. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
  7. Air and Vapor Seal: Maintain continuous air barrier and vapor retarder throughout assembly, primarily in line with inside pane of glazing and inner sheet of infill panel and heel bead of glazing compound.
  8. Expansion/Contraction: Provide for expansion and contraction within system components caused by cycling temperature range of 170 degrees F over a 12 hour period without causing detrimental effect to system components, anchorages, and other building elements.
  9. Member Deflection: Limit member deflection to flexure limit of glass in any direction, with full recovery of glazing materials.
  10. Overall Thermal Transmittance (U-value)for Operable Windows: 0.48, maximum, including glazing, measured on window sizes required for this project.
  11. Overall Thermal Transmittance (U-value)for Fixed Windows: 0.38, maximum, including glazing, measured on window sizes required for this project.
  12. Solar Heat-Gain Coefficient (SHGC), for Operable Windows: NFRC 200 maximum SHGC of 0.27 for the whole window system, calculated based on tested units and computer simulation for window unit sizes and glass type used on this Project.

## 2.2 COMPONENTS

- A. Aluminum Framed Window Wall System: Extruded aluminum frame and sash, factory fabricated, factory finished, unitized systems with operating hardware, related flashings, and anchorage and attachment devices.
  - 1. Frame: Tubular aluminum sections, thermally broken with interior section insulated from exterior, drainage holes and internal weep drainage system; 5-1/2 inches deep
  - 2. Operable Units: Aluminum project-out awning; finished to match window wall; turn handle latch; double weatherstripped.
  - 3. Provide units factory glazed with insulating glass units as specified in Section 08 80 00.
  - 4. Fabrication: Joints and corners flush, hairline, and weatherproof, accurately fitted and secured; prepared to receive anchors; fasteners and attachments concealed from view; reinforced as required for operating hardware and imposed loads.
  - 5. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.
  - 6. Movement: Accommodate movement between window and perimeter framing and deflection of lintel, without damage to components or deterioration of seals. For spans less than 13 feet, six inches, limit member deflection to flexure limit of glass in any direction, and maximum of 1/175 of span or 3/4 inch, whichever is less and with full recovery of glazing materials.
  - 7. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
  - 8. Thermal Movement: Design to accommodate thermal movement caused by 180 degrees F surface temperature without buckling stress on glass, joint seal failure, damaging loads on structural elements, damaging loads on fasteners, reduction in performance or other detrimental effects.
  - 9. Provide window systems that allow reglazing of vision glass from the interior of the building, without modification or alteration of the original window and window wall components, using original materials without the use of supplemental or replacement parts.
- B. Aluminum Terrace Doors: Extruded aluminum frame and side-hinged door, factory assembled, factory finished, with operating hardware, related flashings, and anchorage and attachment devices.
  - 1. Configuration: Outswing, with handing as indicated on drawings.
  - 2. Doors: 3-1/4 inch frame depth; extruded aluminum with integral structural thermal break installed by the door manufacturer in the frame and panel members; equal-leg frame; exterior and interior finishes applied by the door manufacturer; frames and panels assembled by the door manufacturer.
  - 3. Thermal Break: Manufacturer's standard type of thermal break in both door and frame.

4. ADA compliant sill, 1/2 inch high maximum.
5. Weatherstripping: Bulb-type, permanently resilient weatherstripping, in compression, two continuous rows at head, jambs, and sill.
6. Door leaf components: Miter cut and mechanically fasten with stainless steel fasteners. Each corner will have extruded aluminum corner keys.
  - a. Pressure equalize each door leaf utilizing closed cell foam covered with a polypropylene shell weather stripping installed in specifically designed dovetail grooves in the extrusion.
  - b. Seal door leaf corners with small joint sealant to ensure water tightness.
7. Glazing: exterior EPDM gasket; 1 inch insulating glass made with tempered safety glass lites; two weep holes draining to exterior under each glass pocket and sill; foam backer rod and silicone heel bead forming an internal seal; interior bulb gasket threaded into aluminum glazing beads; glazed by the door manufacturer.
8. Interface with Adjacent Systems: Integrate design and connections with adjacent construction.
9. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.
10. Finish: Match color and finish of specified window systems.

C. Framing

1. Framing Members: Manufacturer's extruded-aluminum framing members of thickness required and reinforced as required to support imposed loads.
2. Pressure Caps: Manufacturer's standard aluminum components that mechanically retain glazing.
  - a. Include snap-on aluminum trim that conceals fasteners.
3. Backer Plates: Manufacturer's standard, continuous backer plates for framing members, if not integral, where framing abuts adjacent construction.
4. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.
5. Glazed-in Metal Panels and Slab Cover Panels: Coordinate installation of metal panels and slab cover panels with installation of the window frame system as indicated. Refer to Section 07 42 64 for panel specification requirements. Glazed in panels shall meet air and water infiltration performance requirements as stated for fixed window units.

D. Operable Units

1. Product Standard for Operable Windows: Comply with AAMA/WDMA/CSA 101/I.S.2/A440 for definitions and minimum standards of performance, materials, components, accessories, and fabrication unless more stringent requirements are indicated.

- a. Window Certification: AMMA certified with label attached to each window.
2. Performance Class and Grade of Operable Windows: AAMA/WDMA/CSA 101/I.S.2/A440 as follows:
  - a. Minimum Performance Class: AW.
  - b. Minimum Performance Grade: 80.
3. Operating Types: Provide the following operating types in locations indicated on Drawings:
  - a. Awning: Project out.
4. Frames and Sashes: Aluminum extrusions complying with AAMA/WDMA/CSA 101/I.S.2/A440.
  - a. Thermally Improved Construction: Fabricate frames, sashes, and muntins with an integral, concealed, low-conductance thermal barrier located between exterior materials and window members exposed on interior side in a manner that eliminates direct metal-to-metal contact.
5. Weather Stripping: Provide full-perimeter weather stripping for each operable sash unless otherwise indicated.

E. Accessories

1. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
  - a. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
  - b. Reinforce members as required to receive fastener threads.
  - c. Provide concealed fasteners, unless otherwise indicated.
2. Anchors, General: Unless otherwise indicated, select anchors of type, grade, and class required to produce connections suitable for anchoring indicated items to other types of construction indicated, and as follows:
  - a. Provide anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
  - b. Cast-in-Place Anchors in Concrete: Either threaded type or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A 47/A 47M malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F 2329.
  - c. Post-Installed Anchors: Torque-controlled expansion type, and as follows:

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- 1) Stainless Steel: Alloy Group 1 stainless-steel bolts, ASTM F 593, and nuts, ASTM F 594.
  - 2) Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A 123/A 123M or ASTM A 153/A 153M requirements.
  - 3. Interior Trim: Extruded-aluminum profiles in sizes and configurations indicated on Drawings.
  - 4. Panning Trim: Extruded-aluminum profiles in sizes and configurations indicated on Drawings. Finish color shall match brake metal closure at masonry openings.
  - 5. Exposed Flashing and Trim: Provide flashing and trim in accordance with Section 07 62 00 "Sheet Metal Flashing and Trim" in locations shown on Drawings and in locations required to seal against weather and to provide finished appearance. Unless otherwise indicated, finish flashing and trim with same finish system as adjacent aluminum framing.
  - 6. Concealed Flashing: Dead-soft, 0.018-inch- thick stainless steel, ASTM A 240/A 240M of type recommended by manufacturer.
  - 7. Air and Water Barrier: Refer to Section 0725 00 for product specifications.
  - 8. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos, formulated for 30-mil thickness per coat.
    - a. For bituminous paint located inside the building weather barrier, provide products with VOC content of 200 g/L or less, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  - F. Insect Screens: Extruded aluminum frame with mitered and reinforced corners; screen mesh taut and secure to frame; secured to operable window with adjustable hardware allowing screen removal without use of tools.
    - 1. Hardware: Spring loaded steel pins; four per screen unit.
    - 2. Screen Mesh: Vinyl-coated fiberglass, window manufacturer's standard mesh.
    - 3. Frame Finish: Same as frame and sash.
  - G. Operable Sash Weatherstripping: Wool pile; permanently resilient, profiled to achieve effective weather seal.
  - H. Fasteners: Stainless steel.
  - I. Sealant for Setting Sills and Sill Flashing: Non-curing butyl type.
    - 1. Refer to Section 07 92 00 for additional requirements.

## 2.3 MATERIALS

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. Provide materials without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

- B. Extruded Aluminum: ASTM B221 (ASTM B221M), 6063 alloy, T6 temper.
- C. Extruded Aluminum Structural Pipe and Tubes: ASTM B 429/B 429M.
- D. Structural Aluminum Profiles: ASTM B 308/B 308M.
- E. Steel Reinforcement: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM, and prepare surfaces according to applicable SSPC standard.
  - 1. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
  - 2. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
  - 3. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.
- F. Stainless Steel:
  - 1. Castings: ASTM A 743/A 743M, Grade CF 8 or CF 20.
  - 2. Sheet, Strip, Plate, and Flat Bar: ASTM A 666, Type 304.
  - 3. Bars and Shapes: ASTM A 276, Type 304.

## 2.4 HARDWARE

- A. Hardware, General: Provide manufacturer's standard hardware fabricated from aluminum, stainless steel, carbon steel complying with AAMA 907, or other corrosion-resistant material compatible with adjacent materials; designed to smoothly operate, tightly close, and securely lock windows, and sized to accommodate sash weight and dimensions.
  - 1. Exposed Hardware Color and Finish: As selected by Architect from manufacturer's full range.
- B. Door:
  - 1. Hinges: 5-knuckle full mortise butt hinges with non-removable stainless steel pins; finished to match door and frame; minimum of 3 hinges per door.
  - 2. Locking Mechanism: Minimum 3-point rolling cam type; top and bottom bolts near latch jamb; bolts and internal components stainless steel; finished to match door and frame.
    - a. Locking Control: Top and bottom bolts and jamb deadbolt locked and unlocked by thumbturn inside; no outside cylinder.
    - b. Locking cylinders shall be US Schlage.
    - c. Trim: Pulls inside and outside; no jamb latchbolt; .
- C. Window:

1. Sash lock: Lever handle with cam lock.
2. Projecting Sash Arms: Cadmium plated steel, friction pivot joints with nylon bearings, removable pivot clips for cleaning.
3. Window Opening Control Devices (WOCD): Provide operable window sash hardware that limits openings to only allow passage of 4 inch diameter rigid sphere or less, and are easily releasable to fully open without use of keys, tools, or special knowledge.
4. Limit Stops: Resilient rubber.

## 2.5 FINISHES

- A. Superior Performing Organic Coatings System: Polyvinylidene fluoride (PVDF) multi-coat superior performing organic coatings system complying with AAMA 2605, including at least 70 percent PVDF resin, and at least 80 percent of aluminum extrusion and panels surfaces having minimum total dry film thickness (DFT) of 1.2 mils, 0.0012 inch.
- B. Finish Color: As indicated on drawings.
- C. Operator and Exposed Hardware: Enamelled to color as selected from manufacturer's standard line.
- D. Apply one coat of bituminous coating to concealed aluminum and steel surfaces in contact with dissimilar materials.
- E. Touch-Up Primer for Galvanized Steel Surfaces: SSPC-Paint 20, zinc rich.

## 2.6 FABRICATION

- A. Verification: Confirm aluminum window openings by field measurement prior to fabrication and indicate measurements on shop drawings. Where field measurements cannot be made without delaying the Work, establish opening dimensions and proceed with fabricating aluminum windows without field measurements. Coordinate wall construction to ensure that actual opening dimensions correspond to established dimensions.
- B. General: Fabricate the window, door and window wall assemblies to the designs and sizes shown using the materials specified and shown to produce assemblies which meet or exceed the performance requirements. To the greatest extent possible complete fabrication, assembly, finishing, hardware applications and other work before shipment to Project site.

1. Form or extrude aluminum shapes before finishing.
2. Fabricate components that, when assembled, have the following characteristics:
  - a. Profiles that are sharp, straight, and free of defects or deformations.
  - b. Accurately fitted joints with ends coped or mitered.
  - c. Endcaps for extrusions that are flush.

- d. Physical and thermal isolation of glazing from framing members.
  - e. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
  - f. Fasteners, anchors, and connection devices that are concealed from view.
3. Exposed Fasteners: Not permitted.
- C. Joints in Metal Work: All exposed work shall be carefully fitted and matched to produce continuity of line and design, with all joints, being accurately fitted for hairline contact and rigidly secured. Where additional rigidity or strength is required to satisfy the performance requirements reinforce window and window wall components with aluminum or carbon steel shapes, bars, and plates.
- D. Protection of Metals: Wherever dissimilar metals are in contact, except in the case of aluminum in contact with galvanized steel, zinc, or relatively small areas of stainless steel, separate such surfaces with a coating of bituminous paint or separation gaskets as the condition requires. Wherever aluminum comes in contact with concrete surfaces separate such surfaces with a coating of bituminous paint or separation gaskets as the condition requires.
- E. Welding: Complete the welding of exposed surfaces prior to finishing.
- 1. All welding shall be in accordance with the recommendations of the AWS and shall be performed with electrodes and/or by methods recommended by suppliers of the metal being welded.
  - 2. Welds behind finished surfaces shall be so performed as to minimize distortion on the finished side. Weld spatter and welding oxides on finished surfaces shall be removed immediately.
  - 3. At joints where welding cannot be performed use concealed stainless steel fasteners to join assembly.
- F. Factory-Assembled Window, Door and Window Wall Frame Units:
- 1. Rigidly secure non-movement joints.
  - 2. Preparation includes, but is not limited to, cleaning and priming surfaces.
  - 3. Seal joints watertight unless otherwise indicated.
  - 4. Install glazing to comply with requirements in Section 08 80 00 -Glazing.
- G. Mullions: Provide mullions and cover plates, matching window units, complete with anchors for support to structure and installation of window units. Allow for erection tolerances and provide for movement of window units due to thermal expansion and building deflections, as indicated. Provide mullions and cover plates capable of withstanding design wind loads of window units.
- H. Weepholes: Provide weepholes and internal water passages in the glazing framing recesses as recommended by the respective glass and framing manufacturers to conduct infiltrating water to the exterior. Provide weep baffles secured to inside of frame behind weepholes.

- I. Weather strip each operable sash to provide weathertight installation.
- J. Complete fabrication, assembly, finishing, hardware application, and other work in the factory to greatest extent possible. Disassemble components only as necessary for shipment and installation.
- K. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify that wall openings and adjoining air and vapor seal materials are ready to receive aluminum windows.

### 3.2 INSTALLATION

- A. Install windows and doors in accordance with manufacturer's instructions.
- B. Install window assembly in accordance with AAMA/WDMA/CSA 101/I.S.2/A440.
- C. Attach window frame and shims to perimeter opening to accommodate construction tolerances and other irregularities.
- D. Align window and doors plumb and level, free of warp or twist. Maintain dimensional tolerances and alignment with adjacent work.
- E. Install sill and sill end angles.
- F. Set sill members and sill flashing in continuous bead of sealant.
- G. Provide thermal isolation where components penetrate or disrupt building insulation. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.
- H. Install operating hardware not pre-installed by manufacturer.

### 3.3 TOLERANCES

- A. Maximum Variation from Level or Plumb: 1/16 inches every 3 ft non-cumulative or 1/8 inches per 10 ft, whichever is less.

### 3.4 FIELD QUALITY CONTROL

- A. Provide services of aluminum window manufacturer's field representative to observe for proper installation of system and submit report.
- B. See Section 01 40 00 - Quality Requirements, for independent field testing and inspection requirements, and requirements for monitoring quality of specified product installations.

- C. Provide field testing of installed aluminum windows and doors by independent laboratory in accordance with AAMA 502 and AAMA/WDMA/CSA 101/I.S.2/A440 during construction process and before installation of interior finishes.
  - 1. Perform tests on a minimum of 2 percent of total number of windows, not less than 1 per each type of window in system.
  - 2. Conduct tests on individual windows at first installation 25 percent, 50 percent and 90 percent completion of this work.
  - 3. Field test for water penetration in accordance with AAMA 502; field test pressure shall not be less than 2/3 of the passing laboratory test pressure of the selected product. Water appearing on interior surfaces of test specimen without means to drain to the exterior shall be considered a failure.
  - 4. Field test for air leakage in accordance with ASTM E783 with uniform static air pressure difference of 6.27 psf.
    - a. Maximum allowable rate of air leakage is 0.09 cfm/sq ft at 6.27 psf for fixed glazing and 0.15 cfm.sq ft at 6/27 psf for operable glazing.
    - b. Maximum allowable rate of air leakage is 0.10 cfm/sq ft.
- D. Repair or replace fenestration components that have failed designated field testing, and retest to verify performance conforms to specified requirements.
- E. Deficiencies requiring repair or modification to the work shall require re-testing of units, where the Contractor shall bear all costs for additional re-testing until compliance with the performance standards is accomplished.
- F. In addition, test one additional unit of the same type with similar surrounding conditions at Contractor's expense to ensure failure is not systemic issue. Should failure be determined by the independent inspector and Architect to be systemic, provide repairs uniformly for all units on the project.
- G. Remedial repairs that increase the maintenance requirements of the system (i.e., face sealing of a drained system) will not be accepted. Submit all proposed repairs to the architect for review prior to implementation.
- H. Prepare and submit test and inspection reports for air infiltration and water penetration testing.

### 3.5 ADJUSTING

- A. Adjust hardware for smooth operation and secure weathertight closure.

### 3.6 CLEANING

- A. Refer to Section 01 74 19 - Construction Waste Management and Disposal, for additional requirements.
- B. Remove protective material from factory finished aluminum surfaces.

- C. Wash surfaces by method recommended and acceptable to window manufacturer; rinse and wipe surfaces clean.
- D. Remove excess glazing sealant by moderate use of mineral spirits or other solvent acceptable to sealant and window manufacturer.

END OF SECTION

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## SECTION 08 62 00 - UNIT SKYLIGHTS

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Skylights with integral frame.
- B. Integral insulated curb.

#### 1.2 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry: Wood support curbs.
- B. Section 07 55 52: Roofing system and base flashing at skylight curb.

#### 1.3 REFERENCE STANDARDS

- A. AAMA/WDMA/CSA 101/I.S.2/A440 - North American Fenestration Standard/Specification for Windows, Doors, and Skylights 2017.
- B. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate 2021.
- C. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes 2021.
- D. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric) 2021.
- E. ASTM E2112 - Standard Practice for Installation of Exterior Windows, Doors and Skylights 2019c.

#### 1.4 SUBMITTALS

- A. See Section 01 33 00 for submittal procedures.
- B. Product Data: Include structural, thermal, and daylighting performance values.
- C. Shop Drawings: Indicate configurations, dimensions, locations, fastening methods, and installation details.
- D. Grade Substantiation: Prior to submitting shop drawings or starting fabrication, submit one of the following showing compliance with specified grade:
  1. Evidence of AAMA Certification.
  2. Test report(s) by independent testing agency itemizing compliance and acceptable to authorities having jurisdiction.
- E. Manufacturer's Installation Instructions: Indicate special procedures.

## 1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with not less than three years documented experience.

## 1.6 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.

# PART 2 PRODUCTS

## 2.1 SKYLIGHTS

- A. Skylights: Factory-assembled glazing in aluminum frame, free of visual distortion, and weathertight.
  - 1. Shape: Square dome.
  - 2. Glazing: Double.
  - 3. Operation: None; fixed.
  - 4. Nominal Size: As indicated on drawings.

## 2.2 PERFORMANCE REQUIREMENTS

- A. Provide unit skylights that comply with the following:
  - 1. Grade: AAMA/WDMA/CSA 101/I.S.2/A440 requirements for specific skylight type:
  - 2. Design Pressure (DP): In accordance with applicable codes.
  - 3. Allow for expansion and contraction within system components caused by a cycling surface temperature range of 170 degrees F without causing detrimental effects to system or components.

## 2.3 COMPONENTS

- A. Double Glazing: Acrylic plastic; factory sealed.
  - 1. Outer Glazing: Clear transparent.
  - 2. Inner Glazing: Clear transparent.
- B. Frames: ASTM B221 ASTM B221M Extruded aluminum thermally broken, reinforced and welded corner joints, integral curb frame mounting flange and counterflashing to receive roofing flashing system, with integral condensation collection gutter, glazing retainer; clear anodized finish.
- C. Support Curbs: Sheet aluminum ASTM B209/B209M, sandwich construction; 1 inch wide, 4 inches high; glass fiber insulation; with integral flange for anchorage to roof deck.

## 2.4 ACCESSORIES

- A. Anchorage Devices: Type recommended by manufacturer, exposed to view.
- B. Counterflashings: Same metal type and finish as skylight frame.
- C. Sealant: Elastomeric, silicone or polyurethane, compatible with material being sealed .

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that openings and substrate conditions are ready to receive work of this section.

### 3.2 INSTALLATION

- A. Install unit skylights in accordance with manufacturer's instructions and ASTM E2112.
- B. Install aluminum curb assembly, fastening securely to roof decking; flash curb assembly into roofing system.
- C. Install skylight units and mount securely to curb assembly; install counterflashing as required.
- D. Apply sealant to achieve watertight assembly.

### 3.3 CLEANING

- A. Remove protective material from prefinished aluminum surfaces.
- B. Wash down exposed surfaces; wipe surfaces clean.
- C. Remove excess sealant.

END OF SECTION

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## SECTION 08 71 00 - DOOR HARDWARE

### PART 1 GENERAL

#### 1.1 SUMMARY

- A. This Section includes commercial door hardware for the following:
  - 1. Swinging doors.
  - 2. Sliding doors.
  - 3. Other doors to the extent indicated.
- B. Door hardware includes, but is not necessarily limited to, the following:
  - 1. Mechanical door hardware.
  - 2. Electromechanical door hardware.
  - 3. Automatic operators.

#### 1.2 RELATED SECTIONS:

- A. Section 06 10 53 – Miscellaneous Rough Carpentry.
- B. Section 06 20 00 - Finish Carpentry.
- C. Section 08 06 71 - Door Hardware Schedule.
  - 1. Section 08 11 13 –Hollow Metal Doors and Frames.
- D. Section 08 14 16 - “Flush Wood Doors.
- E. Section 08 43 16 – Storefront Systems”.
- F. Division 28 Section “Multi-Family Access Control”.

#### 1.3 CODES AND REFERENCES:

- A. Comply with the version year adopted by the Authority Having Jurisdiction.
  - 1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
  - 2. ICC/IBC - International Building Code.
  - 3. NFPA 70 - National Electrical Code.
  - 4. NFPA 80 - Fire Doors and Windows.
  - 5. NFPA 101 - Life Safety Code.

6. NFPA 105 - Installation of Smoke Door Assemblies.
  7. UL/ULC and CSA C22.2 - Standards for Automatic Door Operators Used on Fire and Smoke Barrier Doors and Systems of Doors.
  8. State Building Codes, Local Amendments.
- B. Standards: All hardware specified herein shall comply with the following industry standards as applicable. Any undated reference to a standard shall be interpreted as referring to the latest edition of that standard:
1. ANSI/BHMA Certified Product Standards - A156 Series.
  2. UL10C - Positive Pressure Fire Tests of Door Assemblies.
  3. ANSI/UL 294 - Access Control System Units.
  4. UL 305 - Panic Hardware.
  5. ANSI/UL 437- Key Locks.

#### 1.4 SUBMITTALS

- A. Refer to Section 01 33 00 for general submittal procedures.
- B. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.
- C. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
  1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."
  2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.
  3. Content: Include the following information:
    - a. Type, style, function, size, label, hand, and finish of each door hardware item.
    - b. Manufacturer of each item.
    - c. Fastenings and other pertinent information.

- d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
  - e. Explanation of abbreviations, symbols, and codes contained in schedule.
  - f. Mounting locations for door hardware.
  - g. Door and frame sizes and materials.
  - h. Warranty information for each product.
4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.
- D. Shop Drawings: Details of electrified access control hardware indicating the following:
- 1. Wiring Diagrams: Upon receipt of approved schedules, submit detailed system wiring diagrams for power, signaling, monitoring, communication, and control of the access control system electrified hardware. Differentiate between manufacturer-installed and field-installed wiring. Include the following:
    - a. Elevation diagram of each unique access controlled opening showing location and interconnection of major system components with respect to their placement in the respective door openings.
    - b. Complete (risers, point-to-point) access control system block wiring diagrams.
    - c. Wiring instructions for each electronic component scheduled herein.
  - 2. Electrical Coordination: Coordinate with related sections the voltages and wiring details required at electrically controlled and operated hardware openings.
- E. Keying Schedule: After a keying meeting with the owner has taken place prepare a separate keying schedule detailing final instructions. Submit the keying schedule in electronic format. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner must approve submitted keying schedule prior to the ordering of permanent cylinders/cores.
- F. Informational Submittals:
- 1. Product Test Reports: Indicating compliance with cycle testing requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified independent testing agency.
- G. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Section 01 78 00 – Closeout Submittals.

## 1.5 QUALITY ASSURANCE

- A. Manufacturers Qualifications: Engage qualified manufacturers with a minimum 5 years of documented experience in producing hardware and equipment similar to that indicated for this Project and that have a proven record of successful in-service performance.
- B. Certified Products: Where specified, products must maintain a current listing in the Builders Hardware Manufacturers Association (BHMA) Certified Products Directory (CPD).
- C. Installer Qualifications: A minimum 3 years documented experience installing both standard and electrified door hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- D. Door Hardware Supplier Qualifications: Experienced commercial door hardware distributors with a minimum 5 years documented experience supplying both mechanical and electromechanical hardware installations comparable in material, design, and extent to that indicated for this Project. Supplier recognized as a factory direct distributor by the manufacturers of the primary materials with a warehousing facility in Project's vicinity. Supplier to have on staff a certified Architectural Hardware Consultant (AHC) available during the course of the Work to consult with Contractor, Architect, and Owner concerning both standard and electromechanical door hardware and keying.
- E. Source Limitations: Obtain each type and variety of door hardware specified in this section from a single source unless otherwise indicated.
  - 1. Electrified modifications or enhancements made to a source manufacturer's product line by a secondary or third party source will not be accepted.
  - 2. Provide electromechanical door hardware from the same manufacturer as mechanical door hardware, unless otherwise indicated.
- F. Each unit to bear third party permanent label demonstrating compliance with the referenced standards.
- G. Keying Conference: Conduct conference to comply with requirements in Section 01 30 00 – Administration Requirements, Article "Project Meetings." Keying conference to incorporate the following criteria into the final keying schedule document:
  - 1. Function of building, purpose of each area and degree of security required.
  - 2. Plans for existing and future key system expansion.
  - 3. Requirements for key control storage and software.
  - 4. Installation of permanent keys, cylinder cores and software.
  - 5. Address and requirements for delivery of keys.

- H. Pre-Submittal Conference: Conduct coordination conference in compliance with requirements in Section 01 30 00 – Administration Requirements, Article "Project Meetings" with attendance by representatives of Supplier(s), Installer(s), and Contractor(s) to review proper methods and the procedures for receiving, handling, and installing door hardware.
  - 1. Prior to installation of door hardware, conduct a project specific training meeting to instruct the installing contractors' personnel on the proper installation and adjustment of their respective products. Product training to be attended by installers of door hardware (including electromechanical hardware) for aluminum, hollow metal and wood doors. Training will include the use of installation manuals, hardware schedules, templates and physical product samples as required.
  - 2. Inspect and discuss electrical roughing-in, power supply connections, and other preparatory work performed by other trades.
  - 3. Review sequence of operation narratives for each unique access controlled opening.
  - 4. Review and finalize construction schedule and verify availability of materials.
  - 5. Review the required inspecting, testing, commissioning, and demonstration procedures
- I. At completion of installation, provide written documentation that components were applied to manufacturer's instructions and recommendations and according to approved schedule.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.
- B. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.
- C. Deliver, as applicable, permanent keys, cylinders, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner shall be established at the "Keying Conference".

## 1.7 COORDINATION

- A. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing standard and electrified hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing hardware to comply with indicated requirements.
- B. Door Hardware and Electrical Connections: Coordinate the layout and installation of scheduled electrified door hardware and related access control equipment with required connections to source power junction boxes, low voltage power supplies, detection and monitoring hardware, and fire and detection alarm systems.

- C. Door and Frame Preparation: Doors and corresponding frames are to be prepared, reinforced and pre-wired (if applicable) to receive the installation of the specified electrified, monitoring, signaling and access control system hardware without additional in-field modifications.

## 1.8 WARRANTY

- A. General Warranty: Reference Section 01 78 00 – Closeout Submittals. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Warranty Period: Written warranty, executed by manufacturer(s), agreeing to repair or replace components of standard and electrified door hardware that fails in materials or workmanship within specified warranty period after final acceptance by the Owner. Failures include, but are not limited to, the following:
1. Structural failures including excessive deflection, cracking, or breakage.
  2. Faulty operation of the hardware.
  3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
  4. Electrical component defects and failures within the systems operation.
- C. Standard Warranty Period: One year from date of Substantial Completion, unless otherwise indicated.
- D. Special Warranty Periods:
1. Ten years for mortise locks and latches.
  2. Five years for exit hardware.
  3. Twenty five years for manual overhead door closer bodies.
  4. Two years for electromechanical door hardware, unless noted otherwise.

## 1.9 MAINTENANCE SERVICE

- A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

## PART 2 PRODUCTS

### 2.1 SCHEDULED DOOR HARDWARE

- A. General: Provide door hardware for each door to comply with requirements in Door Hardware Sets and each referenced section that products are to be supplied under.

- B. Designations: Requirements for quantity, item, size, finish or color, grade, function, and other distinctive qualities of each type of door hardware are indicated in the Door Hardware Sets at the end of Part 3. Products are identified by using door hardware designations, as follows:
1. Named Manufacturer's Products: Product designation and manufacturer are listed for each door hardware type required for the purpose of establishing requirements. Manufacturers' names are abbreviated in the Door Hardware Schedule.
  - C. Substitutions: Requests for substitution and product approval for inclusive mechanical and electromechanical door hardware in compliance with the specifications must be submitted in writing and in accordance with the procedures and time frames outlined in Section 01 25 00 - Substitution Procedures. Approval of requests is at the discretion of the architect, owner, and their designated consultants.

## 2.2 HANGING DEVICES

- A. Hinges: ANSI/BHMA A156.1 certified butt hinges with number of hinge knuckles and other options as specified in the Door Hardware Sets identified in Section 08 06 71.
  1. Quantity: Provide the following hinge quantity:
    - a. Two Hinges: For doors with heights up to 60 inches.
    - b. Three Hinges: For doors with heights 61 to 90 inches.
    - c. Four Hinges: For doors with heights 91 to 120 inches.
    - d. For doors with heights more than 120 inches, provide 4 hinges, plus 1 hinge for every 30 inches of door height greater than 120 inches.
  2. Hinge Size: Provide the following, unless otherwise indicated, with hinge widths sized for door thickness and clearances required:
    - a. Widths up to 3'0": 4-1/2" standard or heavy weight as specified.
    - b. Sizes from 3'1" to 4'0": 5" standard or heavy weight as specified.
  3. Hinge Weight and Base Material: Unless otherwise indicated, provide the following:
    - a. Exterior Doors: Heavy weight, non-ferrous, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate standard weight.
    - b. Interior Doors: Standard weight, steel, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate heavy weight.
  4. Hinge Options: Comply with the following:
    - a. Non-removable Pins: With the exception of electric through wire hinges, provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for the all out-swinging lockable doors.

5. Manufacturers:

- a. McKinney Products; ASSA ABLOY Architectural Door Accessories (MK).
- B. Continuous Geared Hinges: ANSI/BHMA A156.26 Grade 1-600 certified continuous geared hinge, with minimum 0.120-inch thick extruded 6060 T6 aluminum alloy hinge leaves and a minimum overall width of 4 inches. Hinges are non-handed, reversible and fabricated to template screw locations. Factory trim hinges to suit door height and prepare for electrical cut-outs.

1. Manufacturers:

- a. Pemko Products; ASSA ABLOY Architectural Door Accessories (PE).
- C. Sliding and Folding Door Hardware: Hardware is to be of type and design as specified and should comply with ANSI/BHMA A156.14.
  - 1. Sliding Bi-Passing Pocket Door Hardware: Provide complete sets consisting of track, hangers, stops, bumpers, floor channel, guides, and accessories indicated.
  - 2. Bi-folding Door Hardware: Rated for door panels weighing up to 125 lb.
- 3. Manufacturers:
  - a. Pemko Products; ASSA ABLOY Architectural Door Accessories (PE).

## 2.3 POWER TRANSFER DEVICES

- A. Concealed Quick Connect Electric Power Transfers: Provide concealed wiring pathway housing mortised into the door and frame for low voltage electrified door hardware. Furnish with Molex™ standardized plug connectors and sufficient number of concealed wires (up to 12) to accommodate the electrified functions specified in the Door Hardware Sets. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Wire nut connections are not acceptable.

1. Manufacturers:

- a. Securitron (SU) - EL-CEPT Series.
  - B. Electric Door Wire Harnesses: Provide electric/data transfer wiring harnesses with standardized plug connectors to accommodate up to twelve (12) wires. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Provide sufficient number and type of concealed wires to accommodate electric function of specified hardware. Provide a connector for through-door electronic locking devices and from hinge to junction box above the opening. Wire nut connections are not acceptable. Determine the length required for each electrified hardware component for the door type, size and construction, minimum of two per electrified opening.
1. Provide one each of the following tools as part of the base bid contract:
- a. McKinney Products; ASSA ABLOY Architectural Door Accessories (MK) - Electrical Connecting Kit: QC-R001.

- b. McKinney Products; ASSA ABLOY Architectural Door Accessories (MK) - Connector Hand Tool: QC-R003.
2. Manufacturers:
  - a. McKinney Products; ASSA ABLOY Architectural Door Accessories (MK) - QC-C Series.

## 2.4 DOOR OPERATING TRIM

- A. Flush Bolts and Surface Bolts: ANSI/BHMA A156.3 and A156.16, Grade 1, certified.
  1. Flush bolts to be furnished with top rod of sufficient length to allow bolt retraction device location approximately six feet from the floor.
  2. Furnish dust proof strikes for bottom bolts.
  3. Surface bolts to be minimum 8" in length and U.L. listed for labeled fire doors and U.L. listed for windstorm components where applicable.
  4. Provide related accessories (mounting brackets, strikes, coordinators, etc.) as required for appropriate installation and operation.
5. Manufacturers:
  - a. Rockwood Products; ASSA ABLOY Architectural Door Accessories (RO).
- B. Coordinators: ANSI/BHMA A156.3 certified door coordinators consisting of active-leaf, hold-open lever and inactive-leaf release trigger. Model as indicated in hardware sets.
  1. Manufacturers:
    - a. Rockwood Products; ASSA ABLOY Architectural Door Accessories (RO).
- C. Door Push Plates and Pulls: ANSI/BHMA A156.6 certified door pushes and pulls of type and design specified in the Hardware Sets. Coordinate and provide proper width and height as required where conflicting hardware dictates.
  1. Push/Pull Plates: Minimum .050 inch thick, size as indicated in hardware sets, with beveled edges, secured with exposed screws unless otherwise indicated.
  2. Door Pull and Push Bar Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door unless otherwise indicated.
  3. Offset Pull Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door and offset of 90 degrees unless otherwise indicated.
  4. Fasteners: Provide manufacturer's designated fastener type as indicated in Hardware Sets.
5. Manufacturers:

- a. Rockwood Products; ASSA ABLOY Architectural Door Accessories (RO).

## 2.5 CYLINDERS AND KEYING

- A. General: Cylinder manufacturer to have minimum (10) years experience designing secured master key systems and have on record a published security keying system policy.
- B. Source Limitations: Obtain each type of keyed cylinder and keys from the same source manufacturer as locksets and exit devices, unless otherwise indicated.
  - 1. Manufacturers:
    - a. Yale Commercial (YA).
- C. Cylinder Types: Original manufacturer cylinders able to supply the following cylinder formats and types:
  - 1. Threaded mortise cylinders with rings and cams to suit hardware application.
  - 2. Rim cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.
  - 3. Bored or cylindrical lock cylinders with tailpieces as required to suit locks.
  - 4. Tubular deadlocks and other auxiliary locks.
  - 5. Mortise and rim cylinder collars to be solid and recessed to allow the cylinder face to be flush and be free spinning with matching finishes.
  - 6. Keyway: Manufacturer's Standard.
- D. Removable Cores: Provide removable cores as specified, core insert, removable by use of a special key, and for use with only the core manufacturer's cylinder and door hardware.
- E. Keying System: Each type of lock and cylinders to be factory keyed.
  - 1. Supplier shall conduct a "Keying Conference" to define and document keying system instructions and requirements.
  - 2. Furnish factory cut, nickel-silver large bow permanently inscribed with a visual key control number as directed by Owner.
  - 3. New System: Key locks to a new key system as directed by the Owner.
- F. Key Quantity: Provide the following minimum number of keys:
  - 1. Change Keys per Cylinder: Two (2)
  - 2. Master Keys (per Master Key Level/Group): Five (5).
  - 3. Construction Keys (where required): Ten (10).
  - 4. Construction Control Keys (where required): Two (2).

5. Permanent Control Keys (where required): Two (2).
- G. Construction Keying: Provide temporary keyed construction cores.
- H. Key Registration List (Bitting List):
  1. Provide keying transcript list to Owner's representative in the proper format for importing into key control software.
  2. Provide transcript list in writing or electronic file as directed by the Owner.

## 2.6 KEY CONTROL

- A. Key Control Cabinet: Provide a key control system including envelopes, labels, and tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent markers, and standard metal cabinet. Key control cabinet shall have expansion capacity of 150% of the number of locks required for the project.
  1. Manufacturers:
    - a. Lund Equipment (LU).

## 2.7 MECHANICAL LOCKS AND LATCHING DEVICES

- A. Mortise Locksets, Grade 1 (Heavy Duty): ANSI/BHMA A156.13, Series 1000, Operational Grade 1 Certified Products Directory (CPD) listed. Locksets are to be manufactured with a corrosion resistant steel case and be field-reversible for handing without disassembly of the lock body.
  1. Manufacturers:
    - a. Yale Commercial(YA) - 8800FL Series.
- B. Residential Tubular Locking Devices: Standard ANSI A156.2, Series 4000, Grade 2.
  1. Tubular locksets, deadbolts, and handlesets designed to fit ANSI standard door preps.
  2. Locks are to be non-handed and have adjustable backset.
3. Manufacturers:
  - a. Emtek (EM) - Decorative Series

## 2.8 ELECTROMECHANICAL LOCKING DEVICES

- A. Electromechanical Mortise Locksets, Grade 1 (Heavy Duty): ANSI/BHMA A156.13, Series 1000, Operational Grade 1 Certified Products Directory (CPD) listed, subject to same compliance standards and requirements as mechanical mortise locksets, electrified locksets to be of type and design as specified below and in the hardware sets.

1. Electrified Lock Options: Where indicated in the Hardware Sets, provide electrified options including: outside door lock/unlock trim control, latchbolt and lock/unlock status monitoring, deadbolt monitoring, and request-to-exit signaling. Support end-of-line resistors contained within the lock case. Unless otherwise indicated, provide electrified locksets standard as fail secure.
2. Manufacturers:
  - a. Yale Commercial(YA) - 8800FL Series.

## 2.9 AUXILIARY LOCKS

- A. Cylindrical Deadlocks: ANSI/BHMA A156.36 Grade 1 Certified Products Directory (CPD) listed deadlocks to fit standard ANSI 161 preparation and 1 3/8" to 1 3/4" thickness doors. Provide tapered collars to resist vandalism and 1" throw solid steel bolt with hardened steel roller pins. Deadlocks to be products of the same source manufacturer and keyway as other locksets.

1. Manufacturers:
  - a. Yale Commercial(YA) - D100 Series.

## 2.10 LOCK AND LATCH STRIKES

- A. Strikes: Provide manufacturer's standard strike with strike box for each latch or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, unless otherwise indicated, and as follows:
  1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
  2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
  3. Aluminum-Frame Strike Box: Provide manufacturer's special strike box fabricated for aluminum framing.
  4. Double-lipped strikes: For locks at double acting doors. Furnish with retractable stop for rescue hardware applications.

- B. Standards: Comply with the following:
  1. Strikes for Mortise Locks and Latches: BHMA A156.13.
  2. Strikes for Bored Locks and Latches: BHMA A156.2.
  3. Strikes for Auxiliary Deadlocks: BHMA A156.36.
  4. Dustproof Strikes: BHMA A156.16.

## 2.11 CONVENTIONAL EXIT DEVICES

- A. General Requirements: All exit devices specified herein shall meet or exceed the following criteria:

1. At doors not requiring a fire rating, provide devices complying with NFPA 101 and listed and labeled for "Panic Hardware" according to UL305. Provide proper fasteners as required by manufacturer including sex nuts and bolts at openings specified in the Hardware Sets.
  2. Where exit devices are required on fire rated doors, provide devices complying with NFPA 80 and with UL labeling indicating "Fire Exit Hardware". Provide devices with the proper fasteners for installation as tested and listed by UL. Consult manufacturer's catalog and template book for specific requirements.
  3. Except on fire rated doors, provide exit devices with hex key dogging device to hold the pushbar and latch in a retracted position. Provide optional keyed cylinder dogging on devices where specified in Hardware Sets.
  4. Devices must fit flat against the door face with no gap that permits unauthorized dogging of the push bar. The addition of filler strips is required in any case where the door light extends behind the device as in a full glass configuration.
  5. Lever Operating Trim: Where exit devices require lever trim, furnish manufacturer's heavy duty escutcheon trim with threaded studs for thru-bolts.
    - a. Lock Trim Design: As indicated in Hardware Sets, provide finishes and designs to match that of the specified locksets.
    - b. Where function of exit device requires a cylinder, provide a cylinder (Rim or Mortise) as specified in Hardware Sets.
  6. Vertical Rod Exit Devices: Where surface or concealed vertical rod exit devices are used at interior openings, provide as less bottom rod (LBR) unless otherwise indicated. Provide dust proof strikes where thermal pins are required to project into the floor.
  7. Narrow Stile Applications: At doors constructed with narrow stiles, or as specified in Hardware Sets, provide devices designed for maximum 2" wide stiles.
  8. Dummy Push Bar: Nonfunctioning push bar matching functional push bar.
  9. Rail Sizing: Provide exit device rails factory sized for proper door width application.
  10. Through Bolt Installation: For exit devices and trim as indicated in Door Hardware Sets.
- B. Conventional Push Rail Exit Devices (Commercial Duty): ANSI/BHMA A156.3, Grade 1 Certified Products Directory (CPD) listed panic and fire exit hardware devices furnished in the functions specified in the Hardware Sets. Fabricate latchbolts from cast stainless steel, Pullman type, incorporating a deadlocking feature.
1. Manufacturers:
    - a. Yale Commercial(YA) - 6000 Series.

- C. Electromechanical Push Rail Exit Devices (Commercial Duty): ANSI/BHMA A156.3, Grade 1 Certified Products Directory (CPD) listed panic and fire exit hardware devices subject to same compliance standards and requirements as mechanical exit devices. Electrified exit devices to be of type and design as specified below and in the hardware sets.
  - 1. Where conventional power supplies are not sufficient, include any specific controllers required to provide the proper inrush current.
  - 2. Manufacturers:
    - a. Yale (YA) - 6000 Series.

## 2.12 DOOR CLOSERS

- A. All door closers specified herein shall meet or exceed the following criteria:
  - 1. General: Door closers to be from one manufacturer, matching in design and style, with the same type door preparations and templates regardless of application or spring size. Closers to be non-handed with full sized covers.
  - 2. Standards: Closers to comply with UL-10C for Positive Pressure Fire Test and be U.L. listed for use of fire rated doors.
  - 3. Size of Units: Comply with manufacturer's written recommendations for sizing of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Where closers are indicated for doors required to be accessible to the Americans with Disabilities Act, provide units complying with ANSI ICC/A117.1.
  - 4. Closer Arms: Provide heavy duty, forged steel closer arms unless otherwise indicated in Hardware Sets.
  - 5. Closers shall not be installed on exterior or corridor side of doors; where possible install closers on door for optimum aesthetics.
  - 6. Closer Accessories: Provide door closer accessories including custom templates, special mounting brackets, spacers and drop plates as required for proper installation. Provide through-bolt and security type fasteners as specified in the hardware sets.
- B. Door Closers, Surface Mounted (Heavy Duty): ANSI/BHMA A156.4, Grade 1 Certified Products Directory (CPD) listed surface mounted, heavy duty door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be rack and pinion type, one piece cast iron or aluminum alloy body construction, with adjustable backcheck and separate non-critical valves for closing sweep and latch speed control. Provide non-handed units standard.
  - 1. Manufacturers:
    - a. Yale Commercial(YA) - 4400 Series.

- C. Door Closers, Surface Mounted (Unitrol): ANSI/BHMA A156.4, Grade 1 Certified Products Directory (CPD) listed surface mounted closers with door stop mechanism to absorb dead stop shock on arm and top hinge. Hold-open arms to have a spring loaded mechanism in addition to shock absorber assembly. Arms to be provided with rigid steel main arm and secondary arm lengths proportional to the door width.
1. Manufacturers:
    - a. Yale Commercial(YA) - Unitrol Series.
- D. Door Closers, Surface Mounted (Cam Action): ANSI/BHMA 156.4, Grade 1 Certified Products Directory (CPD) listed surface mounted, high efficiency door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be of the cam and roller design, one piece cast aluminum silicon alloy body with adjustable backcheck and independently controlled valves for closing sweep and latch speed.
1. Manufacturers:
    - a. Norton Door Controls (NO) - 2800ST Series.
- E. Door Closers, Surface Mounted (Commercial Duty): ANSI/BHMA 156.4, Grade 1 Certified Products Directory (CPD) listed surface mounted, institutional grade door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be rack and pinion type, one piece cast iron or aluminum alloy body construction, with adjustable backcheck, closing sweep, and latch speed control valves. Provide non-handed units standard.
1. Manufacturers:
    - a. Yale Commercial (YA) - 5800 Series.
- F. Door Closers, Surface Mounted (Utility Grade): ANSI/BHMA 156.4, Grade 1 Certified Products Directory (CPD) listed surface mounted, utility grade door closers with complete spring power adjustment, sizes 1 thru 6. Closers to be rack and pinion type, cast aluminum case construction, with adjustable backcheck, closing sweep, and latch speed control valves. Provide closer standard packed for regular, top-jamb, and parallel arm type mounting applications.
1. Manufacturers:
    - a. Yale Commercial(YA) - 51BC Series.

## 2.13 ELECTROHYDRAULIC DOOR OPERATORS

- A. General: Provide low energy operators of size recommended by manufacturer for door size, weight, and movement; for condition of exposure; and for compliance with UL 325. Coordinate operator mechanisms with door operation, hinges, and activation devices.
1. Fire-Rated Doors: Provide door operators for fire-rated door assemblies that comply with NFPA 80 for fire-rated door components and are listed and labeled by a qualified testing agency.

- B. Standard: Certified ANSI/BHMA A156.19.
- C. Performance Requirements:
  - 1. Opening Force if Power Fails: Not more than 15 lbf required to release a latch if provided, not more than 30 lbf required to manually set door in motion, and not more than 15 lbf required to fully open door.
  - 2. Entrapment Protection: Not more than 15 lbf required to prevent stopped door from closing or opening.
- D. Configuration: Surface mounted or in-ground as required. Door operators to control single swinging and pair of swinging doors.
- E. Operation: Power opening and spring closing operation capable of meeting ANSI A117.1 accessibility guideline. Provide time delay for door to remain open before initiating closing cycle as required by ANSI/BHMA A156.19. When not in automatic mode, door operator to function as manual door closer with fully adjustable opening and closing forces, with or without electrical power.
- F. Features: Operator units to have full feature adjustments for door opening and closing force and speed, backcheck, motor assist acceleration from 0 to 30 seconds, time delay, vestibule interface delay, obstruction recycle, and hold open time from 0 up to 30 seconds.
- G. Provide outputs and relays on board the operator to allow for coordination of exit device latch retraction, electric strikes, magnetic locks, card readers, safety and motion sensors and specified auxiliary contacts.
- H. Brackets and Reinforcements: Manufacturer's standard, fabricated from aluminum with nonferrous shims for aligning system components.
- I. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Norton Door Controls (NO) - 6000 Series.

## 2.14 SURFACE MOUNTED CLOSER HOLDERS

- A. Electromagnetic Door Holders: Certified ANSI A156.15 electromagnetic door holder/releases with a minimum 20 to 40 pounds holding power and single coil construction able to accommodate 12VDC, 24VAC, 24VDC and 120VAC. Coils to be independently wound, employing an integral fuse and armatures to include a positive release button.

- 1. Manufacturers:
  - a. Rixson (RF) - 980/990 Series.

## 2.15 ARCHITECTURAL TRIM

- A. Door Protective Trim
  - 1. General: Door protective trim units to be of type and design as specified below or in the Hardware Sets.

2. Size: Fabricate protection plates (kick, armor, or mop) not more than 2" less than door width (LDW) on stop side of single doors and 1" LDW on stop side of pairs of doors, and not more than 1" less than door width on pull side. Coordinate and provide proper width and height as required where conflicting hardware dictates. Height to be as specified in the Hardware Sets.
3. Where plates are applied to fire rated doors with the top of the plate more than 16" above the bottom of the door, provide plates complying with NFPA 80. Consult manufacturer's catalog and template book for specific requirements for size and applications.
4. Protection Plates: ANSI/BHMA A156.6 certified protection plates (kick, armor, or mop), fabricated from the following:
  - a. Stainless Steel: 300 grade, 050-inch thick.
5. Options and fasteners: Provide manufacturer's designated fastener type as specified in the Hardware Sets. Provide countersunk screw holes.
6. Manufacturers:
  - a. Rockwood Products; ASSA ABLOY Architectural Door Accessories (RO).

## 2.16 DOOR STOPS AND HOLDERS

- A. General: Door stops and holders to be of type and design as specified below or in the Hardware Sets.
- B. Door Stops and Bumpers: ANSI/BHMA A156.16, Grade 1 certified door stops and wall bumpers. Provide wall bumpers, either convex or concave types with anchorage as indicated, unless floor or other types of door stops are specified in Hardware Sets. Do not mount floor stops where they will impede traffic. Where floor or wall bumpers are not appropriate, provide overhead type stops and holders.
  1. Manufacturers:
    - a. Rockwood Products; ASSA ABLOY Architectural Door Accessories (RO).
- C. Overhead Door Stops and Holders: ANSI/BHMA A156.8, Grade 1 Certified Products Directory (CPD) listed overhead stops and holders to be surface or concealed types as indicated in Hardware Sets. Track, slide, arm and jamb bracket to be constructed of extruded bronze and shock absorber spring of heavy tempered steel. Provide non-handed design with mounting brackets as required for proper operation and function.
  1. Manufacturers:
    - a. Rixson Door Controls (RF).

## 2.17 ARCHITECTURAL SEALS

- A. General: Thresholds, weatherstripping, and gasket seals to be of type and design as specified below or in the Hardware Sets. Provide continuous weatherstrip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated. At exterior applications provide non-corrosive fasteners and elsewhere where indicated.
- B. Smoke Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke control ratings indicated, based on testing according to UL 1784.
  - 1. Provide smoke labeled perimeter gasketing at all smoke labeled openings.
- C. Fire Labeled Gasketing: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to UL-10C.
  - 1. Provide intumescent seals as indicated to meet UL10C Standard for Positive Pressure Fire Tests of Door Assemblies, and NPFA 252, Standard Methods of Fire Tests of Door Assemblies.
- D. Sound-Rated Gasketing: Assemblies that are listed and labeled by a testing and inspecting agency, for sound ratings indicated.
- E. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.
- F. Manufacturers:
  - 1. Pemko Products; ASSA ABLOY Architectural Door Accessories (PE).

## 2.18 ELECTRONIC ACCESSORIES

- A. Switching Power Supplies: Provide power supplies with either single or dual voltage configurations at 12 or 24VDC. Power supplies shall have battery backup function with an integrated battery charging circuit and shall provide capability for power distribution, direct lock control and Fire Alarm Interface (FAI) through add on modules. Power supplies shall be expandable up to 16 individually protected outputs. Output modules shall provide individually protected, continuous outputs and/or individually protected, relay controlled outputs.

- 1. Manufacturers:

- a. Securitron (SU) - AQD Series.

## 2.19 FABRICATION

- A. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to manufacturers recognized installation standards for application intended.

## 2.20 FINISHES

- A. Standard: Designations used in the Hardware Sets and elsewhere indicate hardware finishes complying with ANSI/BHMA A156.18, including coordination with traditional U.S. finishes indicated by certain manufacturers for their products.
- B. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware
- C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Examine scheduled openings, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.
- B. Notify architect of any discrepancies or conflicts between the door schedule, door types, drawings and scheduled hardware. Proceed only after such discrepancies or conflicts have been resolved in writing.

### 3.2 PREPARATION

- A. Hollow Metal Doors and Frames: Comply with ANSI/DHI A115 series.
- B. Wood Doors: Comply with ANSI/DHI A115-W series.

### 3.3 INSTALLATION

- A. Install each item of mechanical and electromechanical hardware and access control equipment to comply with manufacturer's written instructions and according to specifications.
  1. Installers are to be trained and certified by the manufacturer on the proper installation and adjustment of fire, life safety, and security products including: hanging devices; locking devices; closing devices; and seals.
- B. Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:
  1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
  2. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
  3. Where indicated to comply with accessibility requirements, comply with ANSI A117.1 "Accessibility Guidelines for Buildings and Facilities."

4. Provide blocking in drywall partitions where wall stops or other wall mounted hardware is located.
- C. Retrofitting: Install door hardware to comply with manufacturer's published templates and written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 9 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.
- D. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."
- E. Storage: Provide a secure lock up for hardware delivered to the project but not yet installed. Control the handling and installation of hardware items so that the completion of the work will not be delayed by hardware losses before and after installation.

#### 3.4 FIELD QUALITY CONTROL

- A. Field Inspection (Punch Report): Reference Section 01 70 00 – Execution and Closeout Requirements. Produce project punch report for each installed door opening indicating compliance with approved submittals and verification hardware is properly installed, operating and adjusted. Include list of items to be completed and corrected, indicating the reasons or deficiencies causing the Work to be incomplete or rejected.
  1. Organization of List: Include separate Door Opening and Deficiencies and Corrective Action Lists organized by Mark, Opening Remarks and Comments, and related Opening Images and Video Recordings.

#### 3.5 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

#### 3.6 CLEANING AND PROTECTION

- A. Protect all hardware stored on construction site in a covered and dry place. Protect exposed hardware installed on doors during the construction phase. Install any and all hardware at the latest possible time frame.
- B. Clean adjacent surfaces soiled by door hardware installation.
- C. Clean operating items as necessary to restore proper finish. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of owner occupancy.

#### 3.7 DEMONSTRATION

- A. Instruct Owner's maintenance personnel to adjust, operate, and maintain mechanical and electromechanical door hardware.

### 3.8 DOOR HARDWARE SETS

- A. The hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.
1. Quantities listed are for each pair of doors, or for each single door.
  2. The supplier is responsible for handing and sizing all products.
  3. Where multiple options for a piece of hardware are given in a single line item, the supplier shall provide the appropriate application for the opening.
- B. Refer to Section 08 06 71- Door Hardware Sets, for hardware sets.

END OF SECTION

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## SECTION 08 80 00 - GLAZING

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Glass.
- B. Insulating Glass Units
- C. Glazing compounds and accessories.

#### 1.2 RELATED REQUIREMENTS

- A. Section 07 27 00 - Air Barriers.
- B. Section 07 92 00 - Joint Sealers
- C. Section 08 11 13 - Hollow Metal Doors and Frames: Glazed doors and borrowed lites.
- D. Section 08 43 16 - Storefront: Interior storefront systems.
- E. Section 08 44 13 - Glazed Aluminum Curtain Walls: Glazing furnished by wall manufacturer.
- F. Section 08 51 13 - Aluminum Windows: Glazing furnished by window manufacturer.

#### 1.3 REFERENCE STANDARDS

- A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials; current edition.
- B. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings- Safety Performance Specifications and Methods of Test; 2015
- C. ASTM C864 - Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks and Spacers; 2005 (reapproved 2015)
- D. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2014.
- E. ASTM C1036 - Standard Specification for Flat Glass; 2011e1.
- F. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2012.
- G. ASTM C1172 - Standard Specification for Laminated Architectural Flat Glass; 2012
- H. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2013.
- I. ASTM C1376 - Standard Specification for Pyrolytic and Vacuum Deposition Coatings on Flat Glass; 2015
- J. ASTM E1300 - Standard Practice for Determining Load Resistance of Glass in Buildings; 2012a.
- K. ASTM E2188 – Standard Test Method for Insulating Glass Unit Performance.

- L. ASTM E2189 – Standard Test Method for Testing Resistance to Fogging in Insulating Glass Units.
- M. ASTM E2190 - Standard Specification for Insulating Glass Unit Performance and Evaluation; 2010.
- N. ASTM E2269 – Standard Test Method for Determining Argon Concentration in Sealed Insulating Glass Units using Gas Chromatography.
- O. ASTM E2649 – Standard Test Method for Determining Argon Concentration in Sealed Insulating Glass Units Using Spark Emission Spectroscopy.
- P. EN 14179-1 - Glass in Building - Heat Soaked Thermally Toughened Soda Lime Silicate Safety Glass.
- Q. GANA (GM) - GANA Glazing Manual; Glass Association of North America; 2009.
- R. GANA (SM) - GANA Sealant Manual; Glass Association of North America; 2008.
- S. ICC (IBC) - International Building Code; 2012.
- T. IGMA TM-3000 - Notrh American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use; 1990 (2016)
- U. NFRC 100, Procedure for Determining Fenestration Product U-factors
- V. NFRC 200, Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence

#### 1.4 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by all affected installers.
- B. Coordinate work of this section with glazing frames, wall openings, and perimeter air and vapor seal to adjacent work.

#### 1.5 SUBMITTALS

- A. See Section 01 33 00 for general submittal procedures.
- B. Shop Drawings: Submit scaled shop drawings showing layout, jointing, anchoring sizes and types, shapes, thickness, and other detailed information needed to fully describe fabrication and installation. Coordinate shop drawing package with related portions of work; including but not limited to Sections 08 43 13, 08 44 13, and 08 51 13.10.
- C. Product Data on Glass Types: Provide structural, physical and environmental characteristics, size limitations, special handling or installation requirements. Provide guidelines highlighting tolerances and defects in accordance with ASTM C1036, ASTM C1048 and ASTM C1172 for verification of acceptable manufacturing tolerances and defects.
- D. Product Data on Glazing Compounds: Provide chemical, functional, and environmental characteristics, limitations, special application requirements. Identify available colors.

E. Samples:

1. 12 inches by 12 inches in size illustrating color, laminated construction of glass units.
2. 12 inches long bead of glazing sealant, in full range of manufacturer's standard colors for selection by Architect.

F. Certificates: Certify that products meet or exceed specified requirements.

G. Manufacturer's Certificate: Certify that insulated glass units meets or exceeds specified requirements.

H. Delegated Design Submittals:

1. Submit calculations specific to glass sizes and thickness and heat treatments that glass will meet design load requirements for this building.
  2. Perform and submit thermal stress analysis for each glass type and size at each building elevation taking into account shading effects. Append to thermal stress analysis a statement from glass manufacturer that based upon this analysis that resulting thermal stresses will not reduce specified statistical probability of breakage.
  3. Prepare engineering calculations by a licensed professional engineer.
- I. Test Reports: stress and thermal analysis of glass; compatibility and adhesion test reports from sealant manufacturer indicating that glazing materials were tested for compatibility and adhesion with glazing sealant, and other glazing materials including insulating units.

## 1.6 QUALITY ASSURANCE

- A. Perform Work in accordance with GANA Glazing Manual and GANA Sealant Manual for glazing installation methods.
- B. Single Source Responsibility: Glass of each type to be produced by same manufacturer.
- C. Engineer Qualifications: Registered professional engineer licensed to practice structural engineering in the District of Columbia, with minimum of five years experience in design of glass and glazing.
- D. Installer Qualifications: Company specializing in performing the work of this section with minimum three years documented experience.
- E. Testing Agency Qualifications: Independent fire specializing in performing testing and inspections fo the type specified in this section.
- F. Heat-soak test fully tempered glass lites to minimize risk of nickel-sulfide reaction causing spontaneous glass breakage.

## 1.7 MOCK-UP

- A. Refer to Section 01 43 89, for additional mock-up requirements.

- B. Provide materials for the Exterior Technical Wall Mockup including glass and air barrier and vapor retarder seal.

#### 1.8 FIELD CONDITIONS

- A. Do not install glazing when ambient temperature is less than 50 degrees F.
- B. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

#### 1.9 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Sealed Insulating Glass Units: Provide a ten year warranty to include coverage for seal failure, interpane dusting or misting, including replacement of failed units.
- C. Tempered Glass: Provide a five year warranty period for replacement of fully tempered glass that has been heat soaked tested. Warranty shall cover materials and labor associated with replacement of any lites that break as a result of nickel sulfide reaction, as well as other lites batched with the broken lite.
- D. Laminated: Provide a five year warranty period for replacement of glass units that show evidence of delamination, deterioration of laminating films, loss of transparency or other forms of deterioration including edge separation due to defective materials of laminations, or breakage due to flaws.

### PART 2 PRODUCTS

#### 2.1 GENERAL PERFORMANCE REQUIREMENTS - EXTERIOR GLAZING ASSEMBLIES

- A. Provide type and thickness of exterior glazing assemblies to support assembly dead loads, and to withstand live loads caused by positive and negative wind pressure acting normal to plane of glass.
  1. Design Pressure: Calculated in accordance with ASCE 7 based on design pressure and loads indicated on the structural drawings.
  2. Comply with ASTM E1300 for design load resistance of glass type, thickness, dimensions, and maximum lateral deflection of supported glass.
  3. Seismic Loads: Design and size glazing components to withstand seismic loads and sway displacement in accordance with the requirements of ASCE 7
  4. Provide glass edge support system sufficiently stiff to limit the lateral deflection of supported glass edges to less than 1/175 of their lengths under specified design load.
  5. Glass thicknesses listed are minimum.
  6. Provide safety glass at all locations where required as determined by the Architect and/or the AHJ.
- B. Vapor Retarder and Air Barrier Seals: Provide completed assemblies that maintain continuity of building enclosure vapor retarder and air barrier.

1. In conjunction with vapor retarder and joint sealer materials described in other sections.
    - a. Refer to Section 07 27 00.
  2. To utilize the inner pane of multiple pane insulating glass units for the continuity of the vapor retarder and air barrier seal.
  3. To maintain a continuous vapor retarder and air barrier throughout the glazed assembly from glass pane to heel bead of glazing sealant.
- C. Thermal and Optical Performance: Provide exterior glazing products with performance properties as indicated. Performance properties are in accordance with manufacturer's published data as determined with the following procedures and/or test methods:
1. Center of Glass U-Value: Comply with NFRC 100 using Lawrence Berkeley National Laboratory (LBNL) WINDOW 6.3 computer program.
  2. Center of Glass Solar Heat Gain Coefficient (SHGC): Comply with NFRC 200 using Lawrence Berkeley National Laboratory (LBNL) WINDOW 6.3 computer program.
  3. Solar Optical Properties: Comply with NFRC 300 test method.

## 2.2 INSULATING GLASS UNITS

- A. Insulating Glass Units: Double glazed, hermetically sealed around perimeter with continuous metal spacer filled with moisture absorbing desiccant, ASTM E774, adhered to glass lites with:
1. Primary Seal: Polyisobutylene; provide a consistant thickness around the corners..
  2. Secondary Seal: Silicone two-part.
  3. Total Thickness: 1 inch.
    - a. Outer Light: Glazing select, float, ASTM C1036.
      - 1) Type: Tempered safety glass as required.
      - 2) Thickness: 1/4 inch.
      - 3) Color: Clear.
      - 4) Low-E Coating: ASTM C1376; Stacked application on No. 2 inner surface.
      - 5) Etched Glass: Provide at windows and curtain wall systems on No 1 outer surface as indicated.
    - b. Inner Light: Glazing select, float.
      - 1) Type: Heat strengthened; provide tempered safety glass as required.
      - 2) Thickness: 1/4 inch.
    - c. Air Space: 1/2 inch with Argon.

4. Glass: Capable of being in contact with silicone sealants to ensure tenacious glass to silicone to aluminum bond.
5. Furnish insulating glass with edge sealant which is compatible with silicone.
6. Comply with insulating glass manufacturer's written recommendations for venting and sealing units to avoid hermetic seal ruptures due to altitude change.
7. Performance Criteria:
  - a. Visible Light Transmittance: 70 percent.
  - b. Shading Coefficient: 0.35.
  - c. SHGC: <0.35 (fixed), <0.31 (operable).
  - d. Center of Glass U-Value (BTU/hr/ft<sup>2</sup>/degF) - Air: 0.29; Argon: 0.25.
8. Acceptable Manufacturers:
  - a. Vitro Architectural Glass.
  - b. Cardinal IG, Minneapolis, MN.
  - c. Guardian Industries Corp, Corsicana, TX.
  - d. Viracon, Owatonna, MN.
  - e. AFGD, Atlanta GA.
  - f. Tecnoglass,
9. Basis of Design Product: Cardinal LoE 270(2) Clear +Clear IG.

**Do NOT highlight**



## 2.3 GLAZING UNITS

- A. Single Vision Glazing:
  1. Application: All interior glazing unless otherwise indicated.
  2. Type: Annealed float glass.
  3. Tint: Clear.
  4. Thickness: 1/4 inch, nominal.
- B. Fire-Protection-Rated Glazing:
  1. Basis of Design: Firelite Plus, Premium grade by Technical Glass Products.
  2. IBC Fire Protection Rating: D-H-T-90, minimum.

3. Safety Certification: 16 CFR 1201 Category II.
  4. Application: Provide this type of glazing in the following locations:
    - a. Glazed lites in fire doors.
    - b. Sidelights, borrow lites, and other glazed openings in partitions indicated as having an hourly fire rating.
  5. Thickness: 5/16 inch, nominal.
- C. Safety Glazing: Non-fire-rated .
1. Application: Provide this type of glazing in the following locations:
    - a. Glazed lites in doors, except fire doors.
    - b. Glazed sidelights to doors, except in fire-rated walls and partitions.
    - c. Other locations required by applicable federal, state, and local codes and regulations.
    - d. Other locations indicated on the drawings.
  2. Type: Fully tempered ASTM C1048 , heat soaked tested float glass as specified.
  3. Tint: Clear, unless indicated otherwise.
  4. Thickness: 1/4 inch, nominal.
- D. Laminated Glass: ASTM C1172 Type II, K, with plastic interlayer; comply with testing requirements in 16 CFR Part 12 for Category II materials and ANSI Z97.1, Class A for safety glazing.
1. Clear Laminated Glass: Two layers of clear tempered glass with clear polyvinyl laminate layer, Nominal 1/2 inch unless otherwise indicated.
  2. Translucent Laminated Glass: Two layers of clear tempered glass with translucent polyvinyl laminate layer; nominal 1/2 inch thick. Provide for bi-fold door panels only.
  3. Clear tempered glass: ASTM C1048.
  4. Plastic Interlayer: Polyvinyl butyral, minimum 0.045 thick at areas where edge is protected from direct exposure to wetting or humidity;
  5. Polished edge finish where exposed.
  6. Laminated glass subject to rejection include material containing
    - a. Markings on the viewing area of glass;
    - b. Delaminations, blow-ins, short interlayer and air or gas pockets;

- c. Hazing;
  - d. Splicing of interlayer material;
  - e. Permanent deformation of glass during lamination process.
- E. Etched Glass: Etched patterns on glass as full-coverage or discrete designs.
- 1. Applications: Provide at all exterior glazing applications indicated on the drawings.
  - 2. Glass Type: Monolithic; tempered safety glass; low-iron glass.
  - 3. Thickness: As required for application.
  - 4. Bird-Friendly Glass Surface Solutions: Vertical lines with TF score of 30 or less.
  - 5. Sheet Size: As indicated on drawings
  - 6. Finish: F1 - Patterned one side; ASTM C1036.
  - 7. Clear Glass: As indicated on drawings

## 2.4 EXTERIOR GLAZING ASSEMBLIES

- A. Performance Criteria: Select type and thickness of glass to withstand dead and live loads caused by positive and negative wind pressure acting normal to plane of glass.
  - 1. Design Pressure: Calculated in accordance with applicable codes.
  - 2. Use the procedure specified in ASTM E1300 to determine glass type and thickness.
  - 3. Limit glass deflection to 1/200 or flexure limit of glass, whichever is less, with full recovery of glazing materials.
  - 4. Glass thicknesses listed are minimum.
- B. Air and Vapor Seals: Provide completed assemblies that maintain continuity of building enclosure vapor retarder and air barrier:
  - 1. In conjunction with vapor retarder and joint sealer materials described in other sections.
  - 2. To maintain a continuous air barrier and vapor retarder throughout the glazed assembly from glass pane to heel bead of glazing sealant.

## 2.5 GLASS MATERIALS

- A. Float Glass: Provide float glass glazing unless otherwise indicated.
  - 1. Heat-Strengthened and Fully Tempered Types: ASTM C1048.

- a. All tempered glass shall be heat soak tested per EN 14179-1 off line to convert nickel sulfide impurities to the stable beta phase. Statistical heat soaking not permitted.
  - b. Modify testings to Holding Phase Glass Surface Temperature of 260 deg C (+/- 10 deg) for 2 hours minimum.
  - c. Provide tracking of heat soaked pane batches for action in the event of a pane failure.
  - d. Written warranties against nickel sulfide inclusions in lieu of heat soak testing will not be accepted.
- 2. Tinted Types: Color and performance characteristics as indicated.
  - 3. Thicknesses: As indicated; for exterior glazing comply with specified requirements for wind load design regardless of specified thickness.
- B. Fire-Resistance-Rated Glazing: Type, thickness, and configuration as required to achieve indicated ratings.
    - 1. IBC Fire Resistance Rating: W-45, minimum.
    - 2. Provide products listed by Underwriters Laboratories or Intertek Warnock Hersey.
    - 3. Safety Certification: 16 CFR 1201 Category II.
  - C. Fire-Protection-Rated Glazing: Type, thickness, and configuration as required to achieve indicated ratings.
    - 1. IBC Fire Protection Rating: As indicated on drawings.
    - 2. Provide products listed by Underwriters Laboratories or Intertek Warnock Hersey.
    - 3. Labeling: Provide permanent label on each piece giving the IBC rating and other information required by the applicable code.

## 2.6 SEALED INSULATING GLASS UNITS

- A. Sealed Insulating Glass Units: Types as indicated.
  - 1. Durability: Certified by an independent testing agency to comply with ASTM E2190.
  - 2. Edge Spacers: ASTM E 773, with aluminum spacers and silicone sealant for glass-to-spacer seals. bent and soldered corners.
  - 3. Edge Seal: Glass to elastomer with supplementary silicone sealant.
  - 4. Purge interpane space with argon gas.

## 2.7 GLAZING COMPOUNDS

- A. Polyurethane Sealant: Single component, chemical curing, non-staining, non-bleeding; ASTM C920, Type S, Grade NS, Class 25, Uses M, A, and G; with cured Shore A hardness range of 20 to 35. Color selected by Architect from manufacturer's standard range.
- B. Silicone Sealant: Single component; neutral curing; capable of water immersion without loss of properties; non-bleeding, non-staining; ASTM C920, Type S, Grade NS, Class 25, Uses M, A, and G; with cured Shore A hardness range of 15 to 25. Color selected by Architect from manufacturer's standard range.

## 2.8 GLAZING ACCESSORIES

- A. Setting Blocks: Neoprene, 80 to 90 Shore A durometer hardness; ASTM C864 Option II. Length of 0.1 inch for each square foot of glazing or minimum 4 inch x width of glazing rabbet space minus 1/16 inch x height to suit glazing method and pane weight and area.
- B. Spacer Shims: Neoprene, 50 to 60 Shore A durometer hardness; ASTM C864 Option II. Minimum 3 inch long x one half the height of the glazing stop x thickness to suit application, self adhesive on one face.
- C. Glazing Tape, Back Bedding Mastic Type: Preformed, butyl-based, 100 percent solids compound with integral resilient spacer rod applicable to application indicated; hardness range of 5 to 30 cured Shore A durometer; coiled on release paper; black color.
- D. Glazing Gaskets: Resilient silicone or silicone-compatible EPDM, with factory molded or vulcanized corners, extruded shape to suit glazing channel retaining slot; ASTM C864 Option II. Color as selected by Architect.
- E. Glazing Clips: Manufacturer's standard type.
- F. Backer Rod: Closed cell non-gassing polyethylene with diameter 25 percent wider than joint width.
- G. Coordinate weather seal, general glazing and cap bead sealant with Section 07 92 00.

## 2.9 SOURCE QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for additional requirements.
- B. Provide shop inspection and testing for insulated glass units.

## 2.10 FABRICATION

- A. Heat-strengthened glass shall be flat glass that has been heat-treated to have a surface compression between 3,500 and 7,500 psi, resulting in surface compression approximately two times that of annealed glass.
- B. Fully tempered glass is flat glass that has been heat-treated to have a surface compression of not less than 10,000 psi resulting in resistance to impact of approximately four times that of annealed glass.

- C. Tempered glass shall be heat-soak tested in compliance with EN14179 that includes a 2 hour dwell at 290 deg C to avoid occurrence of spontaneous cracking due to nickel-sulfide reaction.
- D. Fully tempered glass shall meet requirements of ANSI Z97.1 and CPSC 16 CFR 1201 and qualifies as a safety glazing material.
- E. Laminated glass shall be factory fabricated in autoclave with heat plus pressure free of foreign substances and air pockets. Laminate glass with two glass lites of equal thickness and specified inter-layer.
- F. Insulating glass panels with both lites heat-strengthened, except needed to satisfy requirements for safety materials. Glass lites shall be separated by spacer. Space between lites shall be hermetically sealed using double-seal, organic sealants. Entrapped air within space shall be at atmospheric pressure and kept dehydrated using dessicant drying agent.
- G. Edgework, holes, and notches in heat-treated glass panels shall be completed before heat-treating. Cut and process edges in compliance with glass manufacturer's recommendations.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify that openings for glazing are correctly sized and within tolerance.
- B. Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement, weeps are clear, and ready to receive glazing.
- C. Examine glass immediately prior to installation. Damaged materials will not be accepted for installation.

### 3.2 PREPARATION

- A. Remove protective coatings, oils from cutting and drilling operations, and residue on metallic surfaces with solvents that leave no residue. Do not allow solvent to air dry without wiping. Wipe metal surfaces with IPA (isopropyl alcohol) unless otherwise required by compatibility and adhesion testing results.
- B. Clean tracks and glazing pockets by blowing out joints with oil-free compressed air or by vacuuming joints.
- C. Seal porous glazing channels or recesses with substrate compatible primer or sealer.
- D. Prime surfaces scheduled to receive sealant.
- E. Install sealants in accordance with ASTM C1193 and GANA Sealant Manual.
- F. Install sealants in accordance with manufacturer's instructions.

### 3.3 INSTALLATION - EXTERIOR/INTERIOR DRY METHOD (GASKET GLAZING)

- A. Place setting blocks at 1/4 points with edge block no more than 6 inch from corners.

- B. Rest glazing on setting blocks and push against fixed stop with sufficient pressure on gasket to attain full contact. Install gaskets to protrude past the face of glazing stops.
- C. Provide pre-molded or vulcanized corners wherever possible. Where lineal gasket material must be used, miter cut and bond units at corners with sealant recommended by gasket manufacturer.
- D. Glazing gaskets must accommodate all variation in infill and all extrusion tolerances for glazing pockets without causing leakage or excessive pressure on glass or other infill materials.
- E. Install removable stops without displacing glazing gasket; exert pressure for full continuous contact.

### 3.4 INSTALLATION - INTERIOR DRY METHOD (TAPE AND TAPE)

- A. Cut glazing tape to length and set against permanent stops, projecting 1/16 inch above sight line.
- B. Place setting blocks at 1/4 points with edge block no more than 6 inch from corners.
- C. Rest glazing on setting blocks and push against tape for full contact at perimeter of pane or unit.
- D. Place glazing tape on free perimeter of glazing in same manner described above.
- E. Install removable stop without displacement of tape. Exert pressure on tape for full continuous contact.
- F. Knife trim protruding tape.

### 3.5 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for additional requirements.
- B. Glass and Glazing product manufacturers to provide field surveillance of the installation of their products.
- C. Monitor and report installation procedures and unacceptable conditions.

### 3.6 CLEANING

- A. Remove glazing materials from finish surfaces.
- B. Remove labels after Work is complete.
- C. Clean excess sealant or compound from glass and framing members immediately after application, using cleaners recommended by the manufacturers.
- D. Glass to be cleaned according to:
  1. GANA Glass Information Bulletin GANA 01-0300 – “Proper Procedure for Cleaning Architectural Glass Products”
  2. GANA Glass Informational Bulletin GANA TD-02-0402 – “Heat Treated Glass Surfaces are Different”.

- E. Clean glass and adjacent surfaces. Provide final cleaning of glass surfaces within 5 days of Substanital Completion. .
- F. See Section 01 74 19 - Construction Waste Management and Disposal, for additional requirements.

### 3.7 PROTECTION

- A. Protect glass from breakage immediately upon installation, by use of crossed streamers attached to framing and held away from glass.
- B. Replace damaged glass that can affect glass performance at Contractor's expense.

END OF SECTION

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## SECTION 08 83 00 - MIRRORS

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Glass mirrors.
  - 1. Tempered safety glass.

#### 1.2 REFERENCE STANDARDS

- A. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass 2018.
- B. ASTM C1193 - Standard Guide for Use of Joint Sealants 2016.

#### 1.3 SUBMITTALS

- A. See Section 01 33 00 for submittal procedures.
- B. Product Data on Mirror Types: Submit structural, physical and environmental characteristics, size limitations, special handling and installation requirements.
- C. Manufacturer's Certificate: Certify that mirrors, meets or exceeds specified requirements.
- D. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

#### 1.4 QUALITY ASSURANCE

- A. Fabricate, store, transport, receive, install, and clean mirrors in accordance with manufacturer's recommendations.

#### 1.5 FIELD CONDITIONS

- A. Do not install mirrors when ambient temperature is less than 50 degrees F.
- B. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

#### 1.6 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Provide five year manufacturer warranty for reflective coating on mirrors and replacement of same.

## PART 2 PRODUCTS

### 2.1 MATERIALS

- A. Mirror Design Criteria: Select materials and/or provide supports as required to limit mirror material deflection to 1/200, or to the flexure limit of glass, with full recovery of glazing materials, whichever is less.
- B. Mirror Glass: Clear, tempered safety glass; ASTM C1048, with copper and silver coatings, and protective overcoating.
  - 1. Thickness: 1/4 inch.
  - 2. Edges: Arrised.
  - 3. Size: As indicated on drawings.

### 2.2 ACCESSORIES

- A. Mirror Attachment Accessories: Stainless steel clips.
- B. Mirror Adhesive: Silicone pre-polymer based, chemically compatible with mirror coating and wall substrate.
  - 1. Application Temperature: Minus 35 to 140 degrees F at contact surfaces.
  - 2. Volatile Organic Content (VOC): Less than 7 percent by weight.
- C. Channel Frame: One piece, channel frame, stainless steel, Type 430, satin finish, 1/2 inch by 1/2 inch by 3/8 inch deep with 90 degree mitered corners.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify that openings for mirrored glazing are correctly sized and within tolerance.
- B. Verify that surfaces of mirror frames or recesses are clean, free of obstructions, and ready for installation of mirrors.

### 3.2 PREPARATION

- A. Clean contact surfaces with solvent and wipe dry.
- B. Seal porous mirror frames or recesses with substrate compatible primer or sealer. Prime surfaces scheduled to receive sealant.
- C. Prepare installation in accordance with ASTM C1193 for solvent release sealants, and install sealant in accordance with manufacturer's instructions.

### 3.3 INSTALLATION

- A. Install mirrors in accordance with manufacturer's recommendations.
- B. Set mirrors plumb and level, and free of optical distortion.
- C. Set mirrors with edge clearance free of surrounding construction including countertops or backsplashes.
- D. Frameless Mirrors: Set mirrors in proper place with adhesive, supporting the bottom of the mirror with clips and anchor in accordance with adhesive manufacturer's instructions.

### 3.4 CLEANING

- A. Remove wet glazing materials from finish surfaces.
- B. Remove labels after work is complete.
- C. Clean mirrors and adjacent surfaces.

END OF SECTION

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## SECTION 08 91 00 - LOUVERS

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Louvers, frames, and accessories.

#### 1.2 REFERENCE STANDARDS

- A. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix) 2017a.
- B. AMCA 511 - Certified Ratings Program Product Rating Manual for Air Control Devices 2021.
- C. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes 2021.
- D. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric) 2021.

#### 1.3 SUBMITTALS

- A. See Section 01 33 00 For submittal procedures.
- B. Product Data: Provide data describing design characteristics, maximum recommended air velocity, design free area, materials and finishes.
- C. Shop Drawings: Indicate louver layout plan and elevations, opening and clearance dimensions, and tolerances; head, jamb and sill details; blade configuration, screens, blank-off areas required, and frames.
- D. Samples: Submit two samples 2 by 2 inches in size illustrating finish and color of exterior and interior surfaces.
- E. Test Reports: Independent agency reports showing compliance with specified performance criteria.
- F. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

#### 1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section, with minimum three years of documented experience.

#### 1.5 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Provide ten year manufacturer's warranty against distortion, metal degradation, and connection failures of louver components.
  1. Finish: Include twenty year coverage against degradation of exterior finish.

## PART 2 PRODUCTS

### 2.1 LOUVERS

- A. Louvers: Factory fabricated and assembled, complete with frame, mullions, and accessories; AMCA Certified in accordance with AMCA 511.
1. Basis of Design: 4 inch Storm Resistant Sightproof Horizontal Louver Model SEH-401 as manufactured by Greenheck, or approved equal subject to the following requirements. Refer to Section 01 25 00 regarding submittal and approval requirements for proposed substitutions.
  2. Material: Heads, sills, jambs and mullions to be one-piece heavy gauge structural aluminum extrusions with integral caulking slot and retaining beads.
  3. Fixed-blade: Chevron Style; Heavy gauge extruded 6063-T5 aluminum, 0.081 in wall thickness, on approximately 4 inch oc.
  4. Wind Load Resistance: Design to resist positive and negative wind load of 25 psf without damage or permanent deformation.
  5. Intake Louvers: Design to allow maximum of 0.01 oz/sq ft water penetration at calculated intake design velocity based on design air flow and actual free area, when tested in accordance with AMCA 500-L.
  6. Screens: Provide insect screens at intake louvers and curtain wall infill; and bird screens at exhaust louvers and garage louvers.
  7. Free Area: Coordinate with HVAC requirements; 50 percent, minimum.
  8. Frame: 4 inches deep, minimum 0.081 inches thick; channel profile; corner joints mitered and, with continuous recessed caulking channel each side.
  9. Aluminum Thickness: Frame 0.080 inch minimum;
  10. Aluminum Finish: High performance organic coatings; finish welded units after fabrication.
- B. Brick Vent Louvers: Aluminum outer frames, louver perimeter frame, non-thermally broken, air ventilator with overlapping louvers and insect screen for exhaust duct. Coordinate size and free area requirements with Mechanical Drawings.
1. Blades: Airfoil-shaped.
  2. Frame: 2 inch deep, [\_\_\_\_] inch wide, extruded aluminum.
  3. Frame Size: As indicated on drawings.

### 2.2 MATERIALS

- A. Extruded Aluminum: ASTM B221 (ASTM B221M), 6063 alloy, T6 temper.

- B. Aluminum Sheet: ASTM B209, Alloy 1100, 3003 or 5005.

### 2.3 FINISHES

- A. Superior Performing Organic Coatings System: Manufacturer's standard multi-coat superior performing organic coatings system complying with AAMA 2605, including at least 70 percent polyvinylidene fluoride (PVDF) resin, and at least 80 percent of aluminum extrusion and panels surfaces having minimum total dry film thickness (DFT) of 1.2 mils, 0.0012 inch.
- B. Color: Custom to match RAL 7021 Black Grey.

### 2.4 ACCESSORIES

- A. Screens: Frame of same material as louver, with reinforced corners; removable, screw attached; installed on inside face of louver frame.
  - 1. Bird Screen: Interwoven wire mesh of steel, 14 gage, 0.0641 inch diameter wire, 1/2 inch open weave, diagonal design. Provide hinged installation for bird screen.
  - 2. Insect Screen: 18 x 16 size aluminum mesh.
- B. Fasteners and Anchors: Stainless steel.
- C. Flashings: Of same material as louver frame, formed to required shape, single length in one piece per location.
- D. Sealant for Setting Sills and Sill Flashing: Non-curing butyl type.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify that prepared openings and flashings are ready to receive this work and opening dimensions are as indicated on shop drawings.
- B. Verify that field measurements are as indicated.

### 3.2 INSTALLATION

- A. Install louver assembly in accordance with manufacturer's instructions.
- B. Install louvers level and plumb.
- C. Set sill members and sill flashing in continuous bead of sealant.
- D. Install flashings and align louver assembly to ensure moisture shed from flashings and diversion of moisture to exterior.
- E. Secure louver frames in openings with concealed fasteners.
- F. Coordinate with installation of mechanical ductwork.

### 3.3 CLEANING

- A. Strip protective finish coverings.
- B. Clean surfaces and components.

### 3.4 SCHEDULES

- A. Refer to drawings.

END OF SECTION

## SECTION 09 21 16 - GYPSUM BOARD ASSEMBLIES

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Performance criteria for gypsum board assemblies.
  - 1. Metal stud wall framing.
  - 2. Metal channel ceiling framing.
  - 3. Acoustic insulation.
  - 4. Cementitious backing board.
  - 5. Gypsum wallboard.
  - 6. Joint treatment and accessories.
  - 7. Acoustic (sound-dampening) wall and ceiling board.

#### 1.2 RELATED REQUIREMENTS

- A. Section 05 40 00 - Cold-Formed Metal Framing: Exterior wind-load-bearing metal stud framing.
- B. Section 07 21 00 - Thermal Insulation: Mineral wool insulation.
- C. Section 07 92 00 - Joint Sealants: Sealing acoustical gaps in construction other than gypsum board or plaster work.
- D. Section 08 44 13 - Glazed Aluminum Curtain Wall Systems.

#### 1.3 REFERENCE STANDARDS

- A. ANSI A108.11 - American National Standard for Interior Installation of Cementitious Backer Units; 2013.1.
- B. ANSI A118.9 - American National Standard Specifications for Test Methods and Specifications for Cementitious Backer Units; 2013.1.
- C. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board; 2012.
- D. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members; 2014.
- E. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2012.
- F. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2011.

- G. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board; 2013.
- H. ASTM C954 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs From 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness; 2011.
- I. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2014.
- J. ASTM C1047 - Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base; 2014a.
- K. ASTM C1288 - Standard Specification for Discrete Non-Asbestos Fiber-Cement Interior Substrate Sheets; 1999 (Reapproved 2010).
- L. ASTM C1325 - Standard Specification for Non-Asbestos Fiber-Mat Reinforced Cement Substrate Sheets; 2008b.
- M. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2014.
- N. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2012.
- O. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009.
- P. ASTM E413 - Classification for Rating Sound Insulation; 2010.
- Q. GA-216 - Application and Finishing of Gypsum Board; Gypsum Association; 2013.
- R. GA-226 - Application of Gypsum Board to Form Curved Surfaces; Gypsum Association; 2008.
- S. ICC-ES AC38 - Acceptance Criteria for Water-Resistive Barriers; ICC Evaluation Service, Inc.; 2013.

#### 1.4 SUBMITTALS

- A. See Section 01 33 00 for general submittal procedures.
- B. Shop Drawings: Indicate fire-rated, smoke-rated, sound-rated, and non-rated assemblies at framing-to-framing and framing-to-decking deflection conditions, including products and systems proposed for maintaining continuity of rating indicated.
  - 1. Provide a shop drawing layout of expansion joins in all public spaces.
- C. Product Data: Provide data on metal framing, gypsum board, acoustical sealants, accessories, and joint finishing system.
- D. Product Data: Provide manufacturer's data on partition head to structure connectors, showing compliance with requirements.

- E. Test Reports: For stud framing products that do not comply with ASTM C645 or ASTM C754, provide independent laboratory reports showing maximum stud heights at required spacings and deflections.
- F. LEED Submittals: Comply with Section 01 81 13.
  - 1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of post-consumer and pre-consumer recycled content. Include statement indicating costs for each product having recycled content.
  - 2. Credit MR 5: Product data for regional materials indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating cost for each regional material and fraction by weight that is considered regional.
- G. Informational Submittals: Submit following packaged separately from other submittals:
  - 1. Certifications specified in Quality Assurance article.
  - 2. Manufacturer's Instructions: Include applicable temperature and humidity ranges, special procedures, and perimeter conditions requiring special attention.

## 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing gypsum board application and finishing, with minimum 5 years of documented experience.
- B. Perform Work in accordance with ASTM C840 - Gypsum Board for Walls and Ceilings, GA-214 and GA-216 - Recommended Specifications for the Application and Finishing of Gypsum Board.
- C. Source Limitations: Provide products manufactured within the United States from materials free of sulfur, formaldehyde or other deleterious chemicals. Natural gypsum ore shall be mined in North America. Synthetic (Byproduct) gypsum shall be pure calcium sulfate from domestic sources.
- D. Sustainability Characteristics: Furnish materials with minimum 50 percent recycled content for gypsum board.

## 1.6 MOCKUP

- A. See Section 01 43 89 - Mockups, for general requirements for Residential Unit mock-up.
- B. Provide material as required for mock-up incorporating all components specified for the location.
- C. Show finishing of joints between units, trim edge finishing, and construction techniques.
  - 1. Levels of Finish:
    - a. Provide for Level of Finish 4.
      - 1) Provide sample of approximately 100 SF for each Level of Finish representing completed work.

2) Skim Coat: Provide sample of approximately 100 SF representing finished work.

- b. Install as directed by Architect.
- c. Show backer plate construction techniques.

## 1.7 DELIVERY, STORAGE, AND HANDLING

A. Comply with Section 01 60 00.

1. Store in dry ventilated space off ground.
2. Protect materials from surface contamination, soiling, corrosion, construction traffic, and damage.
3. Support on level platform and fully protect from weather and direct sunlight exposure.
4. Store and support gypsum board in flat stacks to prevent sagging.
5. Protect materials to keep them dry. Remove wet gypsum board from Project site.
6. Protect gypsum board panels to prevent damage to edges, ends, and surfaces.
7. Do not bend or damage metal trim.

B. Mold Prevention: Comply with Section 01 60 00.

## 1.8 FIELD CONDITIONS

A. Environmental Requirements: Comply with more restrictive of ASTM C840, or manufacturer's recommendations under which products can be installed.

1. Maintain minimum uniform 50F temperature in building for 48 hours before and continuously until joint treatment and bonding adhesives are thoroughly dry.
2. Do not allow ambient temperature to exceed 95F.
3. Provide ventilation to remove moisture in excess of that required for drying of joint treatment materials after its application. Avoid drafts during dry, hot weather to prevent too rapid drying.
4. Provide temporary heating and ventilation as required to keep paper faced products dry during construction operations.

## PART 2 PRODUCTS

### 2.1 GYPSUM BOARD ASSEMBLIES

- A. Provide completed assemblies complying with ASTM C840 and GA-216.
- B. Performance Requirements: Design and install systems to:

1. Interior Suspended Ceilings, Soffits, and Bulkheads: Maintain deflection of not more than L/360 of distance between supports.
  2. Interior Metal Stud/Gypsum Board Assemblies, Typical Locations: Withstand lateral loading (air pressure) indicated on Drawings.
  3. Interior Metal Stud/Gypsum Board Assemblies at Atriums, Lobbies, Service Corridors, Exits, and Elevator Lobbies: Withstand lateral loading (air pressure) of 10 PSF with deflection limit not more than L/360 of partition height.
  4. Interior Metal Stud/Gypsum Board Assemblies at Locations with Ceramic Tile or Other Hard Surface Finishes: Withstand typical lateral loading (air pressure) with deflection limit not more than L/360 of partition height.
  5. Accommodate building structure deflections in connections to structure.
  6. Requirements at Deflection Clips and Bridge Clips: Maintain positive attachment of units while allowing minimum 1/2 inch vertical free movement due to deflection of structure.
  7. Where depth of partition is indicated, provide metal framing components of thickness required to achieve performance requirements specified. Limit depth of framing members to comply with partition depth limitations.
  8. Integrate design and connections with adjacent construction. Accommodate allowable tolerances and deflections for structural members in installation.
- C. Interior Partitions, Indicated as Acoustic: Provide completed assemblies with the following characteristics:
1. Acoustic Attenuation: As indicated on architectural drawings or a minimum of 50 STC calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90.
- D. Shaft Walls at HVAC Shafts: Provide completed assemblies with the following characteristics:
1. Air Pressure Within Shaft: Sustained loads of 5 lbf/sq ft with maximum mid-span deflection of L/240.
  2. Acoustic Attenuation: As indicated on architectural drawings or a minimum of 45 STC calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90.
- E. Shaft Walls at Elevator Shafts: Provide completed assemblies with the following characteristics:
1. Air Pressure Within Shaft: Intermittent loads of 5 lbf/sq ft with maximum mid-span deflection of L/240.
  2. Acoustic Attenuation: As indicated on architectural drawings or a minimum of 50 STC calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90.

- F. Fire Rated Assemblies: Where assemblies with fire ratings are indicated, provide materials and installations which are identical to assemblies tested in accordance with ASTM E119 by testing laboratories acceptable to authorities having jurisdiction.
1. Construct assemblies identical to those indicated by reference in UL Fire Resistance Directory, listing or other agencies acceptable to authorities having jurisdiction.
  2. Smoke Partitions: Construct of materials consistent with the type of construction. Capable of resisting the passage of smoke. Extend from floor to underside of floor or roof deck above.

## 2.2 METAL FRAMING MATERIALS

- A. Non-Loadbearing Framing System Components: ASTM C645; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 for the spacing indicated, with maximum deflection of wall framing of L/240 at 5 psf.
1. Studs: "C" shaped with flat or formed webs with knurled faces.
  2. Runners: U shaped, sized to match studs.
  3. Ceiling Channels: C-shaped.
  4. Furring: Hat-shaped sections, minimum depth of 7/8 inch.
  5. Resilient Furring Channels: 1/2 inch depth, for attachment to substrate through one leg only.
  6. Metal Shaftwall Studs: "CH", "CT", "E", and "I" shaped studs.
  7. Metal Shaftwall Runner Tracks: "J" shaped runner track, same sheet metal thickness as shaftwall studs.
  8. Vibration Isolation Hangers (Floating Ceiling at Loading Dock and Trash Room): Kinetics Isolator AF-100 or equivalent. Comply with Acoustical Details on Drawings.
- B. Loadbearing Studs for Application of Gypsum Board: As specified in Section 05 40 00.
- C. Shaft Wall Studs and Accessories: ASTM C645; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 and specified performance requirements.
- D. Ceiling Hangers: Type and size as specified in ASTM C754 for spacing required.
- E. Partition Head To Structure Connections: Provide track fastened to structure with legs of sufficient length to accommodate deflection, for friction fit of studs cut short and fastened as indicated on drawings.

## 2.3 BOARD MATERIALS

- A. **Acceptable Manufacturers:**

1. **Georgia Pacific Corporation, Atlanta, GA.**

2. Lafarge Corporation, Reston, VA.
  3. National Gypsum Company, Charlotte, NC.
  4. US Gypsum Company, Chicago, IL.
  5. Accepted Substitute in accordance with Section 01 25 00.
- B. Gypsum Wallboard: Paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
1. Application: Use for vertical surfaces and ceilings, unless otherwise indicated.
  2. At Assemblies Indicated with Fire-Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X board, UL or WH listed.
  3. Thickness:
    - a. Vertical Surfaces: 1/2 inch and 5/8 as indicated.
    - b. Ceilings: 1/2 inch.
    - c. Multi-Layer Assemblies: Thicknesses as indicated on drawings.
- C. Backing Board For Wet Areas: One of the following products:
1. Application: Surfaces behind tile in wet areas including tub and shower surrounds and shower ceilings.
  2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
  3. ANSI Cement-Based Board: Non-gypsum-based; aggregated Portland cement panels with glass fiber mesh embedded in front and back surfaces complying with ANSI A118.9 or ASTM C1325.
    - a. Thickness: 1/2 inch.
  4. ASTM Cement-Based Board: Non-gypsum-based, cementitious board complying with ASTM C1288.
    - a. Thickness: 1/2 inch.
- D. Backing Board For Non-Wet Areas: Water-resistant gypsum backing board as defined in ASTM C1396/C1396M; sizes to minimum joints in place; ends square cut.
1. Application: Vertical surfaces behind thinset tile, except in wet areas.
  2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
  3. At Assemblies Indicated with Fire-Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X board, UL or WH listed.

4. Type: Regular and Type X, in locations indicated.
  5. Type X Thickness: 5/8 inch.
  6. Regular Board Thickness: 1/2 inch.
  7. Edges: Tapered.
- E. Ceiling Board: Special sag-resistant gypsum ceiling board as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
1. Application: Ceilings, unless otherwise indicated.
  2. Thickness: 1/2 inch.
  3. Edges: Tapered.
- F. Shaftwall and Coreboard: Type X; 1 inch thick by 24 inches wide, beveled long edges, ends square cut.
1. Paper Faced Type: Gypsum shaftliner board or gypsum coreboard as defined ASTM C1396/C1396M; water-resistant faces.
  2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.

## 2.4 ACCESSORIES

- A. Acoustic Insulation: ASTM C665; preformed glass fiber, friction fit type, unfaced. thickness as indicated.
  - B. Fire-rated Assemblies: ASTM C665, Type I. Rock wool mineral fiber products. Typically, do not use glass fiber products to achieve fire-ratings unless specifically included in fire resistance testing requirements.
  - C. Acoustic Sealant: Acrylic emulsion latex or water-based elastomeric sealant; do not use solvent-based non-curing butyl sealant.
  - D. Sound Barrier Mullion Trim Cap: Model 57 Classic Trim Cap as manufactured by Mull-It-Over Products or approved equal, STC Rating 57 and a low profile of 7/8 inch return leg; Include a layer of intumescent foam to provide a 1 hour fire rating, complies with ASTM E119/S101.
  - E. Water-Resistive Barrier: Plastic sheet complying with ICC-ES AC38.
- F. Metal Trim: ASTM C1047, Zinc alloy or galvanized steel; zinc alloy required for application in shower areas and exterior soffits.
1. Uncoated Sheet Metal Thickness: 16 mil minimum.
  2. Flanges designed for concealment in joint compound, flange width to suit installation requirements.
  3. Paper faced beads or beads requiring crimping or mechanical fastening permitted unless otherwise specified or scheduled.

G. Corner Beads at Straight Surfaces:

1. Drywall Corner Bead, AMICO, Birmingham, AL.
2. Cornerbead, Clinch-On Division of COC Industries, St. Paul, MN.
3. Wallboard Corner Bead, National Gypsum Company, Charlotte, NC.
4. Sheetrock Paper Faced Metal Corner Bead, US Gypsum Company, Chicago, IL.
5. Accepted Substitute in accordance with Section 01 25 00.

H. Edge Trim Beads:

1. Drywall L-Metal, AMICO, Birmingham, AL.
2. L-Bead and U-Bead, Clinch-On Division of COC Industries, St. Paul, MN.
3. Number 100 and 200 Wallboard Casing, National Gypsum Company, Charlotte, NC.
4. 200 Series, US Gypsum Company, Chicago, IL.
5. Accepted Substitute in accordance with Section 01 25 00.

I. Control Joints: V-Shaped slot.

1. N-093, AMICO, Birmingham, AL.
2. E-Z Strip Expansion Joint, National Gypsum Company, Charlotte, NC.
3. 093, US Company, Chicago, IL.
4. Accepted Substitute in accordance with Section 01 25 00.

J. Joint Materials: ASTM C475 and as recommended by gypsum board manufacturer for project conditions.

1. Tape: 2 inch wide, coated glass fiber tape for joints and corners, except as otherwise indicated.
2. Ready-mixed vinyl-based joint compound.

K. High Build Drywall Surfacer: Vinyl acrylic latex-based coating for spray application, designed to take the place of skim coating and separate paint primer in achieving Level 5 finish.

- L. Screws for Attachment to Steel Members Less Than 0.033 inch In Thickness, to Wood Members, and to Gypsum Board: ASTM C1002; self-piercing tapping type; cadmium plated for exterior locations.
- M. Screws for Attachment to Steel Members From 0.033 to 0.112 inch in Thickness: ASTM C954; steel drill screws for application of gypsum board to loadbearing steel studs.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify that project conditions are appropriate for work of this section to commence.
- B. Verify rough-in utilities and blocking are complete and in proper position.

### 3.2 SHAFT WALL INSTALLATION

- A. Shaft Wall Framing: Install in accordance with manufacturer's installation instructions.
  1. Fasten runners to structure with short leg to finished side, using appropriate power-driven fasteners at not more than 24 inches on center.
  2. Install studs at spacing required to meet performance requirements.
- B. Shaft Wall Liner: Cut panels to accurate dimension and install sequentially between special friction studs.
  1. On walls over sixteen feet high, screw-attach studs to runners top and bottom.
  2. Seal perimeter of shaft wall and penetrations with acoustical sealant.

### 3.3 FRAMING INSTALLATION

- A. General: Install in accordance with ASTM C754, ASTM C840 and manufacturer's recommendations, except for more stringent requirements of these specifications.
  1. Install units plumb, level, square, and free from warp and twist while maintaining dimensional tolerances and alignment with surrounding construction.
  2. Control and Expansion Joints: Do not bridge building control and expansion joints with metal framing systems.
    - a. Install independent framing on each side of joints.
    - b. Comply with manufacturer requirements for constructing control and expansion joints in fire-rated and shaftwall assemblies.
- B. Suspended Ceilings and Soffits: Install in accordance with ASTM C636. Space framing and furring members as indicated.
  1. Level ceiling system to a tolerance of 1/1200.
  2. Laterally brace entire suspension system.
  3. Install bracing as required at exterior and garage locations to resist wind uplift.
  4. Install free from contact with insulation and other objects within ceiling plenum that are not part of supporting structural or ceiling suspension system.

- C. Studs: Space studs at 16 inches on center.
  - 1. Extend partition framing to structure where indicated and to ceiling in other locations.
  - 2. Partitions Terminating at Ceiling: Attach ceiling runner securely to ceiling track in accordance with manufacturer's instructions.
  - 3. Partitions Terminating at Structure: Attach extended leg top runner to structure, maintain clearance between top of studs and structure, and brace both flanges of studs with continuous bridging.
- D. Openings: Reinforce openings as required for weight of doors or operable panels, using not less than double studs at jambs.
- E. Standard Wall Furring: Install at concrete walls scheduled to receive gypsum board, not more than 4 inches from floor and ceiling lines and abutting walls. Secure in place on alternate channel flanges at maximum 24 inches on center.
  - 1. Orientation: Vertical.
  - 2. Spacing: As indicated.
- F. Acoustic Furring: Install resilient channels at maximum 24 inches on center. Locate joints over framing members.
- G. Blocking: Install mechanically fastened steel channel blocking for support of:
  - 1. Framed openings.
  - 2. Wall mounted cabinets.
  - 3. Plumbing fixtures.
  - 4. Toilet accessories.
  - 5. Wall mounted door hardware.

### 3.4 ACOUSTIC ACCESSORIES INSTALLATION

- A. Acoustic Insulation: Place tightly within spaces, around cut openings, behind and around electrical and mechanical items within partitions, and tight to items passing through partitions.
- B. Acoustic Sealant: Install in accordance with manufacturer's instructions.
  - 1. Place one bead continuously on substrate before installation of perimeter framing members.
  - 2. Seal around all penetrations by conduit, pipe, ducts, and rough-in boxes, except where firestopping is provided.
- C. Sound Barrier Mullion Trim Cap: Provide at locations where stud walls terminate at curtain wall systems. Add a layer of intumescent foam inside the trim to provide a 1 hour fire rating.

- D. Vibration Isolation Hangers: Install in accordance with manufacturer's recommendations and Acoustical Details on Drawings.

### 3.5 BOARD INSTALLATION

- A. Comply with ASTM C 840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.
- B. Single-Layer Non-Rated: Install gypsum board in most economical direction, with ends and edges occurring over firm bearing. Stagger vertical joints on opposite side of walls to occur on alternate framing members
  1. Do not locate gypsum board joints within 12 inches of external corners of windows, doors, or other such openings, except when control joints are installed at corners.
  2. Place tapered edges to receive joint treatment at right angles to framing.
- C. Double-Layer Non-Rated: Use gypsum board for first layer, placed parallel to framing or furring members, with ends and edges occurring over firm bearing. Place second layer perpendicular to framing or furring members. Offset joints of second layer from joints of first layer.
- D. Fire-Rated Construction: Install gypsum board in strict compliance with requirements of assembly listing.
  1. Install fire-rated assemblies, and joint systems at underside of structural deck, in accordance with tested assembly requirements.
    - a. System: Allow for deflection of deck. See Section 07 84 00 for additional requirements.
  2. Partition Insulation: Friction fit and secure insulation in accordance with fire-rated assembly design requirements of independent testing laboratory for rated partitions.
  3. Stencil assembly rating on partition surfaces, above ceiling, for future identification. Apply prior to firestopping procedures in Section 07 84 00.
    - a. Lettering: 3 inches high with minimum 3/8 inch stroke, all capital, red lettering.
    - b. Text: Assembly rating such as 1 HOUR RATED ASSEMBLY or 2 HOUR FIRE AND SMOKE RATED ASSEMBLY - PROTECT ALL OPENINGS.
    - c. Spacing: Maximum of 30 feet OC and maximum of 15 feet from end of walls.
- E. Sound-Rated Assemblies: Comply with ASTM E497; Offset penetrations, electrical and telephone outlets, wall switches, grilles, diffusers and other items through which sound may be transmitted. Utilize acoustical insulation to prevent sound transmission. Install assemblies in accordance with GA 600.
- F. Exposed Gypsum Board in Interior Wet Areas: Seal joints, cut edges, and holes with water-resistant sealant.
- G. Cementitious Backing Board: Install over steel framing members where indicated, in accordance with ANSI A108.11 and manufacturer's instructions.

- H. Installation on Metal Framing: Use screws for attachment of gypsum board.
- I. Curved Surfaces: Apply gypsum board to curved substrates in accordance with GA-226.
- J. Control and Expansion Joints: GA 234. Use for fire-resistance rated and for non-fire-rated conditions.
  - 1. Spacing: In accordance with GA 234.
  - 2. Do not bridge building control and expansion joints with continuous gypsum board. Utilize details shown in referenced standard.
  - 3. Terminate gypsum board on each side of joints.
  - 4. Comply with manufacturer requirements for constructing control and expansion joints in fire rated and shaftwall assemblies.
    - a. Locate studs on both sides of joints. Attach two layers of gypsum board strips to back of one stud to fill area behind joint; provide continuous fire barrier behind joint without restricting movement.

### 3.6 INSTALLATION OF TRIM AND ACCESSORIES

- A. Install trim flush using longest practical length; miter corners and intersections.
  - 1. Embed flanges in joint compound in accordance with manufacturer's recommendations. Finish condition in accordance with Level of Finish specified for conditions shown.
- B. Control Joints: Place control joints consistent with lines of building spaces and as indicated. Not more than 30 feet apart on walls and ceilings over 50 feet long. Install control joints in accordance with following:
  - 1. Vertical Surfaces: Locate at joints of maximum stress, at points of natural weak planes, such as at openings and at corners of offsets in walls exceeding 30 feet in length.
    - a. Extend control joints from both corners of door frames to top of wall where doors occur in long runs of wall.
    - b. Where gypsum board is vertically continuous, as at stairwells and other long vertical wall areas, provide horizontal control joints at each floor level at top runner of shaftwall, at slip joints in shaftwall framing, and breaks in shaftwall framing.
  - 2. Horizontal Surfaces: Locate where framing or furring changes direction.
    - a. Interior Ceilings: Locate where area exceeds 900 SF and spaced 30 feet OC maximum.
    - b. Exterior Soffits: Locate where area exceeds 225 SF and spaced 15 feet OC maximum.
    - c. Locate in ceilings where wings of L-, U-, and T-shaped areas are joined.

3. Fire Rated Control Joints: Extend mineral fiber insulation into control joints in fire-rated assemblies to maintain fire rating. Attach two layers of Type X gypsum panels to back of stud web on one side of joint to accommodate anticipated movement and to continuously firestop inside face of joint.
- C. Corner Beads: Install at visually-exposed external corners, unless otherwise indicated
- D. Edge Trim: Install at locations where gypsum board abuts dissimilar materials and as indicated.

### 3.7 JOINT TREATMENT

- A. Paper Faced Gypsum Board: Use fiberglass joint tape, bedded with ready-mixed vinyl-based joint compound and finished with ready-mixed vinyl-based joint compound.
- B. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
  1. Level 4: Walls and ceilings to receive paint finish or wall coverings, unless otherwise indicated.
  2. Level 5: Walls and ceilings to receive semi-gloss or gloss paint finish and other areas specifically indicated.
  3. Level 2: In utility areas, behind cabinetry, and on backing board to receive tile finish.
  4. Level 1: Fire rated wall areas above finished ceilings, whether or not accessible in the completed construction.
- C. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
  1. Feather coats of joint compound so that camber is maximum 1/32 inch.
  2. Taping, filling, and sanding is not required at surfaces behind fixed cabinetry.
- D. Where Level 5 finish is indicated, spray apply high build drywall surfacer over entire surface after joints have been properly treated; achieve a flat and tool mark-free finish.
- E. Fill and finish joints and corners of cementitious backing board as recommended by manufacturer.

### 3.8 SKIM COAT

- A. Preparation: Verify that surfaces are clean, dry, and smooth.
  1. Prepare and prime or seal surfaces in accordance with manufacturer's recommendations.
  2. Repair and fill defects in concrete ceiling surfaces as required.
- B. Mix and apply joint compound to concrete ceilings to produce smooth uniform finish to match that of other gypsum board. Skim Coat: Equal Level 4 Level of Finish.
- C. Skim Coat Application: Apply to avoid indication of application pattern.
  1. Apply skim coat to exposed concrete ceiling surfaces indicated or scheduled.

2. Remove drippings and overspray from adjacent surfaces where inadvertently applied.
3. Prevent skim coat from coming in contact with surfaces not indicated to receive skim coat.

### 3.9 TOLERANCES

- A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet in any direction.

### 3.10 ADJUSTING, CLEANING, AND PROTECTION

- A. Adjusting: Adjust and align metal framing to properly receive final finishes in accordance with required tolerances.
  1. Correct damages, defects, and leave work ready for decoration. Clean compounds from trim. Visible cracks, nail heads, tool marks, waves, distortions, or other similar defects shall not appear in finished work.
- B. Cleaning: Comply with Section 01 73 00. Clean as recommended by manufacturer. Do not use materials or methods which may damage finish or surrounding construction.
  1. Promptly remove joint compound from surfaces not intended to receive compound.
  2. Waste Management Procedures: Comply with Section 01 74 19.
- C. Protection: Protect finished work in accordance with Section 01 50 00. Protect metal framing so that it will be without any evidence of damage which would be detrimental to finished work.
- D. Mold Prevention: Comply with Sections 01 50 00 and 01 60 00. Protect paper faced products from moisture exposure.

END OF SECTION

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## SECTION 09 30 00 - TILING

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Tile for floor applications.
- B. Tile for wall applications.
- C. Cementitious backer board as tile substrate.
- D. Stone thresholds.

#### 1.2 RELATED REQUIREMENTS

- A. Section 09 21 16 - Gypsum Board Assemblies: Tile backer board.

#### 1.3 REFERENCE STANDARDS

- A. ANSI A108.1a - American National Standard Specifications for Installation of Ceramic Tile in the Wet-Set Method, with Portland Cement Mortar 2017.
- B. ANSI A108.1b - American National Standard Specifications for Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set or Latex-Portland Cement Mortar 2017.
- C. ANSI A108.1c - Contractor's Option: Installation of Ceramic Tile in the Wet-Set Method with Portland Cement Mortar or Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set or Latex-Portland Cement Mortar 1999 (Reaffirmed 2021).
- D. ANSI A108.2 - American National Standard General Requirements: Materials, Environmental and Workmanship 2019.
- E. ANSI A108.4 - American National Standard Specifications for Installation of Ceramic Tile with Organic Adhesives or Water Cleanable Tile-Setting Epoxy Adhesive 2019.
- F. ANSI A108.5 - American National Standard Specifications for Installation of Ceramic Tile with Dry-Set Portland Cement Mortar or Latex-Portland Cement Mortar 2020.
- G. ANSI A108.6 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant, Water Cleanable Tile-Setting and -Grouting Epoxy 1999 (Reaffirmed 2019).
- H. ANSI A108.8 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant Furan Resin Mortar and Grout 1999 (Reaffirmed 2019).
- I. ANSI A108.9 - American National Standard Specifications for Installation of Ceramic Tile with Modified Epoxy Emulsion Mortar/Grout 1999 (Reaffirmed 2019).
- J. ANSI A108.10 - American National Standard Specifications for Installation of Grout in Tilework 2017.

- K. ANSI A108.11 - American National Standard Specifications for Interior Installation of Cementitious Backer Units 2018.
- L. ANSI A108.12 - American National Standard for Installation of Ceramic Tile with EGP (Exterior Glue Plywood) Latex-Portland Cement Mortar 1999 (Reaffirmed 2019).
- M. ANSI A108.13 - American National Standard for Installation of Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone 2005 (Reaffirmed 2021).
- N. ANSI A108.19 - American National Standard Specifications for Interior Installation of Gauged Porcelain Tiles and Gauged Porcelain Tile Panels/Slabs by the Thin-Bed Method Bonded with Modified Dry-Set Cement Mortar or Improved Modified Dry-Set Cement Mortar 2020.
- O. ANSI A118.4 - American National Standard Specifications for Modified Dry-Set Cement Mortar 2012 (Revised).
- P. ANSI A118.7 - American National Standard Specifications for High Performance Cement Grouts for Tile Installation 2010 (Reaffirmed 2016).
- Q. ANSI A118.9 - American National Standard Specifications for Test Methods and Specifications for Cementitious Backer Units 1999 (Reaffirmed 2016).
- R. ANSI A118.10 - American National Standard Specifications for Load Bearing, Bonded, Waterproof Membranes For Thin-Set Ceramic Tile And Dimension Stone Installation 2014.
- S. ANSI A118.12 - American National Standard Specifications for Crack Isolation Membranes for Thin-Set Ceramic Tile and Dimension Stone Installation 2014.
- T. ANSI A118.13 - American National Standard Specifications for Bonded Sound Reduction Membranes for Thin-Set Ceramic Tile Installation 2014.
- U. ASTM E492 - Standard Test Method for Laboratory Measurement of Impact Sound Transmission Through Floor-Ceiling Assemblies Using the Tapping Machine 2009, with Editorial Revision (2016).
- V. ASTM E2179 - Standard Test Method for Laboratory Measurement of the Effectiveness of Floor Coverings in Reducing Impact Sound Transmission Through Concrete Floors 2021.
- W. TCNA (HB) - Handbook for Ceramic, Glass, and Stone Tile Installation 2019.

#### 1.4 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by affected installers.

#### 1.5 SUBMITTALS

- A. See Section 01 33 00 for submittal procedures.
- B. Product Data: Provide manufacturers' data sheets on tile, mortar, grout, and accessories. Include instructions for using grouts and adhesives.

- C. Shop Drawings: Indicate tile layout, patterns, color arrangement, perimeter conditions, junctions with dissimilar materials, control and expansion joints, and thresholds.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- E. Master Grade Certificate: Submit for each type of tile, signed by the tile manufacturer and tile installer.
- F. Maintenance Data: Include recommended cleaning methods, cleaning materials, and stain removal methods.
- G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. See Section 01 60 00 - Product Requirements, for additional provisions.
  - 2. Extra Tile: 1 percent of each size, color, and surface finish combination.

#### 1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the types of products specified in this section, with minimum five years of documented experience.

#### 1.7 MOCK-UP

- A. See Section 01 40 00 - Quality Requirements, for general requirements for mock-up.
- B. Construct tile mock-up where indicated on drawings, incorporating all components specified for the location.
  - 1. Minimum size of mock-up is indicated on drawings.
  - 2. Approved mock-up may remain as part of the Work.

#### 1.8 FIELD CONDITIONS

- A. Maintain ambient and substrate temperature above 50 degrees F and below 100 degrees F during installation and curing of setting materials.

### PART 2 PRODUCTS

#### 2.1 TILE

- A. Provide tile type and manufacturer as indicated on the finish products schedule listed on the Drawings or approved equal meeting type, color and quality of specified product.

#### 2.2 SETTING MATERIALS

- A. Latex-Portland Cement Mortar Bond Coat: ANSI A118.4.
  - 1. Applications: Use this type of bond coat where indicated.

## 2.3 GROUTS

- A. High Performance Polymer Modified Grout: ANSI A118.7 polymer modified unsanded cement grout.
  1. Applications: Use this type of grout where indicated .
  2. Color(s): As indicated on drawings.

## 2.4 MAINTENANCE MATERIALS

- A. Grout Sealer: Liquid-applied, moisture and stain protection for existing or new Portland cement grout.
  1. Composition: Water-based colorless silicone.
- B. Tile Sealer: Stain protection for natural stone and concrete tile.

## 2.5 ACCESSORY MATERIALS

- A. Concrete Floor Slab Crack Isolation Membrane: Material complying with ANSI A118.12; not intended as waterproofing.
  1. Type: A flat, resilient, recycled rubber underlayment.
  2. Thickness: 5 mm maximum.
  3. Crack Resistance: ANSI A118.12, high performance; No failure at 1/16 inch gap, minimum.
  4. STC rating for tile over concrete: Delta IIC 23.
  5. **Basis of Design:** QT scu 4005 as manufactured by QT Sound Insulation or approved equal.
- B. Waterproofing Membrane at Floors: Specifically designed for bonding to cementitious substrate under thick mortar bed or thin-set tile; complying with ANSI A118.10.
  1. Crack Resistance: No failure at 1/16 inch gap, minimum; comply with ANSI A118.12.
  2. Bonded Sheet Membrane Type:
    - a. Material: Polyethylene sheet membrane with non-woven fabric laminated to both sides, 20 to 30 mils thick, nominal.
- C. Sloped Waterproof Shower Base: ANSI A118.10; sloped composite, made from high-strength polypropylene, with composite sheet membrane made from Chlorinated Polyethylene (CPE), with non-woven fiber laminated to the top.
  1. **Basis of Design:** Probase by Noble Co.
- D. Waterproofing Membrane at Showers and Tiled Tubs: Specifically designed for bonding to cementitious substrate under thick mortar bed or thin-set tile; complying with ANSI A118.10.
  1. Fluid or Trowel Applied Type:

- E. Membrane at Walls:
  - 1. Material: 6 mil thick polyethylene film.
- F. Underlayment at Floors: Specifically designed for bonding to thin-set setting mortar; not primarily a waterproofing material and having the following characteristics:
  - 1. Sound Reduction: Comply with ANSI A118.13 bonded membrane, ASTM E492, and ASTM E2179.
  - 2. Crack Resistance: No failure at 1/16 inch gap, minimum; comply with ANSI A118.12.
  - 3. Water Resistance: Comply with ANSI A118.10, bonded waterproofing.
  - 4. Uncoupling Function: Allow for separation between membrane and the mortar adhering tile to the membrane when subjected to excessive substrate movement.
  - 5. Suitable for installation over green concrete.
  - 6. Type: Fluid or Trowel Applied.
- G. Backer Board: Cementitious type complying with ANSI A118.9; high density, glass fiber reinforced, 1/2 inch thick; 2 inch wide coated glass fiber tape for joints and corners.
- H. Mesh Tape: 2 inch wide self-adhesive fiberglass mesh tape.

### PART 3 EXECUTION

#### 3.1 EXAMINATION

- A. Verify that subfloor surfaces are smooth and flat within the tolerances specified for that type of work and are ready to receive tile.
- B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive tile.
- C. Verify that required floor-mounted utilities are in correct location.

#### 3.2 PREPARATION

- A. Protect surrounding work from damage.
- B. Vacuum clean surfaces and damp clean.
- C. Seal substrate surface cracks with filler. Level existing substrate surfaces to acceptable flatness tolerances.
- D. Install backer board in accordance with ANSI A108.11 and board manufacturer's instructions. Tape joints and corners, cover with skim coat of setting material to a feather edge.

### 3.3 INSTALLATION - GENERAL

- A. Install tile, thresholds, and stair treads and grout in accordance with applicable requirements of ANSI A108.1a through ANSI A108.19 , manufacturer's instructions, and TCNA (HB) recommendations.
- B. Lay tile to pattern indicated. Do not interrupt tile pattern through openings.
- C. Cut and fit tile to penetrations through tile, leaving sealant joint space. Form corners and bases neatly. Align floor joints.
- D. Place tile joints uniform in width, subject to variance in tolerance allowed in tile size. Make grout joints without voids, cracks, excess mortar or excess grout, or too little grout.
- E. Form internal angles square and external angles bullnosed.
- F. Sound tile after setting. Replace hollow sounding units.
- G. Keep control and expansion joints free of mortar, grout, and adhesive.
- H. Prior to grouting, allow installation to completely cure; minimum of 48 hours.
- I. Grout tile joints unless otherwise indicated. Use standard grout unless otherwise indicated.
- J. At changes in plane and tile-to-tile control joints, use tile sealant instead of grout, with either bond breaker tape or backer rod as appropriate to prevent three-sided bonding.

### 3.4 INSTALLATION - FLOORS - THIN-SET METHODS

- A. Over exterior concrete substrates, install in accordance with TCNA (HB) Method F102, with standard grout.
- B. Over interior concrete substrates, install in accordance with TCNA (HB) Method F136, with standard grout, unless otherwise indicated.
  1. Use uncoupling membrane under all floor tile unless other underlayment is indicated.

### 3.5 INSTALLATION - SHOWERS AND BATHTUB WALLS

- A. At bathtub walls install in accordance with TCNA (HB) Method B412, over cementitious backer units with waterproofing membrane.
- B. Grout with standard grout as specified above.

### 3.6 CLEANING

- A. Clean tile and grout surfaces.

### 3.7 PROTECTION

- A. Do not permit traffic over finished floor surface for 4 days after installation.

END OF SECTION

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## SECTION 09 64 29 - WOOD STRIP AND PLANK FLOORING

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Wood plank flooring, nailed.
- B. Sheet vapor retarder.

#### 1.2 REFERENCE STANDARDS

- A. ASTM E492 - Standard Test Method for Laboratory Measurement of Impact Sound Transmission Through Floor-Ceiling Assemblies Using the Tapping Machine 2009, with Editorial Revision (2016).

#### 1.3 SUBMITTALS

- A. See Section 01 33 00 for submittal procedures.
- B. Product Data: Provide data for flooring.
- C. Shop Drawings: Indicate floor joint pattern and termination details.
- D. Samples: Submit two sample panels 12 by 12 inch in size illustrating floor finish, color, and sheen.
- E. Sustainable Design Submittal: Submit VOC content documentation for field-applied adhesives, stains, finish coatings, and sealers.
- F. Installation Instructions: Indicate standard and special installation procedures.
- G. Maintenance Data: Include maintenance procedures and recommended maintenance materials.

#### 1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect work from moisture damage.
- B. Do not deliver wood materials to project site until building is fully enclosed and interior temperature and humidity are in accordance with manufacturer's recommendations.

#### 1.6 FIELD CONDITIONS

- A. Do not install wood flooring until wet construction work is complete and ambient air at installation space has moisture content stabilized at maximum moisture content of 40 percent.

- B. Provide heat, light, and ventilation prior to installation.
- C. Store materials in area of installation for minimum period of 24 hours prior to installation.
- D. Maintain minimum room temperature of 65 degrees F for a period of two days prior to delivery of materials to installation space, during installation, and after installation.

## PART 2 PRODUCTS

### 2.1 MATERIALS

#### A. Wood Plank Flooring - Type WDP-02:

- 1. Species and Distributer as indicated on Finish Products Schedule on Drawings.
- 2. Moisture Content: 12 percent.
- 3. Edge: Square.
- 4. End: End matched.

### 2.2 ACCESSORIES

- A. Sound Control Underlayment: Cork and recycled rubber composite type, fully-adhered.
  - 1. Sound Reduction: Comply with ASTM E492.
  - 2. Thickness: 13/64 inch, nominal.
- B. Transition Strip: Same species and finish as flooring material; profiles indicated.

### 2.3 SOURCE QUALITY CONTROL

- A. Inspect and stamp species and grade on underside of each piece of wood flooring at factory.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify existing conditions before starting this work.
- B. Verify that concrete subfloor surface is smooth and flat to plus or minus 1/4 inch in 10 feet.
- C. Verify that required floor-mounted utilities are in correct location.

### 3.2 PREPARATION

- A. Prepare substrate to receive wood flooring in accordance with manufacturer's instructions.
- B. Broom clean substrate.

### 3.3 INSTALLATION

- A. Underlays: Install in accordance with underlayment manufacturer's instructions.
- B. Wood Flooring:
  - 1. Install in accordance with manufacturer's instructions; predrill and blind nail to subfloor.
  - 2. Lay flooring parallel to length of room areas. Verify alignment as work progresses.
  - 3. Arrange flooring with end matched grain set flush and tight.
  - 4. Terminate flooring at centerline of door openings where adjacent floor finish is dissimilar; provide divider strips and transition strips in accordance with flooring manufacturer's recommendations and as indicated.
  - 5. Install edge strips at unprotected or exposed edges, and where flooring terminates.
  - 6. Secure edge strips before installation of flooring with stainless steel screws.
  - 7. Install flooring tight to floor access covers.
  - 8. Provide 1/2 inch expansion space at fixed walls and other interruptions.

### 3.4 CLEANING

- A. Clean and polish floor surfaces in accordance with floor finish manufacturer's instructions.

### 3.5 PROTECTION

- A. Prohibit traffic on floor finish for 48 hours after installation.
- B. Place protective coverings over finished floors; do not remove coverings until Date of Substantial Completion.

END OF SECTION

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## SECTION 09 64 33 - LAMINATED WOOD FLOORING

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Laminated wood flooring.
- B. Installation accessories.

#### 1.2 REFERENCE STANDARDS

- A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2021a.

#### 1.3 SUBMITTALS

- A. See Section 01 33 00 for submittal procedures.
- B. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, wood species and colors available; and installation instructions.
- C. Shop Drawings: Indicate floor joint pattern and termination details.
- D. Samples: Submit two sample panels 12 by 12 inch in size illustrating floor finish, color, and sheen.
- E. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning.

#### 1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
- B. Installer Qualifications: Company specializing in performing the type of work specified in this section.
  - 1. Minimum three years of documented experience.

#### 1.5 FIELD CONDITIONS

- A. Do not install wood flooring until wet construction work is complete and ambient air at installation space has moisture content stabilized at maximum moisture content of 40 percent.
- B. Provide heat, light, and ventilation prior to installation.
- C. Store materials in area of installation for minimum period of 24 hours prior to installation.
- D. Maintain minimum room temperature of 65 degrees F and relative humidity in accordance with adhesive manufacturer's instructions for a minimum period of 48 hours prior to delivery of materials to installation space, during installation, and after installation.

## PART 2 PRODUCTS

### 2.1 MATERIALS

- A. Laminated Wood Flooring:
  - 1. Construction: Tongue and groove, 5-ply laminated wood planks.
  - 2. Installation Method: Floating floor.
  - 3. Surface Burning Characteristics: Flame Spread Index of 200, maximum; Smoke Developed Index of 450, maximum; when tested in accordance with ASTM E84.
  - 4. Species: as indicated on the Finish Products Schedule on drawings. .
  - 5. Thickness: 5/8 inch.
  - 6. Face Width: 7.5 inch.
  - 7. Edge Profile: Square.
  - 8. Length: Random, minimum of 9 inches.
- B. Vapor Retarder: Polyethylene sheet, 6 mil thick; 2 inch wide polyethylene tape for sealing joints.

### 2.2 ACCESSORIES

- A. Sound Control Underlayment: Cork and recycled rubber composite type, fully-adhered.
  - 1. Thickness: 13/64 inch, nominal.
- B. Subfloor Filler: White premix latex. Type recommended by adhesive material manufacturer.
- C. Transition Strip: Same species and finish as flooring material; profiles indicated.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify that subfloor surfaces are smooth and flat within the tolerances required for type of substrate and ready to receive laminated wood flooring.
- B. Verify that subfloor surfaces are dust-free and free of substances that could impair bonding of materials to substrate surface.
- C. Verify that required floor-mounted utilities are in correct location.

### 3.2 PREPARATION

- A. Prepare subfloor in accordance with flooring manufacturer's installation instructions.

- B. Remove subfloor ridges and bumps. Fill minor or local low spots, cracks, joints, holes, and other defects with subfloor filler to achieve smooth, flat, hard surface.
- C. Prohibit traffic until filler is fully cured.
- D. Vacuum clean substrate.

### 3.3 INSTALLATION

- A. Vapor Retarder: Install loose laid, seams overlapped 4 inches and sealed with polyethylene tape. Run material 2 inches up the wall and trim after flooring is installed.
- B. Underlayment: Install in accordance with manufacturer's installation instructions.
- C. Wood Flooring:
  - 1. Install flooring in accordance with manufacturer's installation instructions.
  - 2. Lay flooring in patterns indicated on drawings. Verify alignment as work progresses.
  - 3. Arrange flooring with end matched grain set flush and tight.
  - 4. Terminate flooring at centerline of door openings where adjacent floor finish is dissimilar; provide divider strips and transition strips in accordance with flooring manufacturer's recommendations and as indicated.
  - 5. Install flooring tight to floor access covers.
  - 6. Provide 1/2 inch expansion space at fixed walls and other interruptions.

### 3.4 CLEANING

- A. Clean floor surfaces in accordance with the flooring manufacturer's instructions.

### 3.5 PROTECTION

- A. Prohibit traffic on finished floor for 24 hours after installation.
- B. Place protective coverings over finished floors; do not remove coverings until after Date of Substantial Completion.

END OF SECTION

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## SECTION 09 65 00 - RESILIENT FLOORING

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Resilient tile flooring.
- B. Luxury vinyl tile flooring
- C. Resilient fitness flooring.
- D. Resilient base.
- E. Installation accessories.

#### 1.2 REFERENCE STANDARDS

- A. ASTM E492 - Standard Test Method for Laboratory Measurement of Impact Sound Transmission Through Floor-Ceiling Assemblies Using the Tapping Machine 2009, with Editorial Revision (2016).
- B. ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source 2019a, with Editorial Revision (2020).
- C. ASTM E2179 - Standard Test Method for Laboratory Measurement of the Effectiveness of Floor Coverings in Reducing Impact Sound Transmission Through Concrete Floors 2021.
- D. ASTM F1066 - Standard Specification for Vinyl Composition Floor Tile 2004 (Reapproved 2018).
- E. ASTM F1859 - Standard Specification for Rubber Sheet Floor Covering Without Backing 2021a.
- F. ASTM F1861 - Standard Specification for Resilient Wall Base 2021.
- G. NFPA 253 - Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source 2019.

#### 1.3 SUBMITTALS

- A. See Section 01 33 00 for submittal procedures.
- B. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.
- C. Verification Samples: Submit two samples, 12 by 12 inch in size illustrating color and pattern for each resilient flooring product specified.
- D. Sustainable Design Submittal: Submit VOC content documentation for flooring and adhesives.
- E. Concrete Subfloor Test Report: Submit a copy of the moisture and alkalinity (pH) test reports.

F. Certification: Prior to installation of flooring, submit written certification by flooring manufacturer and adhesive manufacturer that condition of subfloor is acceptable.

G. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.

#### 1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing specified flooring with minimum three years documented experience.
- B. Installer Qualifications: Company specializing in installing specified flooring with minimum three years documented experience.
- C. Testing Agency Qualifications: Independent firm specializing in performing concrete slab moisture testing and inspections of the type specified in this section.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Upon receipt, immediately remove any shrink-wrap and check materials for damage and the correct style, color, quantity and run numbers.
- B. Store all materials off of the floor in an acclimatized, weather-tight space.
- C. Maintain temperature in storage area between 55 degrees F and 90 degrees F.
- D. Protect roll materials from damage by storing on end.
- E. Do not double stack pallets.

#### 1.6 FIELD CONDITIONS

- A. Store materials for not less than 48 hours prior to installation in area of installation at a temperature of 70 degrees F to achieve temperature stability. Thereafter, maintain conditions above 55 degrees F.

### PART 2 PRODUCTS

#### 2.1 GENERAL

- A. Provide materials indicated below, refer to Finish Products Schedule for Basis of Design manufacturer, product, and color selections.
- B. Refer to Section 01 25 00 for submittal and acceptance requirements for proposed substitutions.

#### 2.2 SHEET FLOORING

- A. Rubber Sheet Flooring: 100 percent recycled rubber composition, color and pattern through total thickness.
  1. Manufacturer and Product as indicated on Finish Product Schedule on Drawings or approved equal.

2. Minimum Requirements: Comply with ASTM F1859, Type 1, without backing.
  - a. Density: ASTM D3676; 80 pcf
  - b. Hardness: ASTM D2240; (Shore A) 60 +/- 5
  - c. Tear Strength: ASTMD624; 70 pli min
  - d. Elongation: ASTM D412; greater than 300 percent
  - e. Tensile Strength: ASTM D412; greater than 200 PSI
  - f. Flexibility: ASTM F137; 0.25 inch Mandrel Pass
  - g. Coefficient of Friction: ASTM D2047; greater than 0.95
  - h. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E648 or NFPA 253.
3. VOC Content Limits: As specified in Section 01 61 16.
4. Thickness: 4 mm.
5. Sheet Width: 48 inch minimum.
6. Seams: Glued with application adhesive.
7. Surface Texture: Smooth.

### 2.3 TILE FLOORING

- A. Vinyl Composition Tile: Homogeneous, with color extending throughout thickness.
  1. Minimum Requirements: Comply with ASTM F1066, of Class corresponding to type specified.
  2. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E648 or NFPA 253.
  3. Size: 12 by 12 inch.
  4. VOC Content Limits: As specified in Section 01 61 16.
  5. Thickness: 0.125 inch.
  6. Color: As indicated on drawings.
- B. Vinyl Tile: Luxury Vinyl Plank ,
  1. Minimum Requirements: Comply with ASTM F1700, of Class corresponding to type specified.
  2. Critical Radiant Flux (CRF): Class 1, Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E648.

3. Mold and Microbial Resistance: Highly resistant when tested in accordance with ASTM D6329; certified in accordance with UL 2824.
4. VOC Content Limits: As specified in Section 01 61 16.
5. Slip Resistance: ADA Compliant per ASTM D2047
6. Plank Tile Nominal Size: 9 by 36 inch.
7. Wear Layer: Quartz-enhanced Urethane; thickness 0.030 inch.
8. Backing: Commercial Grade
9. Total Thickness: 0.118 inch.
10. Color: To be selected by Architect from manufacturer's full range.
11. Installation: Glue down.

## 2.4 RESILIENT BASE

- A. Resilient Base: ASTM F1861, Type TS rubber, vulcanized thermoset; top set Style B, Cove. Located in back of house areas only.
  1. Height: 6 inch.
  2. Thickness: 0.125 inch.
  3. Finish: Satin.
  4. Length: Roll.
  5. Color: As indicated on drawings.
  6. Accessories: Premolded external corners and internal corners.

## 2.5 ACCESSORIES

- A. Subfloor Filler: White premix latex; type recommended by adhesive material manufacturer.
- B. Primers, Adhesives, and Seam Sealer: Waterproof; types recommended by flooring manufacturer.
  1. VOC Content Limits: As specified in Section 01 61 16.
- C. Moldings, Transition and Edge Strips: Same material as flooring.
- D. Sealer and Wax: Types recommended by flooring manufacturer.
- E. Sound Control Underlayment: Rebonded vulcanized rubber impact sound insulation.
  1. Basis of Design: ECOsilence5 by Ecore

2. Roll Thickness: 1/4 inch, nominal.
3. Sound Reduction: IIC rating of 54 or greater when tested over a 8 inch concrete slab in accordance with ASTM E492 and ASTM E2179.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify that surfaces are flat to tolerances acceptable to flooring manufacturer, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of flooring to substrate.
- B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive resilient base.
- C. Cementitious Subfloor Surfaces: Verify that substrates are ready for resilient flooring installation by testing for moisture and alkalinity (pH).
  1. Obtain instructions if test results are not within limits recommended by resilient flooring manufacturer and adhesive materials manufacturer.
- D. Verify that required floor-mounted utilities are in correct location.

### 3.2 PREPARATION

- A. Remove subfloor ridges and bumps. Fill minor low spots, cracks, joints, holes, and other defects with subfloor filler to achieve smooth, flat, hard surface.
- B. Prohibit traffic until filler is fully cured.
- C. Clean substrate.
- D. Apply primer as required to prevent "bleed-through" or interference with adhesion by substances that cannot be removed.

### 3.3 INSTALLATION - GENERAL

- A. Starting installation constitutes acceptance of subfloor conditions.
- B. Install in accordance with manufacturer's written instructions.
- C. Adhesive-Applied Installation:
  1. Fit joints and butt seams tightly.
  2. Set flooring in place, press with heavy roller to attain full adhesion.
- D. Where type of floor finish, pattern, or color are different on opposite sides of door, terminate flooring under centerline of door.

- E. Install edge strips at unprotected or exposed edges, where flooring terminates, and where indicated.
  - 1. Resilient Strips: Attach to substrate using adhesive.
- F. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.

### 3.4 INSTALLATION - SOUND CONTROL UNDERLAYMENT

- A. Install in accordance with underlayment manufacturer's instructions.

### 3.5 INSTALLATION - SHEET FLOORING

- A. Lay flooring with joints and seams parallel to longer room dimensions, to produce minimum number of seams. Lay out seams to avoid widths less than 1/3 of roll width; match patterns at seams.
- B. Cut sheet at seams in accordance with manufacturer's instructions.
- C. Chemically bond seams using seam sealer where indicated.

### 3.6 INSTALLATION - TILE FLOORING

- A. Mix tile from container to ensure shade variations are consistent when tile is placed, unless otherwise indicated in manufacturer's installation instructions.
- B. Lay flooring with joints and seams parallel to building lines to produce symmetrical pattern.
- C. Install square tile to basket weave pattern. Allow minimum 1/2 full size tile width at room or area perimeter.
- D. Install plank tile with a random offset of at least 6 inches from adjacent rows.

### 3.7 INSTALLATION - RESILIENT BASE

- A. Fit joints tightly and make vertical. Maintain minimum dimension of 18 inches between joints.
- B. Miter internal corners. At external corners, use premolded units. At exposed ends, use premolded units.
- C. Install base on solid backing. Bond tightly to wall and floor surfaces.
- D. Scribe and fit to door frames and other interruptions.

### 3.8 CLEANING

- A. Remove excess adhesive from floor, base, and wall surfaces without damage.
- B. Clean in accordance with manufacturer's written instructions.

### 3.9 PROTECTION

- A. Prohibit traffic on resilient flooring for 48 hours after installation.

END OF SECTION

## SECTION 09 68 13 - TILE CARPETING

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Carpet tile, fully adhered.

#### 1.2 RELATED REQUIREMENTS

- A. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 01 74 19 - Construction Waste Management and Disposal: Reclamation/Recycling of new carpet tile scrap.
- C. Section 03 30 00 - Cast-in-Place Concrete: Restrictions on curing compounds for concrete slabs and floors to receive adhesive-applied flooring.

#### 1.3 REFERENCE STANDARDS

- A. ASTM D2859 - Standard Test Method for Ignition Characteristics of Finished Textile Floor Covering Materials 2016 (Reapproved 2021).
- B. ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source 2019a, with Editorial Revision (2020).
- C. NFPA 253 - Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source 2019.

#### 1.4 SUBMITTALS

- A. See Section 01 33 00 for submittal procedures.
- B. Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns, colors available, and method of installation.
- C. Shop Drawings: Indicate layout of joints.
- D. Sustainable Design Submittal: Submit VOC content documentation for adhesives.
- E. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.
- F. Concrete Subfloor Test Report: Submit a copy of the moisture and alkalinity (pH) test reports.
- G. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning.

## 1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing specified carpet tile with minimum three years documented experience.
- B. Installer Qualifications: Company specializing in installing carpet tile with minimum three years documented experience and approved by carpet tile manufacturer.
- C. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of the type specified in this section.

## 1.6 FIELD CONDITIONS

- A. Store materials in area of installation for minimum period of 24 hours prior to installation.

# PART 2 PRODUCTS

## 2.1 MATERIALS

- A. General Requirements:
  - 1. Critical Radiant Flux: Minimum of 0.22 watts/sq cm, when tested in accordance with ASTM E648 or NFPA 253.
  - 2. Surface Flammability Ignition: Pass ASTM D2859 (the "pill test").
  - 3. VOC Content: Comply with Section 01 61 16.
- B. Tile Carpetings: Refer to the Finish Products Schedule on the Drawings. Provide as indicated or approved equal as required in Section 01 25 00.

## 2.2 ACCESSORIES

- A. Subfloor Filler: White premix latex; type recommended by flooring material manufacturer.
- B. Edge Strips: Rubber, color as selected by Architect.
- C. Adhesives:
  - 1. Compatible with materials being adhered; maximum VOC content as specified in Section 01 61 16.
- D. Carpet Tile Adhesive: Recommended by carpet tile manufacturer; releasable type.

# PART 3 EXECUTION

## 3.1 EXAMINATION

- A. Verify that subfloor surfaces are smooth and flat within tolerances specified for that type of work and are ready to receive carpet tile.

- B. Verify that subfloor surfaces are dust-free and free of substances that could impair bonding of adhesive materials to subfloor surfaces.
- C. Cementitious Subfloor Surfaces: Verify that substrates are ready for flooring installation by testing for moisture and alkalinity (pH).
  - 1. Obtain instructions if test results are not within limits recommended by flooring material manufacturer and adhesive materials manufacturer.
- D. Verify that required floor-mounted utilities are in correct location.

### 3.2 PREPARATION

- A. Remove subfloor ridges and bumps. Fill minor or local low spots, cracks, joints, holes, and other defects with subfloor filler.
- B. Apply, trowel, and float filler to achieve smooth, flat, hard surface. Prohibit traffic until filler is cured.
- C. Vacuum clean substrate.

### 3.3 INSTALLATION

- A. Starting installation constitutes acceptance of subfloor conditions.
- B. Install carpet tile in accordance with manufacturer's instructions.
- C. Blend carpet from different cartons to ensure minimal variation in color match.
- D. Cut carpet tile clean. Fit carpet tight to intersection with vertical surfaces without gaps.
- E. Lay carpet tile in square pattern, with pile direction parallel to next unit, set parallel to building lines.
- F. Locate change of color or pattern between rooms under door centerline.
- G. Trim carpet tile neatly at walls and around interruptions.
- H. Complete installation of edge strips, concealing exposed edges.

### 3.4 CLEANING

- A. Remove excess adhesive without damage, from floor, base, and wall surfaces.
- B. Clean and vacuum carpet surfaces.

END OF SECTION

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## SECTION 09 72 00 - WALL COVERINGS

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Surface preparation and prime painting.
- B. Wall covering.

#### 1.2 RELATED REQUIREMENTS

- A. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.

#### 1.3 REFERENCE STANDARDS

- A. ASTM D1308 - Standard Test Method for Effect of Household Chemicals on Clear and Pigmented Coating Systems 2020.
- B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2021a.

#### 1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on wall covering and adhesive.
- C. Shop Drawings: Indicate wall elevations with seaming layout.
- D. Test Reports: Indicate verification of flame and smoke ratings, when tested by UL.
- E. Manufacturer's Installation Instructions: Indicate special procedures.
- F. Maintenance Data: Submit data on cleaning, touch-up, and repair of covered surfaces.
- G. Manufacturer's Qualification Statement.
- H. Installer's Qualification Statement.

#### 1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

#### 1.6 MOCK-UP

- A. Provide panel, 3 panel drops wide, full height, illustrating installed wall covering and joint seaming technique.

- B. Locate where directed.
- C. Mock-up may remain as part of the Work.

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Inspect roll materials at arrival on site, to verify acceptability.
- B. Protect packaged adhesive from temperature cycling and cold temperatures.
- C. Do not store roll goods on end.

## 1.8 FIELD CONDITIONS

- A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the adhesive or wall covering product manufacturer.
- B. Maintain these conditions 24 hours before, during, and after installation of adhesive and wall covering.
- C. Provide lighting level of 80 ft candles measured mid-height at substrate surfaces.

# PART 2 PRODUCTS

## 2.1 WALL COVERINGS

- A. General Requirements:
  - 1. Surface Burning Characteristics: Flame spread/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84.
  - 2. Chemical and Stain Resistance: No visible staining or discoloration and no damage to surface texture when tested in accordance with ASTM D1308.
- B. Wall Coverings: Refer to the Finish Products Schedule on the Drawings for product and manufacturer information. Provide as indicated or approved equal as required in Section 01 25 00.
- C. Adhesive: Type recommended by wall covering manufacturer to suit application to substrate.
- D. Termination Trim: Extruded plastic, clear.
- E. Substrate Filler: As recommended by adhesive and wall covering manufacturers; compatible with substrate.
- F. Substrate Primer and Sealer: Alkyd enamel type.

# PART 3 EXECUTION

## 3.1 EXAMINATION

- A. Verify that substrate surfaces are ready to receive work, and comply with requirements of wall covering manufacturer.

- B. Measure moisture content of surfaces using an electronic moisture meter. Do not apply wall coverings if moisture content of substrate exceeds level recommended by wall covering manufacturer.
- C. Verify flatness tolerance of surfaces does not vary more than 1/8 inch in 10 feet nor vary at a rate greater than 1/16 inch/ft.

### 3.2 PREPARATION

- A. Fill cracks in substrate and smooth irregularities with filler; sand smooth.
- B. Wash impervious surfaces with tetra-sodium phosphate, rinse and neutralize; wipe dry.
- C. Surface Appurtenances: Remove or mask electrical plates, hardware, light fixture trim, escutcheons, and fittings prior to preparing surfaces or finishing.
- D. Marks: Seal with shellac those that may bleed through surface finishes.
- E. Apply one coat of primer sealer to substrate surfaces. Allow to dry. Lightly sand smooth.
- F. Vacuum clean surfaces free of loose particles.

### 3.3 INSTALLATION

- A. Apply adhesive and wall covering in accordance with manufacturer's instructions.
- B. Use wall covering in roll number sequence.
- C. Razor trim edges on flat work table. Do not razor cut on gypsum board surfaces.
- D. Apply wall covering smooth, without wrinkles, gaps or overlaps. Eliminate air pockets and ensure full bond to substrate surface.
- E. Overlap adjacent panels as recommended by manufacturer.
- F. Horizontal seams are not acceptable.
- G. Do not seam within 2 inches of internal corners or within 6 inches of external corners.
- H. Install wall covering before installation of bases and items attached to or spaced slightly from wall surface.
- I. Do not install wall covering more than 1/4 inch below top of resilient base.
- J. Cover spaces above and below windows, above doors, in pattern sequence from roll.
- K. Where wall covering tucks into reveals, or metal wallboard or plaster stops, apply with contact adhesive within 6 inches of wall covering termination. Ensure full contact bond.
- L. Install termination trim.

M. Remove excess adhesive while wet from seam before proceeding to next wall covering sheet. Wipe clean with dry cloth.

#### 3.4 CLEANING

- A. Clean wall coverings of excess adhesive, dust, dirt, and other contaminants.
- B. Reinstall wall plates and accessories removed prior to work of this section.

#### 3.5 PROTECTION

- A. Do not permit construction activities at or near finished wall covering areas.

END OF SECTION

## SECTION 09 90 00 - PAINTINGS AND COATINGS

### PART 1 - GENERAL

#### 1.1 SECTION INCLUDES

- A. Surface preparation.
- B. Field application of paints.
- C. Scope: Finish all interior and exterior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated.
  - 1. Both sides and edges of plywood backboards for electrical and telecom equipment before installing equipment.
  - 2. Elevator pit ladders.
  - 3. Exposed surfaces of steel lintels and ledge angles.
  - 4. Prime surfaces to receive wall coverings.
  - 5. Mechanical and Electrical:
    - a. In finished areas, paint all insulated and exposed pipes, unless otherwise indicated.
    - b. In finished areas, paint shop-primed items.
    - c. Paint interior surfaces of air ducts and convector and baseboard heating cabinets that are visible through grilles and louvers with one coat of flat black paint to visible surfaces.
    - d. Paint dampers exposed behind louvers, grilles, and convector and baseboard cabinets to match face panels.
- D. Do Not Paint or Finish the Following Items:
  - 1. Items fully factory-finished unless specifically so indicated; materials and products having factory-applied primers are not considered factory finished.
  - 2. Items indicated to receive other finishes.
  - 3. Items indicated to remain unfinished.
  - 4. Fire rating labels, equipment serial number and capacity labels, and operating parts of equipment.
  - 5. Stainless steel, anodized aluminum, bronze, terne, and lead items.
  - 6. Marble, granite, slate, and other natural stones.
  - 7. Floors, unless specifically so indicated.

8. Ceramic and other tiles.
9. Brick, architectural concrete, cast stone, integrally colored plaster and stucco.
10. Glass.
11. Concealed pipes, ducts, and conduits.

## 1.2 DEFINITIONS

- A. Conform to ASTM D16 for interpretation of terms used in this section.

## 1.3 REFERENCE STANDARDS

- A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency current edition.
- B. ASTM D16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications 2014.

## 1.4 SUBMITTALS

- A. See Section 01 33 00 for submittal procedures.
- B. Product Data: Provide complete list of all products to be used, with the following information for each:
  1. Manufacturer's name, product name and/or catalog number, and general product category (e.g. "alkyd enamel").
  2. Cross-reference to specified paint system(s) product is to be used in; include description of each system.
  3. Manufacturer's installation instructions.
- C. Samples: Submit three paper "draw down" samples, 8-1/2 by 11 inches in size, illustrating range of colors available for each finishing product specified.
  1. Where sheen is specified, submit samples in only that sheen.
  2. Where sheen is not specified, discuss sheen options with Architect before preparing samples, to eliminate sheens definitely not required.
  3. Allow 30 days for approval process, after receipt of complete samples by Architect.
  4. Paint color submittals will not be considered until color submittals for major materials not to be painted, such as masonry, have been approved.
- D. Sustainability Certifications: Provide LEED Submittal in accordance with Section 01 81 13 to include completed "LEED Submittal Coversheet" and provide manufacturer supporting documentation that identifies the LEED product requirements listed.

- E. Maintenance Data: Submit data including finish schedule showing where each product/color/finish was used.

## 1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified, with minimum three years documented experience.
- B. Applicator Qualifications: Company specializing in performing the type of work specified with minimum 5 years experience.
- C. Sustainability Requirements: To the greatest extent possible as outlined in Section 01 81 13 -
  - 1. Procure materials that have publicly available EPD.
  - 2. Paint products must have been tested according to California Department of Public Health (CDPH) Standard Method v1.2–2017 using Office Environment (i.e. GREENGUARD GOLD). The above requirement is applicable to products that are field applied within the building's waterproofing system.
  - 3. Paint product must comply with VOC limits as defined by SCAQMD Rule 1113 (02/05/16),

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
- B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
- C. Paint Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

## 1.7 FIELD CONDITIONS

- A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.
- B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.
- C. Do not apply exterior coatings during rain or snow, or when relative humidity is outside the humidity ranges required by the paint product manufacturer.
- D. Minimum Application Temperatures for Latex Paints: 45 degrees F for interiors; 50 degrees F for exterior; unless required otherwise by manufacturer's instructions.
- E. Provide lighting level of 80 ft candles measured mid-height at substrate surface.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Provide all paint and coating products from the same manufacturer to the greatest extent possible.
  1. In the event that a single manufacturer cannot provide all specified products, minor exceptions will be permitted provided approval by Architect is obtained using the specified procedures for substitutions.
  2. Substitution of other products by the same manufacturer is preferred over substitution of products by a different manufacturer.
- B. Substitutions: See Section 01 25 00 - Substitution Procedures.

### 2.2 PAINTS AND COATINGS - GENERAL

- A. Paints and Coatings: Ready mixed, unless intended to be a field-catalyzed coating.
  1. Provide paints and coatings of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
  2. Provide materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
  3. For opaque finishes, tint each coat including primer coat and intermediate coats, one-half shade lighter than succeeding coat, with final finish coat as base color.
  4. Supply each coating material in quantity required to complete entire project's work from a single production run.
  5. Do not reduce, thin, or dilute coatings or add materials to coatings unless such procedure is specifically described in manufacturer's product instructions.
- B. Primers: As follows unless other primer is required or recommended by manufacturer of top coats; where the manufacturer offers options on primers for a particular substrate, use primer categorized as "best" by the manufacturer.
- C. Volatile Organic Compound (VOC) Content:
  1. Provide coatings that comply with the most stringent requirements specified in the following:
    - a. 40 CFR 59, Subpart D--National Volatile Organic Compound Emission Standards for Architectural Coatings.
    - b. Architectural coatings VOC limits of The Commonwealth of Virginia.

2. Determination of VOC Content: Testing and calculation in accordance with 40 CFR 59, Subpart D (EPA Method 24), exclusive of colorants added to a tint base and water added at project site; or other method acceptable to authorities having jurisdiction.
- D. Chemical Content: The following compounds are prohibited:
  1. Aromatic Compounds: In excess of 1.0 percent by weight of total aromatic compounds (hydrocarbon compounds containing one or more benzene rings).
  2. Acrolein, acrylonitrile, antimony, benzene, butyl benzyl phthalate, cadmium, di (2-ethylhexyl) phthalate, di-n-butyl phthalate, di-n-octyl phthalate, 1,2-dichlorobenzene, diethyl phthalate, dimethyl phthalate, ethylbenzene, formaldehyde, hexavalent chromium, isophorone, lead, mercury, methyl ethyl ketone, methyl isobutyl ketone, methylene chloride, naphthalene, toluene (methylbenzene), 1,1,1-trichloroethane, vinyl chloride.
- E. Flammability: Comply with applicable code for surface burning characteristics.
- F. Sheens: Provide the sheens specified; where sheen is not specified, sheen will be selected later by Architect from the manufacturer's full line.
- G. Colors: As indicated in Color Schedule
  1. Extend colors to surface edges; colors may change at any edge as directed by Architect.
  2. In finished areas, finish pipes, ducts, conduit, and equipment the same color as the wall/ceiling they are mounted on/under.

### 2.3 PAINT SYSTEMS - EXTERIOR

- A. All Exterior Surfaces Indicated to be Painted, Unless Otherwise Indicated: Including concrete masonry, primed wood, and primed metal.
  1. Preparation as specified by manufacturer.
  2. Two top coats and one coat primer recommended by manufacturer.
  3. Top Coat(s): Exterior Light Industrial Coating, Water Based;
  4. Semi-Gloss: MPI gloss level 5; use this sheen at all locations.
- B. Wood, Opaque, Latex, 3 Coat:
  1. One coat of latex primer sealer.
  2. Semi-gloss: Two coats of latex enamel.
- C. Masonry/Concrete, Opaque, Latex, 3 Coat:
  1. One coat of block filler.

2. Flat: Two coats of latex enamel.
- D. Ferrous Metals, Primed, Latex, 2 Coat:
  1. Touch-up with rust-inhibitive primer recommended by top coat manufacturer.
  2. Semi-gloss: Two coats of latex enamel.
- E. Galvanized Metals, Latex, 3 Coat:
  1. One coat galvanize primer.
  2. Semi-gloss: Two coats of latex enamel.
- F. Pavement Marking Paint:
  1. White: One coat, with reflective particles.

#### 2.4 PAINT SYSTEMS - INTERIOR

- A. All Interior Surfaces Indicated to be Painted, Unless Otherwise Indicated: Including gypsum board, concrete, concrete masonry, wood, uncoated steel, shop primed steel, and galvanized steel.
  1. Two top coats and one coat primer.
  2. Top Coat(s): Interior Latex.
  3. Eggshell: MPI gloss level 3; use this sheen at all locations.
  4. Primer(s): As recommended by manufacturer of top coats.
- B. Medium Duty Door/Trim: For surfaces subject to frequent contact by occupants, including metals and wood.
  1. Medium duty applications include doors, door frames, railings, handrails, guardrails, and balustrades.
  2. Two top coats and one coat primer.
  3. Top Coat(s): Interior Epoxy-Modified Latex.
  4. Semi-Gloss: MPI gloss level 5; use this sheen at all locations.
  5. Primer(s): As recommended by manufacturer of top coats.
- C. Medium Duty Vertical/Overhead: Including gypsum board, plaster, concrete, concrete masonry, uncoated steel, shop primed steel, and galvanized steel.
  1. Applications: See Finish Schedule.
  2. Two top coats and one coat primer.

3. Top Coat(s): Interior Epoxy-Modified Latex.
  4. Semi-Gloss: MPI gloss level 5; use this sheen at all locations.
  5. Primer(s): As recommended by manufacturer of top coats.
- D. Dry Fall: Metals; exposed structure and overhead-mounted services in utilitarian spaces, including shop primed metal fabrications, galvanized conduit, and galvanized piping.
1. Shop primer by others.
  2. One top coat color to match adjacent surfaces.
  3. Top Coat: Latex Dry Fall.
  4. Eggshell: MPI gloss level 3; use this sheen at all locations.

## 2.5 ACCESSORY MATERIALS

- A. Accessory Materials: Provide all primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials required to achieve the finishes specified whether specifically indicated or not; commercial quality.
- B. Patching Material: Latex filler.
- C. Fastener Head Cover Material: Latex filler.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify that surfaces are ready to receive work as instructed by the product manufacturer.
- B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.
- C. Test shop-applied primer for compatibility with subsequent cover materials.
- D. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
  1. Gypsum Wallboard: 12 percent.
  2. Masonry, Concrete, and Concrete Unit Masonry: 12 percent.

### 3.2 PREPARATION

- A. Clean surfaces thoroughly and correct defects prior to coating application.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

- C. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.
- D. Seal surfaces that might cause bleed through or staining of topcoat.
- E. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.
- F. Concrete and Unit Masonry Surfaces to be Painted: Remove dirt, loose mortar, scale, salt or alkali powder, and other foreign matter. Remove oil and grease with a solution of tri-sodium phosphate; rinse well and allow to dry. Remove stains caused by weathering of corroding metals with a solution of sodium metasilicate after thoroughly wetting with water. Allow to dry.
- G. Gypsum Board Surfaces to be Painted: Fill minor defects with filler compound. Spot prime defects after repair.
- H. Galvanized Surfaces to be Painted: Remove surface contamination and oils and wash with solvent. Apply coat of etching primer.
- I. Uncorroded Uncoated Steel and Iron Surfaces to be Painted: Remove grease, mill scale, weld splatter, dirt, and rust. Where heavy coatings of scale are evident, remove by hand wire brushing or sandblasting; clean by washing with solvent. Apply a treatment of phosphoric acid solution, ensuring weld joints, bolts, and nuts are similarly cleaned. Prime paint entire surface; spot prime after repairs.
- J. Shop-Primed Steel Surfaces to be Finish Painted: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces. Re-prime entire shop-primed item.
- K. Wood Doors to be Field-Finished: Seal wood door top and bottom edge surfaces with clear sealer.
- L. Metal Doors to be Painted: Prime metal door top and bottom edge surfaces.

### 3.3 APPLICATION

- A. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
- B. Apply products in accordance with manufacturer's instructions.
- C. Where adjacent sealant is to be painted, do not apply finish coats until sealant is applied.
- D. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
- E. Apply each coat to uniform appearance.
- F. Sand wood and metal surfaces lightly between coats to achieve required finish.
- G. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.

- H. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

### 3.4 CLEANING

- A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

### 3.5 PROTECTION

- A. Protect finished coatings until completion of project.
- B. Touch-up damaged coatings after Substantial Completion.

### 3.6 FINISH PAINTING SCHEDULE

- A. Refer to Finish Products Schedule on Drawings and in Section 09 06 01 - Residential Unit Finishes Schedule
- B. General: Unless noted otherwise:
  1. System DFT specified identifies the minimum of the acceptable range.
  2. All walls and ceilings: Eggshell sheen except as noted otherwise.
  3. Bathroom walls and ceilings: Eggshell sheen.
  4. All doors, frames, base and trim: Semi-gloss sheen.

END OF SECTION

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## SECTION 09 96 00 - HIGH PERFORMANCE COATINGS

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. High performance coatings.
  - 1. Surface preparation.

#### 1.2 REFERENCE STANDARDS

- A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2014.
- B. ASTM D4258 - Standard Practice for Surface Cleaning Concrete for Coating; 2005 (Reapproved 2012).
- C. MPI (APL) - Master Painters Institute Approved Products List; Master Painters and Decorators Association; current edition, [www.paintinfo.com](http://www.paintinfo.com).
- D. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual; current edition, [www.paintinfo.com](http://www.paintinfo.com).
- E. SSPC-SP 1 - Solvent Cleaning; Society for Protective Coatings; 1982 (Ed. 2004).
- F. SSPC-SP 2 - Hand Tool Cleaning; Society for Protective Coatings; 1982 (Ed. 2004).
- G. SSPC-SP 6 - Commercial Blast Cleaning; Society for Protective Coatings; 2007.
- H. SSPC-SP 13 - Surface Preparation of Concrete; Society for Protective Coatings; 2003 (Reaffirmed 2015).

#### 1.3 SUBMITTALS

- A. See Section 01 33 00 for general submittal procedures.
- B. Product Data: Provide complete list of all products to be used, with the following information for each:
  - 1. Manufacturer's name, product name and/or catalog number, and general product category (e.g. "alkyd enamel").
  - 2. MPI product number (e.g. MPI #47).
  - 3. Cross-reference to specified coating system(s) product is to be used in; include description of each system.
  - 4. Manufacturer's installation instructions.
- C. Samples: Submit two samples 4 x 8 inch in size illustrating colors available for selection.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

- E. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.
- F. Maintenance Data: Include cleaning procedures and repair and patching techniques.

#### 1.4 QUALITY ASSURANCE

- A. Single Source Responsibility: Provide products of single manufacturer for use in each coating system. Do not mix products of different manufacturers without approval of Architect and manufacturers involved.
- B. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- C. Applicator Qualifications: Company specializing in performing the work of this section with minimum 3 years documented experience.
- D. Regulatory Requirements:
  - 1. Lead Content: Comply with CPSC 16, CFR 1303, and other applicable federal, state, and local regulations.
  - 2. Volatile Organic Compound Content: Code of Federal Regulations 40 CFR 59. Refer to Section 01 81 13 for LEED Requirements for low-emitting products.

#### 1.5 FIELD SAMPLES

- A. General: Comply with Section 01 40 00.
- B. Sample Installation: Duplicate finishes of approved coating system samples on wall surfaces and other interior and exterior components selected by Architect.
  - 1. Provide full-coat finish on at least 10 lineal feet of surface until required color, sheen, and texture are obtained. Simulate finished lighting conditions for review of in-place work.
  - 2. Request review by Architect of first finished room, space, or item for each coating system for color, texture, quality, and workmanship before proceeding with rest of Work.
  - 3. Accepted Field Sample: May remain part of completed Work.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
- B. Container Label: Include manufacturer's name, type of coating, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
- C. Coating Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

## 1.7 FIELD CONDITIONS

- A. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.
- B. Do not install materials when temperature is below 55 degrees F or above 90 degrees F.
- C. Maintain this temperature range, 24 hours before, during, and 72 hours after installation of coating.
- D. Restrict traffic from area where coating is being applied or is curing.

## 1.8 WARRANTY

- A. Special Warranty: Prepare and submit in accordance with Section 01 78 00.
  - 1. Warrant against defects in material and workmanship for five years.
  - 2. Repair or replace defects occurring during warranty period.
  - 3. Defects include but are not limited to holidays, wrinkling, pinholes, crazing and cracking, loss of adhesion to substrate, deficient thickness, improper materials and workmanship.
- B. Correct defective Work within a five year period after Date of Substantial Completion.

# PART 2 PRODUCTS

## 2.1 MANUFACTURERS

- A. Provide high performance coating products from the same manufacturer to the greatest extent possible.
  - 1. In the event that a single manufacturer cannot provide specified products, minor exceptions will be permitted provided approval by Architect is obtained using the specified procedures for substitutions.
  - 2. Substitution of a different high performance coating system using MPI-approved products by the same manufacturer will be considered.
- B. High-Performance Coatings: Provide complete multi-coat systems formulated and recommended by manufacturer for the applications indicated, in the thicknesses indicated; number of coats specified does not include primer or filler coat.
  - 1. Substitutions: Refer to Section 01 25 00 for requirements regarding submittal and approval procedures for Substitutions.

## 2.2 HIGH-PERFORMANCE COATINGS

- A. Elastomeric Coating: Textured 100 percent acrylic, elastomeric waterproof coating; Basis of design is 1129 Kel-seal Terpolymer as manufactured by Kelly-Moore Paints or approved equal;
  - 1. Conforms to MPI approved product #42.

2. Color: as selected by the Architect from Manufacturer's standard range.
  3. Finish: Flat
  4. Number of Coats: Two.
  5. Product characteristics:
  6. Percentage of solids by volume: 45, minimum.
  7. Dry film thickness, per coat: 8 to 10 mils, minimum.
- B. High Build Acrylic Polyurethane Coatings:
1. **Acceptable Manufacturers and Products:**
    - a. Carbozinc 11 WB or Carbozinc 18 WB from Carbozinc, gloss.
    - b. Tnemec Series 1081, gloss.
    - c. Accepted Substitute in accordance with Section 01 25 00.
  2. Solids Content by Volume: 57 percent minimum.
  3. Sheen: Gloss.
  4. Performance Requirements: Tests are based on one coat of primer and one finish coat at manufacturer's recommended DFT.
  5. Abrasion: ASTM D4060, CS17 wheel with 1000 g load, maximum 90 mg loss after 1000 cycles.
  6. Adhesion: ASTM D4541, not less than 800 PSI pull, average of three trials.
  7. Humidity: ASTM D4585, no blistering, cracking, and delamination of film after 1000 hours exposure.
  8. Salt Spray (Fog): ASTM B117, No blistering, cracking, softening, and delamination of film. No more than 1/8 inch rust creepage at scribe and no more than one percent rusting at edges after 1000 hours exposure.

## 2.3 PRIMERS

- A. Primers: Provide the following unless other primer is required or recommended by coating manufacturer.
- B. Primer Sealer, 100 percent acrylic primer as recommended by coating manufacturer.
- C. Block Filler, Latex; as recommended by the coating manufacturer.

## 2.4 ACCESSORY MATERIALS

- A. Accessory Materials: Provide all primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of coated surfaces.

# PART 3 EXECUTION

## 3.1 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Do not begin application of coatings until substrates have been properly prepared.
- C. Verify that substrate surfaces are ready to receive work as instructed by the coating manufacturer. Obtain and follow manufacturer's instructions for examination and testing of substrates.
- D. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.
- E. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
  1. Cementitious Substrates: Do not begin application until substrate has cured 28 days minimum and measured moisture content is not greater than 12 percent.
  2. Masonry, Concrete, and Concrete Unit Masonry: 12 percent.

## 3.2 PREPARATION

- A. Clean surfaces of loose foreign matter.
- B. Remove substances that would bleed through finished coatings. If unremovable, seal surface with shellac.
- C. Remove finish hardware, fixture covers, and accessories and store.
- D. Concrete:
  1. Remove release agents, curing compounds, efflorescence, and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.
  2. Clean surfaces with pressurized water. Use pressure range of 1500 to 4000 psi at 6 to 12 inches. Allow to dry.
  3. Clean concrete according to ASTM D4258. Allow to dry.
  4. Prepare surface as recommended by coating manufacturer and according to SSPC-SP 13.
- E. Masonry:

1. Remove efflorescence and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces or if alkalinity of mortar joints exceed that permitted in manufacturer's written instructions. Allow to dry.
  2. Prepare surface as recommended by coating manufacturer.
  3. Clean surfaces with pressurized water. Use pressure range of 600 to 1500 psi at 6 to 12 inches. Allow to dry.
- F. Protect adjacent surfaces and materials not receiving coating from spatter and overspray; mask if necessary to provide adequate protection. Repair damage.

### 3.3 PRIMING

- A. Apply primer to all surfaces, unless specifically not required by coating manufacturer. Apply in accordance with coating manufacturer's instructions.
- B. Concrete: Prior to priming, patch with masonry filler to produce smooth surface.
- C. Concrete Masonry: Apply masonry filler to thickness required to fill holes and produce smooth surface; minimum thickness of 30 mils.

### 3.4 COATING APPLICATION

- A. Apply coatings in accordance with manufacturer's written instructions, to thicknesses specified and recommendations in "MPI Architectural Painting and Specification Manual".
- B. Apply in uniform thickness coats, without runs, drips, pinholes, brush marks, or variations in color, texture, or finish. Finish edges, crevices, corners, and other changes in dimension with full coating thickness.

### 3.5 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for general requirements for field inspection.
- B. Dry Film Thickness Testing: Owner will engage the services of a qualified testing and inspecting agency to inspect and test coatings for dry film thickness.
  1. Touch up and restore coated surfaces damaged by testing.
  2. If test results show that dry film thickness of applied coating does not comply with coating manufacturer's written recommendations, and specified thickness, Contractor shall pay for retesting and apply additional coats as needed to provide dry film thickness that complies with coating manufacturer's written recommendations, and specified thickness.

### 3.6 CLEANING

- A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

- B. Clean surfaces immediately of overspray, splatter, and excess material.
- C. After coating has cured, clean and replace finish hardware, fixtures, and fittings previously removed.
- D. See Section 01 74 19 - Construction Waste Management and Disposal, for additional requirements.

### 3.7 PROTECTION

- A. Protect finished work from damage.

END OF SECTION

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## SECTION 10 14 00 - SIGNAGE

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Room and door signs.
- B. Interior directional and informational signs.
- C. Building identification signs.

#### 1.2 REFERENCE STANDARDS

- A. 36 CFR 1191 - Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines current edition.
- B. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design 2010.
- C. ICC A117.1 - Accessible and Usable Buildings and Facilities 2017.

#### 1.3 SUBMITTALS

- A. See Section 01 33 00 for submittal procedures.
- B. Product Data: Manufacturer's printed product literature for each type of sign, indicating sign styles, font, foreground and background colors, locations, overall dimensions of each sign.
- C. Signage Schedule: Provide information sufficient to completely define each sign for fabrication, including room number, room name, other text to be applied, sign and letter sizes, fonts, and colors.
  - 1. When room numbers to appear on signs differ from those on drawings, include the drawing room number on schedule.
  - 2. When content of signs is indicated to be determined later, request such information from Owner through Architect at least 2 months prior to start of fabrication; upon request, submit preliminary schedule.
  - 3. Submit for approval by Owner through Architect prior to fabrication.
- D. Manufacturer's Installation Instructions: Include installation templates and attachment devices.

#### 1.4 QUALITY ASSURANCE

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Package signs as required to prevent damage before installation.
- B. Package room and door signs in sequential order of installation, labeled by floor or building.
- C. Store tape adhesive at normal room temperature.

## 1.6 FIELD CONDITIONS

- A. Do not install tape adhesive when ambient temperature is lower than recommended by manufacturer.
- B. Maintain this minimum temperature during and after installation of signs.

## PART 2 PRODUCTS

### 2.1 SIGNAGE APPLICATIONS

- A. Accessibility Compliance: Signs are required to comply with ADA Standards and ICC A117.1 and applicable building codes, unless otherwise indicated; in the event of conflicting requirements, comply with the most comprehensive and specific requirements.
- B. Room and Door Signs: Provide a sign for every public doorway, whether it has a door or not, not including corridors, lobbies, and similar open areas.
  - 1. Sign Type: Flat signs with engraved panel media as specified.
  - 2. Provide "tactile" signage, with letters raised minimum 1/32 inch and Grade II braille.
  - 3. Character Height: 1 inch.
  - 4. Sign Height: 2 inches, unless otherwise indicated.
  - 5. Office Doors: Identify with room numbers to be determined later, not the numbers indicated on drawings; in addition, provide "window" section for replaceable occupant name.
  - 6. Amenity Areas and Rooms: Identify with room numbers to be determined later, not the numbers indicated on drawings.
  - 7. Service Rooms: Identify with room names and numbers to be determined later, not those indicated on drawings.
  - 8. Rest Rooms: Identify with pictograms, the names "MEN" and "WOMEN", room numbers to be determined later, and braille.
  - 9. Residential Unit Entry Doors: Identify with unit numbers to be determined later, not those shown on the drawings.
- C. Interior Directional and Informational Signs:
  - 1. Sign Type: Same as room and door signs.
  - 2. Sizes: As indicated on drawings.
  - 3. Allow for 20 signs 4 inches high by 16 inches long.
  - 4. Wording of signs is scheduled on drawings.
- D. Building Identification Signs:

1. Use individual metal letters.
2. Refer to Drawings for mounting and configuration.

## 2.2 SIGN TYPES

- A. Flat Signs: Signage media without frame.
  1. Edges: Square.
  2. Corners: Square.
  3. Wall Mounting of One-Sided Signs: Tape adhesive.
- B. Color and Font: Unless otherwise indicated:
  1. Character Font: Helvetica, Arial, or other sans serif font.
  2. Character Case: Upper case only.
  3. Background Color: Clear.
  4. Character Color: Contrasting color.

## 2.3 TACTILE SIGNAGE MEDIA

- A. Engraved Panels: Laminated colored plastic; engraved through face to expose core as background color:
  1. Total Thickness: 1/16 inch.

## 2.4 DIMENSIONAL LETTERS

- A. Metal Letters: Size and font as indicated on Drawings
  1. Metal: Aluminum casting.
  2. Metal Thickness: 1/8 inch minimum.
  3. Mounting: as indicated on Drawings. .

## 2.5 ACCESSORIES

- A. Concealed Screws: Stainless steel, galvanized steel, chrome plated, or other non-corroding metal.
- B. Tape Adhesive: Double sided tape, permanent adhesive.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify that substrate surfaces are ready to receive work.

### 3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install neatly, with horizontal edges level.
- C. Locate signs and mount at heights indicated on drawings and in accordance with ADA Standards and ICC A117.1.
- D. Protect from damage until Substantial Completion; repair or replace damaged items.

END OF SECTION

## SECTION 10 26 03 - WALL GUARDS

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Bumper rails.
- B. Corner guards.

#### 1.2 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry: Blocking for wall and corner guard anchors.

#### 1.3 REFERENCE STANDARDS

- A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2021a.

#### 1.4 SUBMITTALS

- A. See Section 01 33 00 for submittal procedures.
- B. Product Data: Indicate physical dimensions, features, anchorage details, and rough-in measurements.
- C. Manufacturer's Instructions: Indicate special procedures, perimeter conditions requiring special attention.

### PART 2 PRODUCTS

#### 2.1 COMPONENTS

- A. Bumper Rails: Factory- or shop-fabricated, with preformed end caps and internal and external corners:
  - 1. Performance of Installed Assembly:
    - a. Support vertical live load of 100 lb/lineal ft with deflection not to exceed 1/50 of span between supports.
    - b. Resist lateral force of 250 lbs at any point without damage or permanent set.
  - 2. Material: Extruded EPDM Rubber, with single bulb; color black.
  - 3. Surface Burning Characteristics: Provide assemblies with flame spread index of 25 or less and smoke developed index of 450 or less, when tested in accordance with ASTM E84.
  - 4. Mounting: Surface.
  - 5. Projection From Wall to Outside of Rail: 5 inch.
  - 6. Length: Minimum one piece length not less than 120 inches; flush splicing.
- B. Mounting Brackets and Attachment Hardware: Appropriate to component and substrate.

## 2.2 FABRICATION

- A. Fabricate components with tight joints, corners and seams.
- B. Pre-drill holes for attachment.
- C. Form end trim closure by capping and finishing smooth.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify that rough openings, concealed blocking, and anchors are correctly sized and located.
- B. Verify that field measurements are as indicated on drawings.

### 3.2 INSTALLATION

- A. Install components in accordance with manufacturer's instructions, level and plumb, secured rigidly in position to wall framing members only.
- B. Position top of bumper rail 32 inches from finished floor.
- C. Terminate rails 8 inches short of door opening.

### 3.3 TOLERANCES

- A. Maximum Variation From Required Height: 1/4 inch.
- B. Maximum Variation From Level or Plane For Visible Length: 1/4 inch.

END OF SECTION

## SECTION 10 28 00 - TOILET AND BATH ACCESSORIES

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Commercial toilet accessories.
- B. Residential toilet, shower, and bath accessories.

#### 1.2 RELATED REQUIREMENTS

- A. Section 08 83 00 - Mirrors:

#### 1.3 REFERENCE STANDARDS

- A. ASTM A269/A269M - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service 2015a (Reapproved 2019).
- B. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar 2015.

#### 1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate the work with the placement of internal wall reinforcement and reinforcement of toilet partitions to receive anchor attachments.

#### 1.5 SUBMITTALS

- A. See Section 01 33 00, for submittal procedures.
- B. Product Data: Submit data on accessories describing size, finish, details of function, and attachment methods.
- C. Manufacturer's Installation Instructions: Indicate special procedures and conditions requiring special attention.

### PART 2 PRODUCTS

#### 2.1 PRODUCTS

- A. Provide products and manufacturers as indicated on the toilet accessory schedule on the drawings.

#### 2.2 MATERIALS

- A. Accessories - General: Shop assembled, free of dents and scratches and packaged complete with anchors and fittings, steel anchor plates, adapters, and anchor components for installation.
  1. Grind welded joints smooth.
  2. Fabricate units made of metal sheet of seamless sheets with flat surfaces.

- B. Stainless Steel Sheet: ASTM A666, Type 304.
- C. Stainless Steel Tubing: ASTM A269/A269M, Grade TP304 or TP316.
- D. Adhesive: Two component epoxy type, waterproof.
- E. Fasteners, Screws, and Bolts: Hot dip galvanized; tamper-proof; security type.
- F. Expansion Shields: Fiber, lead, or rubber as recommended by accessory manufacturer for component and substrate.

## 2.3 FINISHES

- A. Stainless Steel: Satin finish, unless otherwise noted.

## 2.4 RESIDENTIAL TOILET, SHOWER, AND BATH ACCESSORIES

- A. Decorative Aluminum Grab Bars: Smooth surface.
  - 1. Push/Pull Point Load: 250 pound-force, minimum.
  - 2. Dimensions: 1.6 inch outside diameter, minimum 0.080 inch wall thickness, bracket, 1-1/2 inch clearance between wall and inside of grab bar.
  - 3. Finish: Matte silver.
  - 4. Length and Configuration: As indicated on drawings.
- B. Towel Bar: Square tubular bar; rectangular mounting posts, concealed attachment.
  - 1. Mounting Post Material: Stainless steel; bright polished finish.
  - 2. Bar Material: Stainless steel; bright polished finish.
  - 3. Length: as indicated on the Drawings
- C. Shower Curtain Rod: Straight tube, 1 inch diameter, with mounting flanges for concealed attachment.
  - 1. Material: Stainless steel; bright polished finish.
  - 2. Length: as indicated on the Drawings.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify exact location of accessories for installation.
- C. Verify that field measurements are as indicated on drawings.

### 3.2 PREPARATION

- A. Deliver inserts and rough-in frames to site for timely installation.
- B. Provide templates and rough-in measurements as required.

### 3.3 INSTALLATION

- A. Install accessories in accordance with manufacturers' instructions in locations indicated on drawings.
- B. Install plumb and level, securely and rigidly anchored to substrate.
- C. Mounting Heights: As required by accessibility regulations, unless otherwise indicated.
  - 1. Grab Bars: As indicated on drawings.
  - 2. Mirrors: As indicated on drawings.

### 3.4 PROTECTION

- A. Protect installed accessories from damage due to subsequent construction operations.

END OF SECTION

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## SECTION 10 31 00 - MANUFACTURED FIREPLACES

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Manufactured steel box fireplace, gas fired, vent free.
- B. Manufactured fire pits for amenity areas as indicated,

#### 1.2 REFERENCE STANDARDS

- A. UL (DIR) - Online Certifications Directory Current Edition.
- B. UL 127 - Standard for Factory-Built Fireplaces Current Edition, Including All Revisions.

#### 1.3 SYSTEM DESCRIPTION

- A. Built-in gas fired fireboxes, vent free, linear onesided configuration; electronic remote ignition and circulating fan.
- B. Exterior freestanding fire pit, gas fired, remote electronic ignition; glass surround.

#### 1.4 SUBMITTALS

- A. See Section 01 33 00 for general submittal procedures.
- B. Product Data: Provide fire box cabinet dimensions, clearances required from adjacent dissimilar construction, applicable regulatory agency approvals, electrical characteristics of fan.
- C. Shop Drawings: Indicate firebox rough opening dimensions, supply piping for gas, and electrical connections for ignition and fan operation.
- D. Manufacturer's Certificate: Certify that fireplace components meet or exceed UL (DIR) requirements.
- E. Manufacturer's Instructions: Indicate installation procedures and component installation sequence, clearances and tolerances from adjacent construction.

### PART 2 PRODUCTS

#### 2.1 REGULATORY REQUIREMENTS

- A. Comply with applicable code for clearances from adjacent materials, chimney height above roof line requirements, and unit UL approval.
- B. Comply with certification requirements for ANSI Z21.11.2.
- C. Listed by Underwriters Laboratories Inc. (UL) as complying with UL 127.
- D. Products Requiring Electrical Connection: Listed and labeled by UL (DIR) or testing firm acceptable to authorities having jurisdiction, as suitable for the purpose specified and indicated.

## 2.2 COMPONENTS

- A. Linear Fireplace: Single sided Fireplace; H Series, model HVF-60-P, as manufactured by European Home or approved equal.

1. Gas Type: Natural Gas
2. Heat Input (Natural Gas): 25,000 - 37,500 BTU/hr
3. Viewable Opening: 60 inches wide by 18 inches high.
4. Venting: N/A
5. Flame Adjustment: Yes
6. Remote Control: Yes
7. Certification: ANSI Z21.11.2
8. Interior: Satin Black.
9. Fire Media: Carrara Pebbles.

- B. Roof Deck Fire Pit:

1. Approved Manufacturers:

- a. Ore Inc. model 4020 Linear Fire Pit; Refer to Landscape drawings for placement and product options.

2. Accessories:

- a. Emergency Flame Shut-Off Switch: Weatherproof maintained contact red mushroom head pushbutton switch with cover labeled "EMERGENCY SHUTOFF," suitable for wiring in series in low-voltage gas control circuit.

- 1) Provide signage adjacent to Emergency Shutoff Switch.

- b. All other components required for complete installation.

- c. Warning Plaques: Warning plaques, located as shown on Drawings, with text as follows oriented to be read from adjoining walking surfaces:

- 1) NOTICE: DO NOT LEAVE CHILDREN UNATTENDED."

## 2.3 ACCESSORIES

- A. Circulating Fans: Motor and fan, UL approved, 120 volts with remote on/off switch, sheet steel enclosure, and face grille.

- B. Fasteners and Anchors: Galvanized steel type.

## PART 3 EXECUTION

### 3.1 VERIFICATION OF CONDITIONS

- A. Verify that prepared openings are ready to receive work and opening dimensions are as indicated on drawings.
- B. Verify that proper power supply and fuel source are available.

### 3.2 INSTALLATION

- A. Install unit assemblies in accordance with manufacturer's instructions.
- B. Carefully cut holes for fan wall switch and grilles.

END OF SECTION

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## SECTION 10 44 00 - FIRE PROTECTION SPECIALTIES

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Fire extinguishers.
- B. Fire extinguisher cabinets.
- C. Accessories.

#### 1.2 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry: Wood blocking product and execution requirements.

#### 1.3 REFERENCE STANDARDS

- A. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems 2013a (Reapproved 2017).
- B. NFPA 10 - Standard for Portable Fire Extinguishers 2017, with Errata (2018).
- C. UL (DIR) - Online Certifications Directory Current Edition.

#### 1.4 SUBMITTALS

- A. See Section 01 33 00 for submittal procedures.
- B. Product Data: Provide extinguisher operational features, extinguisher ratings and classifications, and installation instructions.
- C. Shop Drawings: Indicate locations of cabinets and cabinet physical dimensions.
- D. Manufacturer's Installation Instructions: Indicate special criteria and wall opening coordination requirements.
- E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- F. Maintenance Data: Include test, refill or recharge schedules and re-certification requirements.

#### 1.5 FIELD CONDITIONS

- A. Do not install extinguishers when ambient temperature may cause freezing of extinguisher ingredients.

### PART 2 PRODUCTS

#### 2.1 FIRE EXTINGUISHERS

- A. Fire Extinguishers - General: Comply with product requirements of NFPA 10 and applicable codes, whichever is more stringent.

1. Provide extinguishers labeled by UL (DIR) for purpose specified and as indicated.
- B. Multipurpose Dry Chemical Type Fire Extinguishers: Carbon steel tank, with pressure gauge.
  1. Provide at Amenity Spaces and Corridors.
  2. Stored Pressure Operated: Deep Drawn.
  3. Class: 2A:20B:C type.
  4. Size: 20 pound.
  5. Finish: Baked polyester powder coat, red color.
  6. Temperature range: Minus 65 degrees F to 120 degrees F.
- C. Multipurpose Dry Chemical Type Fire Extinguishers: Carbon steel tank, with pressure gauge.
  1. Provide at Elevator Machine Room.
  2. Cartridge Operated: Spun shell.
  3. Stored Pressure Operated: Deep Drawn.
  4. Class: 2A:10B:C type.
  5. Size: 5 pound.
  6. Size and classification as scheduled.
  7. Finish: Baked polyester powder coat, red color.
  8. Temperature range: Minus 40 degrees F to 120 degrees F.
- D. FE-36 Clean Agent Type Fire Extinguishers: Stainless steel tank, with pressure gauge.
  1. Locate at units under kitchen sink area
  2. Class: A:B:C type.
  3. Size: 2.5 pound.
  4. Temperature Range: Minus 40 degrees F to 120 degrees F.

## 2.2 FIRE EXTINGUISHER CABINETS

- A. Fire Rating: Listed and labeled in accordance with ASTM E814 requirements for fire resistance rating of walls where being installed.
- B. Basis of Design: Occult Series Cabinet as manufactured by Larsen.

1. Provide as indicated or approved equal; refer to Section 01 25 00 for submittal and acceptance requirements for proposed substitutions.
- C. Fire Rated Cabinet Construction: One-hour fire rated.
  1. Steel; double wall or outer and inner boxes with 5/8 inch thick fire barrier material.
- D. Cabinet Configuration: Recessed type.
  1. Size to accommodate accessories.
  2. Trimless type.
  3. Provide cabinet enclosure with right angle inside corners and seams, and with formed perimeter trim and door stiles.
- E. Door: Stainless steel; 0.036 inch metal thickness, reinforced for flatness and rigidity with nylon catch. Hinge doors for 180 degree opening with two butt hinge; Vertical Duo style door
- F. Door Glazing: Float glass, clear, 1/8 inch thick, and set in resilient channel glazing gasket.
- G. Cabinet Mounting Hardware: Appropriate to cabinet, with pre-drilled holes for placement of anchors.
- H. Fabrication: Weld, fill, and grind components smooth.
- I. Finish of Cabinet Exterior Trim and Door: No.4 - Brushed stainless steel.
- J. Finish of Cabinet Interior: White colored enamel.

## 2.3 ACCESSORIES

- A. Extinguisher Brackets: Formed steel, chrome-plated. Provide for extinguishers located in back of house and garage areas.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify rough openings for cabinet are correctly sized and located.

### 3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Secure rigidly in place.
- C. Place extinguishers in cabinets.

### 3.3 SCHEMES

A. Refer to Drawings for locations.

END OF SECTION

## SECTION 10 51 33 - ENCLOSED STORAGE UNITS

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Enclosed storage units, including walls, swinging doors, mesh ceiling, and accessories..

#### 1.2 REFERENCE STANDARDS

- A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design 2010.
- B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel 2019.
- C. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes 2021a.
- D. ASTM A510/A510M - Standard Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel, and Alloy Steel 2020.
- E. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2020.
- F. ICC A117.1 - Accessible and Usable Buildings and Facilities 2017.

#### 1.3 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meetings: Review coordination requirements in accordance with Section 01 30 00.

#### 1.4 SUBMITTALS

- A. See Section 01 33 00 for general submittal procedures.
- B. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of storage unit and bench..
- C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
  - 1. Show relationship with adjacent construction.
  - 2. Include storage unit identification system.
- D. Operation and Maintenance Data: For adjusting and replacing doors and latching mechanisms to include in maintenance manuals.
- E. Manufacturer's Installation Instructions: Indicate component installation assembly.

#### 1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with at least three years of documented experience.

- B. A. Installer Qualifications: An authorized representative of manufacturer for installation and maintenance of units required for this Project.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. See Section 01 74 19 - Construction Waste Management and Disposal for packaging waste requirements.
- B. Do not deliver storage units until spaces to receive them are clean, dry, and ready for storage unit installation.

## 1.7 FIELD CONDITIONS

- A. Field Measurements: Verify the following by field measurements before fabrication and indicate measurements on Shop Drawings:

1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish recessed opening dimensions and proceed with fabricating storage units without field measurements. Coordinate wall and floor construction to ensure that actual recessed opening dimensions correspond to established dimensions.

## 1.8 COORDINATION

- A. Coordinate size and location of bases for storage units.
- B. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that storage units can be supported and installed as indicated.

# PART 2 PRODUCTS

## 2.1 SYSTEMS

- A. Description: Modular component storage unit system; [Basis of Design Bradyl Bins Storage System by Bradyl](#).
- B. Accessibility: Design units indicated on drawings as 'accessible' to comply with ICC A117.1 and ADA Standards.
- C. Assembly:
  1. Shop fabricate to the greatest extent possible.
- D. Finish: Manufacturer's standard high performance powder coated finish, colors as acceptable to Architect from manufacturer's standard range.

## 2.2 COMPONENTS

- A. Hallway and Unit Divider Panels: 20 inch sections of corrugated 26 gauge steel.

- B. Doors: Outward swinging doors; 26 gauge corrugated steel with reinforced solid-square tube X-bracing. 3 inch wide vertical stiles and 180 degree hinges. Factory installed slide latch that accepts padlock and over-lock.
- C. Corner Guard: 3 inch by 3 inch, 26 gauge steel angle, prefinished.
- D. Accessories: Galvanized steel base channel, midspan, top channel, side angle.
- E. Wire Mesh Ceiling: 2 inch x 2 inch, 16 gauge welded wire mesh.

## 2.3 FASTENERS

- A. Bolts, Nuts and Washers: Hot dip galvanized.
- B. Anchorage Devices: Provide power driven, powder actuated, and drilled expansion bolts.
- C. Exposed Mechanical Fastenings: Flush countersunk screws or bolts, unobtrusively located, consistent with design of structure.

## 2.4 MATERIALS

- A. Precoated Steel Sheet: Hot-dipped galvanized steel sheet, ASTM A653/A653M, with G90/Z275 coating; continuous coil-coated on exposed surfaces with specified finish coating and on panel back with specified panel back coating.
- B. Welded Wire Mesh: ASTM A510/A510M Uncoated steel wire; light duty, 16 gauge, 2 inch by 2 inch opening size.
- C. Framing and Support Members:
  1. Material: ASTM A36/A36M steel shapes and ASTM A500/A500M cold-formed steel tubing.
  2. Framing, Corner Posts, and Intermediate Support Members: Manufacturer's standard sizes for system specified and as indicated on drawings.
- D. Number Plates: Provide square shaped aluminum plates. Form numbers 1-1/2 inch high of block font style with ADA designation, in contrasting color.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify that substrate surfaces are ready to receive work. Examine walls, floors, and support bases for compliance with requirements for installation tolerances and other conditions affecting performance of work.

### 3.2 INSTALLATION

- A. Install storage units in accordance with manufacturer's instructions and in proper relationship with adjacent construction.

- B. Install storage units plumb and square.
- C. Secure with anchor devices to suit substrate materials. Minimum Pullout Force: 100 pounds.
- D. Bolt adjoining locker components together to provide rigid installation.
- E. Doors to hang plumb and balanced.
- F. Clean, lubricate, and adjust hardware. Adjust doors and latches to operate easily without binding. Verify that integral locking devices operate properly.
- G. Install fittings if not factory installed.
- H. Replace components that do not operate smoothly.

### 3.3 CLEANING AND PROTECTION

- A. Clean locker interiors and exterior surfaces.
- B. Protect storage units from damage, abuse, dust, dirt, stain, or paint from subsequent construction operations. Do not permit storage unit use during construction.
- C. Touch up marred finishes, or replace storage units that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by storage unit manufacturer.

END OF SECTION

## SECTION 10 55 00 - POSTAL SPECIALTIES

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Central mail delivery boxes.
- B. Parcel lockers.

#### 1.2 REFERENCE STANDARDS

#### 1.3 SUBMITTALS

- A. See Section 01 33 00 for submittal procedures.
- B. Product Data: Provide manufacturer's specifications and descriptive literature, installation instructions, maintenance information, and current USPS approval documentation.
- C. Shop Drawings: Indicate plans for each unit or groups of units, front elevations with compartment layout and model number, overall dimensions, rough-in opening sizes, construction and anchorage details.

#### 1.4 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Provide manufacturer's warranty against defects in materials or workmanship for a period of 5 years from Date of Substantial Completion.

### PART 2 PRODUCTS

#### 2.1 CENTRAL MAIL DELIVERY BOXES

- A. Central Mail Delivery Boxes: Provide products approved for United States Postal Service (USPS) delivery.

1. Basis of Design: Recessed Mount 4C10D-18 as manufactured by Florence Manufacturing.
2. Materials: Aluminum with stainless steel hardware.
3. Finish: Finish and color as selected from manufacturer's standard colors.
4. Unit Types and Sizes: As indicated on drawings.
5. Configurations: See drawings for overall dimensions and layouts.

- B. Parcel Locker: Provide products approved for United States Postal Service (USPS) delivery and compliant with ADA standards for Accessible Design.

1. Basis of Design: Luxer Locker, Main Unit as manufactured by Luxer One.

2. Materials: 12 guage corrosion resistant steel.
3. Finish: Finish and color as selected from manufacturer's standard colors.
4. Unit Types and Sizes: As indicated on drawings.
5. Configurations: See drawings for overall dimensions and layouts.
6. Combination Master Lock with digital access.

## 2.2 COMPONENTS

- A. Locking - Front Loading Master Door: Three-point latching mechanism with USPS master lock furnished and installed by postmaster.
- B. Locking - Customer Compartment Doors: USPS approved cam lock, 3 keys each lock.
- C. Identification - Customer and Parcel Compartments: Sequential numerical or alphabetic characters, top to bottom, left to right; factory-installed.
  1. Engraved characters, 3/4 inch high, with white fill.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify that concrete base and anchor bolts are ready to receive pedestal-mounted units.
- B. Verify that rough-openings are ready to receive wall-mounted units.
- C. Do not begin installation until unacceptable conditions are corrected.

### 3.2 INSTALLATION

- A. Install postal specialties in accordance with approved shop drawings, manufacturer's instructions, and USPS requirements.
- B. Adjust and lubricate door hardware to operate properly.

END OF SECTION

## SECTION 11 12 00 - PARKING CONTROL EQUIPMENT

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Parking access controls for garage door operation.
- B. Maintenance.

#### 1.2 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Placement of anchors and components to be embedded in concrete.
- B. Section 08 33 23 - Overhead Coiling Doors: Electric door operator.
- C. Section 08 71 00 Door Hardware: Access control coordination with residential access to building.
- D. Section 26 05 83 - Wiring Connections: Electrical characteristics and wiring connections.

#### 1.3 REFERENCE STANDARDS

- A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2020.
- B. IEC 60950-1 - Information Technology Equipment – Safety - Part 1: General Requirements 2013.
- C. ITS (DIR) - Directory of Listed Products current edition.
- D. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum) 2020.
- E. NEMA MG 1 - Motors and Generators 2018.
- F. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- G. UL (DIR) - Online Certifications Directory Current Edition.

#### 1.4 SUBMITTALS

- A. See Section 01 33 00 for submittal procedures.
- B. Product Data: Provide data on operating equipment, characteristics, limitations, and temperature range of operation.
- C. Shop Drawings: Indicate plan layout of equipment access lanes, curbing, mounting bolt dimensions, conduit and outlet locations, power requirements, and wiring diagrams.
- D. Manufacturer's Qualification Statement.

- E. Installer's Qualification Statement.
- F. Maintenance Contract.
- G. Operation Data: Submit data for operating equipment, clock timer, and changing security access code.
- H. Maintenance Data: Provide lubrication and periodic maintenance requirement schedules.
- I. Warranty Documentation: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.
- J. Record Documentation: Record and submit actual locations of concealed conduit.
- K. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. See Section 01 60 00 - Product Requirements, for additional provisions.

## 1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

## 1.6 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective Work within a five year period after Date of Substantial Completion.
- C. Provide five year manufacturer warranty for operating equipment.

## PART 2 PRODUCTS

### 2.1 DESCRIPTION

- A. Parking Control System: Automatic operation at entrance and automatic operation at exit.
  - 1. Provide protection against interference or damage by lightning or other electrical influences; include fuse, over-voltage protection, flash-over protection, and line filter.
  - 2. Entry: Automatic parking access control system is activated upon activation by building access control device.
  - 3. Exit: Automatic parking access control system is activated upon detection of vehicle by sensing loop in pavement.

## 2.2 REGULATORY REQUIREMENTS

- A. Comply with applicable code and requirements of authorities having jurisdiction for emergency vehicle access.
- B. Products Requiring Electrical Connection: Listed and classified by ITS (DIR), UL (DIR), or testing firm acceptable to authorities having jurisdiction as suitable for purpose specified.

## 2.3 PERFORMANCE CRITERIA

- A. Operating Temperature: Minus 20 to 140 degrees F.
- B. Humidity: 15 to 95 percent RH noncondensing.
- C. Agency Certifications: IEC 60950-1.
- D. Rating: IEC 60950-1 under NEMA 250.

## 2.4 PARKING ENTRY/EXIT COMPONENTS

### 2.5 ELECTRICAL CHARACTERISTICS AND COMPONENTS

- A. Electrical Characteristics: Coordinate with Electric operator for overhead coiling door.
  - 1. Refer to Section 26 05 83 - Wiring Connections: Electrical connections.
- B. Electrical Components: Self-contained, plug-in, and replaceable components that comply with NFPA 70 and are listed and labeled by UL (DIR) or ITS (DIR).
  - 1. Provide wiring for control units, zinc plated connection box, grounded convenience outlet, switch for automatic or manual operation, switch to disconnect power unit, thermostatically controlled with at least 250 watt heater strip, and thermally protected disconnect for motor.
- C. Motor: NEMA MG 1 compliant.
- D. Backup Power Inverter: Provides electrical power to allow system to remain in operation upon loss of primary electrical power.
- E. Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized in compliance with NFPA 70.
- F. Disconnect Switch: Factory mount disconnect switch in control panel.

## 2.6 VEHICLE DETECTION

- A. Vehicle Detection: For use in temperature range of minus 40 to 160 degrees F; consisting of detection unit in conjunction with sensing loop to activate parking revenue control device or access control device when vehicle enters or exits.

- B. Sensing Loop: 14 gauge, 0.064 inch insulated wire; loop size of 48 by 72 inches, with loop extension cable and detector.

## 2.7 ACCESSORIES

- A. Curb Frames: Formed steel type, 6 inch high above pavement, galvanized finish.
- B. Overhead Height Limitation Bar: {CH#259023}, {CH#259027}, one piece, finished with two coats of {CH#71834} enamel based paint with {CH#71833} on both sides of bar.

# PART 3 EXECUTION

## 3.1 EXAMINATION

- A. Verify that anchor bolts are ready to receive this work and dimensions are as required by manufacturer.
- B. Verify that electric connections are properly located and have necessary characteristics.

## 3.2 INSTALLATION

- A. Install parking control system and components in accordance with manufacturer's instructions and in compliance with requirements.
- B. Install curb frame as indicated and complying to requirements.
- C. Install overhead height limitation bar level within the garage entrance with galvanized chain at indicated allowable height limit.
- D. Cut grooves in pavement surface, install vehicle detection loops and lead-in wires, and fill grooves with loop filler.
- E. Install internal electrical wiring, conduit, junction boxes, transformers, circuit breakers, and auxiliary components as required.

## 3.3 ADJUSTING

- A. Adjust system components for smooth operation.

## 3.4 MAINTENANCE

- A. See Section 01 70 00 - Execution and Closeout Requirements, for additional requirements relating to maintenance service.
- B. Provide a separate maintenance contract for specified maintenance service.
- C. Provide service and maintenance of operating equipment for a period of two years from Date of Substantial Completion.

END OF SECTION

## SECTION 11 24 26 - FALL RESTRAINT EQUIPMENT

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Suspended access support equipment including
  - 1. System design
  - 2. Tieback anchors
  - 3. Suspension line anchors
  - 4. Fall arrest anchors
  - 5. Rigging sleeves
  - 6. Davits

#### 1.2 RELATED SECTIONS

- A. Section 03 30 00 Cast-In-Place Concrete
- B. Section 05 12 00 Structural Steel
- C. Section 05 50 00 Metal Fabrications
- D. Section 07 55 52 - Modified Bituminous Protected Membrane Roofing: Roofing system
- E. Section 07 62 00 Sheet Metal Flashing and Trim
- F. Section 07 90 05 Joint Sealers

#### 1.3 REFERENCES

- A. Occupational Safety and Health Standard
  - 1. IWCA I-14.1-2001 Window Cleaning Safety Standard
  - 2. 1910 Subpart D (Walking and Working Surfaces)
  - 3. 1910.66 Appendix C (Personal Fall Arrest)
  - 4. 1910.66 Subpart F (Powered Platforms)
- B. American Institute of Steel Construction (AISC)
  - 1. AISC Publication Load and Resistance Factor Design for Structural Steel Buildings
  - 2. AISC Specifications for the Design of Cold-Formed Steel Structural Members

- C. American Society for Testing and Materials (ASTM)
  - 1. ASTM A36 Specification for Structural Steel
  - 2. ASTM A123 Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Hardware
  - 3. ASTM A500 Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
  - 4. ASTM A780 Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
  - 5. ASTM B209-04 Specification for Aluminum and Aluminum-Alloy Sheet and Plate
  - 6. ASTM B221-02 Specification for Aluminum and Aluminum-Alloy Extruded Bars, Wire, Shapes, and Tubes
  - 7. ASTM B308/B308M-02 Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles
  - 8. ASTM A193 Specification for Alloy-Steel and Stainless-Steel Bolting Materials.
  - 9. ASTM A436 Specification for Hardened Steel Washers
- D. American Welding Society (AWS)
  - 1. AWS D1.1 Structural Welding Code – Steel
  - 2. AWS D1.2 Structural Welding Code – Aluminum

#### 1.4 SYSTEM DESCRIPTION

- A. Anchorage Design Requirements
  - 1. Safety anchor system design shall comply with current OSHA, ANSI, and local regulations pertaining to window cleaning and fall protection.
  - 2. Anchor system shall provide independent fall arrest anchorages in addition to suspension line anchorages for each descent location as required by OSHA and ANSI requirements.
  - 3. Structural design requirements of anchorages and tie-back
    - a. Anchorage shall be capable of sustaining a minimum ultimate load of 5,000 lbs., in any direction the load may be applied, without fracture or failure.
    - b. Anchorage shall be capable of sustaining a minimum proof load of 2,500 lbs., in any direction the load may be applied, without permanent deformation or damage to anchorage.
    - c. Anchorages shall be designed with a minimum 1,250 lb. working load, in any direction the load may be applied.

- d. Parapet or guardrails subject to direct loading by workers' ropes, possibly cables, shall be designed to withstand such loading (typically 1,800 lbs) without damage to either the structure or the rigging component in contact with it.
  - 4. Locate primary support and fall arrest anchors in conjunction with areas on façade of building to be serviced. Give consideration to the type of suspension equipment to be used at the building and conditions including but not limited to: workers' reach, rigging methods, and roof edge conditions. Provide unobstructed anchorages and locate behind and in line with equipment or portion of building they are intended to service. Anchors shall not be located within 6 feet of the roof edge unless fall protection is provided to access those areas safely.
- B. Davit Design Requirements and Rigging Sleeve
- 1. Locate rigging sleeves and davits to accommodate suspended maintenance during swing stage operations. Typical spacing of davits shall be column lines or every 20 feet, on center, where possible. Typical spacing of rigging sleeves is 6 feet 8 inches, on center. Placement of supports should allow cables suspending powered equipment to hang either parallel and in plane or slightly angulated with the building façade as required by users. Consider operating other equipment that may be required for access.
  - 2. Locate independent anchorages for personal fall protection when using rigging sleeves or davits in accordance with Anchorage Design Requirements above.
  - 3. Davits shall be capable of supporting an ultimate load of not less than 4 times the rated load. The rated load of the davit shall be based on the swing stage hoist and powered platform load capacity, which is frequently 1,000 lbs or more.
  - 4. Manufacture shall provide engineer's calculations and test report to verify that davit will support load requirements.
  - 5. Outreach of portable davit boom shall not exceed 8 foot 6 six inches.
  - 6. Rigging sleeves shall meet the loading requirements in Anchorage Design Requirements above.

## 1.5 SUBMITTALS

- A. Refer to Section 01 33 00 for general submittal procedures.
- B. Product Data: Manufacturer's data sheets on each product proposed
  - 1. Test report certified by a professional engineer
  - 2. General product data
  - 3. Detailed drawings of equipment proposed
  - 4. Installation instructions
- C. Shop Drawings

1. Submit scaled shop drawings showing location plan of all support equipment and sections detailing all parts and accessories.
2. Clearly specify equipment dimensions, materials, fabrication details, hardware, and installation instructions.
3. Include notes with guidelines of proper use of system.
4. Equipment location plan to include identification number next to each piece of equipment, i.e. (anchors, davits, and rigging sleeves.) that are permanently affixed to a structure.
5. Field welds shall be indicated on equipment details using AWS symbols and showing length and size. Auxiliary views shall be shown to clarify welding as required.
6. Include P.E. certified report of tested equipment.

D. Quality Assurance Submittal Certificates

1. Designer/Manufacturer's Qualification Statement: Provide documentation verifying company's amount of experience and successful performance in design, fabrication, and installation of permanent window washing equipment.
2. Submit listing of company's installations representing similar scope and complexity to project requirements for previous 10 years. List shall include information as follows:
  - a. Project name and address
  - b. Name of owner
  - c. Name of contractor
  - d. Name of architect (if applicable)
  - e. Date of completion
3. Installer's Qualifications: Provide documentation verifying that installers have been trained by the manufacturer and are competent.

E. Contract Close-out Submittals

1. Operation and Maintenance
  - a. Provide a safety inspection logbook for yearly inspections. Log book shall include a certification of compliance letter. The certification of compliance shall state that access system follows current OSHA regulations and IWCA I-14.1-2001 Window Cleaning Safety Standard.
2. Project Record Document Data
  - a. Record anchor locations and details.

- b. Submit 2 copies of a reduced, plastic laminated Project Record Drawing showing as-installed anchor locations, details, and instructional text in English (and Spanish upon request). Post one copy on interior of each roof door or adjacent to exit on roof; owner shall establish exact location.
- c. Submit a letter of certification by a registered professional engineer licensed in the state of Maryland verifying that installed anchors and system are in compliance with OSHA and ANSI requirements as specified. Each piece of access equipment dedicated to the building shall be tested on site under the supervision of a P.E. in accordance with IWCA I-14.1-2001 Window Cleaning Safety and manufacturer's test procedures.

## 1.6 QUALITY ASSURANCE

### A. Qualifications

1. Provide products from a company specializing in design, fabrication, and installation of permanent suspended access equipment with a minimum of 5 years documented experience. Companies like miscellaneous metal fabricators not normally engaged in design and fabrications of suspended access equipment are not acceptable.
2. Delegated Design and shop drawings shall be prepared under supervision of a registered professional engineer and shall bear engineer's seal and signature. Professional engineer shall be licensed in the the State in which the Project is located.
3. Manufacturer and installer shall have specific liability insurance (products and completed operations) in an amount not less than \$5,000,000.
4. Installer(s) shall be trained or qualified by manufacturer in installation techniques and procedures of permanent suspended access equipment.

### B. Regulatory Requirements

1. Comply with Occupational Health and Safety Standards:
  - a. IWCA I-14.1-2001 Window Cleaning Safety Standard
  - b. 1910 Subpart D (Walking and Working Surfaces)
  - c. 1910.66 Appendix C (Personal Fall Arrest)
  - d. 1910.66 Subpart F (Powered Platforms)
2. Welding shall comply with AWS D1.1/D1.1M and shall be performed by welders qualified to work in jurisdiction where project is located.
3. Comply with AISC publications:
  - a. Load and Resistance Factor Design for Structural Steel Buildings
  - b. Specifications for the Design of Cold-Formed Steel Structural Members

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original unopened packaging.
- B. Storage and Protection
  - 1. Store materials in a protected area away from construction activities.
  - 2. Clean bolts that have become dirty before installing.
  - 3. Do not install damaged materials, removing them from site.

## 1.8 SEQUENCING AND COORDINATION

- A. General contractor is responsible for coordinating the schedule so as not to conflict with other trades.
- B. Manufacturer to provide detailed installation instructions and directions for installation of embedded items, welded items, and through-bolted items, etc.
- C. Manufacturer to provide installation assistance during installation of the equipment. However, the responsibility of the installation rest with the general contractor unless equipment is installed and certified by the manufacturer.

# PART 2 PRODUCTS

## 2.1 BASIS OF DESIGN

- A. Suspended Access and Fall Restraint System as manufactured by Summit Anchor Company, Inc.
- B. Substitutions: Submit equivalent or superior materials and/or system substitutions to Architect and for review in compliance with substitution procedures in Section 01 25 00.

## 2.2 STRUCTURAL COMPONENTS' MATERIALS

- A. Exposed Structural Components Finish: Galvanized Mild Steel or Stainless Steel
  - 1. Steel: ASTM A572 GR 50
  - 2. Steel: ASTM A A36
  - 3. Galvanizing: ASTM A123
  - 4. Stainless Steel; 304 ASTM A 193 Grade B8, Class 2
  - 5. Aluminum; 6061-T6 Alloy
- B. Yield Strength
  - 1. Base Plates and Bottom Plates, High Strength Steel: 50 ksi minimum
  - 2. Other Sections: 36 ksi minimum

C. Non-Structural Components

1. Aluminum; 6061-T6 Alloy
2. Alloys shall conform to requirements published in AA Aluminum Standards.
3. Sheet and Plate: ASTM B209
4. Extruded Bars, Rods, Shapes, and Tubes: ASTM B221

D. Cold-Rolled Sections

1. ASTM A500
2. Yield Strength: 46 ksi minimum
3. Tensile Strength: 62 ksi minimum

E. Nuts, Bolts, Davit Pins, and Washers

1. Stainless Steel; 304 ASTM A 193 Grade B8 or F593C
2. Galvanized Flat Washers ASTM F-436 or 18 -8 Stainless Steel

F. Anchor Bolts (for securing base plate)

1. Metal: Stainless Steel, 304 Stainless Steel; ASTM A 193 Grade 8, B8
2. Size: 5/8 in. diameter minimum

## 2.3 MANUFACTURED UNITS

A. Anchor

1. Capable of withstanding 5000 lbs. (2268kg) in any direction without permanent deformation.
2. Anchor eye size: Forge Eye with 2 ¼ in (60 mm) minimum eye opening.
3. Anchor eye metals: Forged, 1035 quenched and tempered per ASTM 576-90-b, with 72ksi minimum yield strength and 240-280 BHN.
4. Anchor tube height: not less than 4 in. above the finished roof.

B. Davits

1. Pedestal to mate with davit socket secured with pins with steel safety ring snap-pins.
2. Davit socket; with two stainless steel hinge pins and self-locking ring snap-pins.
3. Pier Height: generally, not less than 8 in. above finished roof surface to allow proper fit up with adaptor.

4. Davit arm assembly shall weigh less than 300 lb. total weight, easily broken down into components weighing less than 80 lb. for ease of transport to each davit pedestal.

C. Rigging Sleeves

1. Assembled complete with cap tethered to cross bar.
2. Length of bottom of rigging sleeve as required to clear under side of façade by a minimum two inches.
3. Not less than 6" above the finished roof.

D. Cable system

1. Install complete with inline shock absorber to limit load to 2,250 lbs. or less at terminating anchors.
2. Intermediate pass through cable restraint anchors to allow up to two workers to traverse straight cable runs with single lanyard without detachment off lanyard.

E. Flashing with one E.P.D.M. gasket seal top and base

1. Seamless Spun Aluminum Flashing: ASTM B221; Type 6061-T6 alloy
2. Stainless Steel: 304

F. Cast in place equipment

1. A minimum of two cast-in-place steel studs are required for concrete embedded anchors.

G. Hilti HDA Undercut Anchoring System or approved equal.

1. HAD-T Undercut Anchor (Through-Set Type)
2. Anchor size and embedment depth: As needed to suit loads imposed by Summit Anchor equipment. Consult project engineer to determine proper anchoring system based on concrete condition, psi, and thickness before ordering Summit equipment.
3. Installed per Hilti installation instructions.
4. Substitutions: Refer to Section 01 25 00 for submittal and acceptance requirements for substitutions.

H. Hilti HIT-RE 500-SD V3 Epoxy Adhesive Anchor System or approved equal.

1. Anchor size and embedment depth: As needed, but not less than 5/8" diameter threaded rods, to suit loads imposed by Summit Anchor equipment. Consult project engineer to determine proper anchoring system based on concrete condition, psi, edge distance, and thickness before ordering Summit equipment.
2. Installed per Hilti installation instructions.

3. Installed by ACI accredited installers only.
  4. Each installed anchor assembly shall be load tested to 50 percent of its rated capacity. Test results shall be certified a P.E. with experience in suspended access equipment.
  5. Substitutions: Refer to Section 01 25 00 for submittal and acceptance requirements for substitutions.
- I. Cover Plates: Provide Aluminum cover plates in coordination with roof terrace pavers and green roof systems. Plate shall be supported on all sides, capable of supporting 40 psf live load with minimum deflection; Finish as directed to blend in with adjacent roofing materials.

## 2.4 FABRICATION

- A. Fabricate work true to dimension, square, plumb, level, and free from distortion or defects detrimental to appearance and performance.
- B. Grind off surplus welding material to ensure exposed surfaces are smooth so as not to abrade workers' ropes.
- C. Welding shall be in accordance with the AWS Structural Welding Code D1.1/D1.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Site Verification of Conditions
  1. Examine areas and conditions under which permanent window washing equipment shall be installed.
  2. Report to general contractor any conditions that deviate from shop drawings or any defects in workmanship that would cause an unsafe installation. This report shall be verified in writing to the general contractor and any other responsible party.
  3. Correct conditions detrimental to timely and proper execution of work.
  4. Do not proceed until unsatisfactory conditions have been corrected.
  5. Commencement of installation constitutes acceptance of conditions and responsibility for satisfactory performance by installer.
  6. Faults occurring in work of this section due to acceptance of unsatisfactory conditions shall be corrected at no additional cost to owner.

### 3.2 INSTALLATION

- A. General Requirements

1. Install window washing system in compliance with manufacturer's instructions. Install equipment level, tightly fitted, and flush to adjacent surfaces as needed for proper installation.
  2. Coordinate anchor installation with roofing installation to ensure a watertight and warrantable condition of the roofing. Anchors shall be directly flashed into roofing in a manner compatible with roofing system and anchors.
  3. When components come into contact with dissimilar metals, surfaces shall be kept from direct contact to prevent corrosion.
  4. No wall anchors shall be installed through membrane roofing system without specification detailing such from the architect or water proofing company warranting the roof.
  5. Threaded fasteners shall be secured to prevent accidental removal or vandalism by one of the following:
    - a. Deformation of threads with 2/32" stainless steel punch
    - b. Stainless Steel Lock nuts.
    - c. Stainless Steel Tack weld.
- B. Instructions for welding access equipment to structure
1. All welders must be certified to American Welding Society (AWS) in accordance with AWS standards.
  2. Welding rods used to weld the anchor system to be E70 xx electrodes.
  3. Prior to welding anchors to structure, abrasively remove, within one inch of all welded surfaces, galvanizing, mill, scale, and rust.
  4. Immediately after welding, chip away slag to prepare for welding inspector to inspect welds.
  5. An AWS certified welding inspector must inspect and confirm size of all field welds. Following the inspection, a written report must be supplied to the building owner and/or general contractor.  
Welded joints shall not be painted until after welding has been completed and the weld accepted.
  6. Immediately after an acceptable inspection, paint welded areas with cold-galvanizing compound to protect from corrosion.
  7. Structural steel to receive roof or wall anchors shall have a surface wide enough so that base plate can be welded all the way around. For example, anchors equipped with 4½ in. (112.5 mm) base plates would require a minimum 5 in. (137.5 mm) surface to weld to.
- C. Adhesive and Undercut Anchor Fasteners
1. Installation of Summit Anchor Co. equipment mounted with epoxy type anchor fasteners shall be performed by ACI accredited installers only.

2. Installation of Summit Anchor Co. equipment mounted with undercut type anchor fasteners shall be performed by Hilti trained installers only.

D. Aluminum Flashing

1. Deck flange shall be flashed in compliance with National Roofing Contractor Association recommendations.

3.3 REPAIR/RESTORATION

A. Galvanizing Touch-Up

1. Immediately after erection clean field welds and abraded areas. Repair damaged areas in compliance with ASTM A780.

3.4 FIELD QUALITY CONTROL

A. Inspection and site visits

1. Perform inspections and site visits while installation of equipment is in progress under the supervision qualified professional engineer registered in the jurisdiction where the project is located.
2. On site inspection of equipment welded to structure shall be performed by an AWS Certified Welding Inspector verifying, in writing, size and quality of welds. Such an inspection shall be performed on each piece of equipment before roofing material is installed.
3. On site inspection shall be performed on all cast in place items while being tied in with the rebar with sufficient time before concrete is poured to allow to adjustments to embedded items as recommended by inspector.
4. Schedule above site visits and inspections with sufficient advanced notice given to the inspection company.

B. Site Tests

1. All equipment shall be tested on site in accordance with manufacturer's recommendations, under the supervision of a professional engineer, and IWCA I-14.1-2001 Window Cleaning Safety Standards, before being placed in service.
2. Equipment shall be tested under the supervision of a professional engineer with experience with suspended maintenance equipment and manufacturers guidelines.

C. Manufacturer shall assist and/or supervise installation of window washing equipment installed by others when such is included in project.

3.5 ADJUSTING

- A. Verify that completed work has been installed correctly and products function properly. Make adjustments where needed to ensure satisfactory operation.

- B. Complete inspection logbook to certify system for use noting any deviations, changes, or corrections from original shop drawings. Provide as-built anchor layout plan on 11 in. x 17 in. paper or larger together with annual inspection log book.

END OF SECTION

## SECTION 11 30 13 - RESIDENTIAL APPLIANCES

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Kitchen appliances.
- B. Laundry appliances.

#### 1.2 RELATED REQUIREMENTS

- A. Section 22 10 05 - Plumbing Piping: Plumbing connections for appliances.
- B. Section 26 05 83 - Wiring Connections: Electrical connections for appliances.

#### 1.3 REFERENCE STANDARDS

- A. UL (DIR) - Online Certifications Directory Current Edition.

#### 1.4 SUBMITTALS

- A. See Section 013300 013300 for submittal procedures.
- B. Product Data: Manufacturer's data indicating dimensions, capacity, and operating features of each piece of residential equipment specified.
- C. Copies of Warranties: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

#### 1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.
- B. Electric Appliances: Listed and labeled by UL (DIR) and complying with NEMA Standards (National Electrical Manufacturers Association).

#### 1.6 DELIVERY AND HANDLING

- A. Deliver equipment and associated accessories to site in manufacturer's original packaging.
- B. Store in secure, weather protected enclosure prior to installation.

#### 1.7 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. **Provide five (5) year manufacturer warranty on refrigeration system of refrigerators.**
- C. **Provide ten (10) year manufacturer warranty on magnetron tube of microwave ovens.**

D. Provide ten (10) year manufacturer warranty on tub and door liner of dishwashers.

## PART 2 PRODUCTS

### 2.1 KITCHEN AND LAUNDRY APPLIANCES

- A. Provide Equipment Eligible for Energy Star Rating: Energy Star Rated.
- B. Refer to the Appliance and Small Appliance Schedules on Drawings and ID sets for basis of design product and manufacturers. Provide as indicated or approved equal. Refer to Section 01 25 00 for submittal and acceptance requirements for proposed substitutions.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify utility rough-ins are provided and correctly located.

### 3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.

### 3.3 ADJUSTING

- A. Adjust equipment to provide efficient operation.

### 3.4 CLEANING

- A. Remove packing materials from equipment and properly discard.
- B. Wash and clean equipment.

END OF SECTION

## SECTION 11 82 26 - FACILITY WASTE COMPACTORS

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Packaged waste compactor for separate container.
- B. Discharge containers.
- C. Chute intake door interlock controls.

#### 1.2 RELATED REQUIREMENTS

- A. Section 14 91 00 - Facility Chutes: Chute intake door locking mechanism and interlocking requirements.

#### 1.3 REFERENCE STANDARDS

- A. ANSI Z245.2 - American National Standard for Equipment Technology and Operations for Wastes and Recyclable Materials — Stationary Compactors - Safety Requirements for Installation, Maintenance, Operation, Modification and Repair 2013.
- B. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum) 2020.
- C. NEMA MG 1 - Motors and Generators 2018.
- D. UL (DIR) - Online Certifications Directory Current Edition.
- E. WASTEC (SCRG) - WASTEC Listing of Rated Stationary Compactors 2001.

#### 1.4 SUBMITTALS

- A. See Section 01 33 00 for submittal procedures.
- B. Product Data: Provide product data for trash compactor vibration isolation materials. Submittal shall include at a minimum:
  - 1. Manufacturer name and contact information
  - 2. Vendor name and contact information
  - 3. Model designations for each product to be used
  - 4. Physical dimensions
- C. Product Data: Provide unit capacities, physical dimensions, utility requirements and locations, point loads.
- D. Shop Drawings: Indicate machine location, rough-in and anchor placement dimensions and tolerances, clearances required and [\_\_\_\_\_].

- E. Manufacturer's Certificate: Certify that Products meet or exceed specified requirements.
- F. Manufacturer's Installation Instructions: Indicate special installation requirements and [\_\_\_\_\_].
- G. Operation Data: Include description of system operation, adjusting and testing required.
- H. Maintenance Data: Identify system maintenance requirements, servicing cycles, lubrication types required and local spare part sources.
- I. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

## 1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years of documented experience.

## 1.6 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective Work within a five year period after Date of Substantial Completion.

# PART 2 PRODUCTS

## 2.1 COMPACTORS - GENERAL

- A. Provide the following as required for installation and operation of the Owner leased compactor and discharge containers.
- B. Sound Damping Materials: Visco-elastic material formulated to meet fire code; trowel or brush applied; **Acceptable manufacturer is Kinetics** or approved equal.
- C. **Neoprene Lining:** BBF by Mason Industries or approved equal.
- D. Compactors: Rated by WASTEC (SCRG) in accordance with ANSI Z245.2.
  - 1. Provide certificate of compliance from authorities having jurisdiction indicating approval of unit.
  - 2. Electrically Operated Equipment and Components: Individually UL (DIR) listed.
  - 3. Finish: Factory primed and painted.
- E. Motors: NEMA MG 1.
- F. Control Panels and Remote Equipment Enclosures: NEMA 250 Type 4 enclosures; factory finished; wall-mounted unless otherwise indicated.
- G. Discharge Containers: Heavy duty steel; factory-finished for outdoor use; manufacturer's standard type unless otherwise indicated.

- H. Anchors and Fasteners: Galvanized steel; where embedded in concrete, provide to concrete installer for installation.

## 2.2 APARTMENT COMPACTORS

- A. Apartment Compactors: Small footprint; heavy duty steel body consisting of a charge box over a compactor unit that compresses horizontally into separate container; hydraulically driven compaction ram.
1. Waste Intake: Top chute and left side.
  2. Configuration: As indicated on drawings.
  3. Power Unit: Hydraulic pump and oil reservoir; located inside compactor room; provide hydraulic piping and electrical connections.
  4. Electrical Characteristics: 208/230/480 V, 3 phase, 60 Hz.
  5. Controls and Safeties:
    - a. "On/Off" key switch.
    - b. Automatic photoelectric sensor start and stop.
    - c. Emergency stop button.
    - d. "Container-Full" indicator light.
    - e. Magnetic door and container interlock.
    - f. Chute interlock controls, for conditions specified in chutes section.
    - g. Container removal safety signal.
    - h. Built-in container stops.
- B. Chute Extension: Provide extension of chute to fit compactor, as indicated on drawings.
- C. Discharge Container: Roll-off type.
  1. Provide one container per compactor.
- D. **Basis of Design:** Marathon, a Dover Company; Model Mini-M.A.C. 5A/5hp Apartment Compactor.
1. Characteristics: ANSI Z245.2; 74 cy capacity per hour, with 14 second cycle time; 5 hp motor; 120 VAC; 22.5 x 28 inch top opening; 23.2 Normal ram face force.
  2. Container Size: 2.0 Cubic yard capacity.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify that anchors are correctly positioned.
- B. Coordinate and provide power with a three phase disconnect.

### 3.2 INSTALLATION

- A. Install unit and inlet hopper in accordance with manufacturer's instructions and with standards required by authorities having jurisdiction.
- B. Coordinate with waste chute discharge.
- C. Anchor unit securely in place.
- D. Touch-up minor damaged surfaces caused during installation, and replace damaged components as directed by Architect.
- E. Adjust unit mechanism to achieve specified requirements.

### 3.3 COMPACTOR - INSTALLATION

- A. Install Trash Compactor in accordance with manufacturer's instructions and the following:
- B. Mount the trash room pump on spring-type vibration isolators with a static deflection of at least 1 inch.
- C. Use flexible conduit connections to the pump with a loop.
- D. Use a 6 inch to 12 inch long flexible pipe connector between the pump and the compactor.
- E. Apply sound dampening material to all outside surfaces of the trash compactor, including the bottom surface.
- F. Maintain at least 2 inch gap between the chute and compactor.

### 3.4 TRASH CONTAINER - INSTALLATION

- A. Install trash containers in accordance with manufacturer's instructions and the following:
- B. Apply sound dampening material to all outside surfaces of the trash container, including the bottom surface.
- C. Apply 1/4 inch (minimum) thick neoprene lining to all interior surfaces of the trash bin.
- D. Use rubber casters.

### 3.5 CLOSEOUT ACTIVITIES

- A. Demonstrate and instruct Owner on unit operation, and describe unit limitations.

END OF SECTION

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## SECTION 11 73 40 - PET WASHING STATION

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Dog wash system basin and dryer system.

#### 1.2 RELATED REQUIREMENTS

- A. Division 22 Plumbing: Plumbing rough in
- B. Division 26 Electrical: Electrical rough in.

#### 1.3 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate the installation of dog wash system with size, location and installation of service utilities.
- B. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

#### 1.4 SUBMITTALS

- A. See Section 01 33 00 for general submittal procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
  1. Preparation instructions and recommendations.
  2. Storage and handling requirements and recommendations.
  3. Installation methods.
- C. Shop Drawings: Indicate size, shape, and dimensions, including clearances from adjacent walls, doors, and obstructions.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.

### PART 2 PRODUCTS

#### 2.1 DOG WASH BASIN

- A. **Basis of Design Manufacturer: PW7302 ADA Elite Pet Wash by Dog-On-It-Parks**
- B. Description:
  1. A free standing package unit constructed from heavy duty, high quality stainless steel.
  2. Designed to accomodate wheelchair bound pet owners.

3. System Features:

- a. A 5 inch deep basin with a generous 33 inch floor to basin height.
- b. Lowered plumbing access for the spray nozzle and restraints in both the front and back of tub. The plumbing kit includes a heavy duty coiled hose, spray head with hold down lever, and drain/hair trap.
- c. A removable stainless steel tray for bathing smaller dogs, an elevated floor grate to keep paws above the soapy water and either non-slip steps or ramp, both with rolling casters.
- d. Variable speed warm air blow dryer designed for pets; the low speed and high speed fans are individually selectable; include 10 foot hose with two blower tips and a 120 V outlet for clippers. Basis of Design is K-9 III Blower/dryer variable speed.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verification of Conditions: Verify that utility rough in connections for power, water and drainage are in place as required for wash system..

### 3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.

### 3.3 SYSTEM STARTUP

- A. Prepare and start equipment and systems in accordance with manufacturers' instructions and recommendations.
- B. Adjust for proper operation within manufacturer's published tolerances.

### 3.4 CLOSEOUT ACTIVITIES

- A. See Section 01 78 00 - Closeout Submittals, for closeout submittals.
- B. Demonstrate proper operation of equipment to Owner's designated representative.

END OF SECTION

## SECTION 12 24 00 - WINDOW SHADES

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Interior motorized roller shades.
- B. Motor controls.

#### 1.2 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry: Concealed wood blocking for attachment of headrail brackets.
- B. Section 26 27 26 - Wiring Devices: Finish requirements for wall controls specified in this section.

#### 1.3 REFERENCE STANDARDS

- A. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi 2015 (Reapproved 2021)e1.
- B. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- C. NFPA 701 - Standard Methods of Fire Tests for Flame Propagation of Textiles and Films 2019.
- D. UL (GGG) - GREENGUARD Gold Certified Products Current Edition.
- E. UL 325 - Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems Current Edition, Including All Revisions.

#### 1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
  - 1. Coordinate the work with other trades to provide rough-in of electrical wiring as required for installation of hardwired motorized shades.
- B. Preinstallation Meeting: Convene one week prior to commencing work related to products of this section; require attendance of affected installers.
- C. Sequencing:
  - 1. Do not fabricate shades until field dimensions for each opening have been taken with field conditions in place.
  - 2. Do not install shades until final surface finishes and painting are complete.

#### 1.5 SUBMITTALS

- A. See Section 013300 for submittal procedures.

- B. Product Data: Provide manufacturer's standard catalog pages and data sheets, including materials, finishes, fabrication details, dimensions, profiles, mounting requirements, and accessories.
  - 1. Motorized Shades: Include power requirements and standard wiring diagrams for specified products.
- C. Shop Drawings: Include shade schedule indicating size, location and keys to details, head, jamb and sill details, mounting dimension requirements for each product and condition, and operation direction.
  - 1. Motorized Shades: Provide schematic system riser diagram indicating component interconnections. Include requirements for interface with other systems.
- D. Certificates: Manufacturer's documentation that line voltage components are UL listed or UL recognized.
- E. Selection Samples: Include fabric samples in full range of available colors and patterns.
- F. Verification Samples: Minimum size 6 inches square, representing actual materials, color and pattern.
- G. Manufacturer's Instructions: Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- H. Project Record Documents: Record actual locations of control systems and show interconnecting wiring.
- 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.
- K. Maintenance contracts.

#### 1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than ten years of documented experience.
- B. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

#### 1.7 MOCK-UP

- A. Refer to Section 014389 for requirements to include in Residential Unit Mockup.
- B. Mock-Up: Provide full size mock-up of window shade system complete with selected shade fabric including example of seams and batten pockets when applicable.
  - 1. Obtain Architect's approval of light and privacy characteristics of fabric prior to fabrication.
  - 2. Full-sized mock-up may become part of the final installation.

## 1.8 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.

## 1.9 FIELD CONDITIONS

- A. Do not install products under environmental conditions outside manufacturer's absolute limits.

## 1.10 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Provide manufacturer's warranty against defects in materials and workmanship from Date of Substantial Completion, covering the following:
  1. Shade Hardware: Three years.
  2. Electric Motors: One year.
  3. Electronic Control Equipment: One year.
  4. Fabric: Three years.
  5. Aluminum and Steel Coatings: Three years.

# PART 2 PRODUCTS

## 2.1 MANUFACTURERS

- A. Interior Motorized Roller Shades, Motors and Motor Controls: The following manufacturer's are acceptable:
  1. Draper, Inc; Motorized FlexShade: [www.draperinc.com/#sle](http://www.draperinc.com/#sle).
  2. MechoShade Systems LLC; UrbanShade Single Roller - Motorized: [www.mechoshade.com/#sle](http://www.mechoshade.com/#sle).
  3. SWFcontract, a division of Springs Window Fashions, LLC: [www.swfcontract.com/#sle](http://www.swfcontract.com/#sle).
- 4. Substitutions: Refer to Section 01 25 00 for submittal and acceptance requirements for proposed substitutions. .

## 2.2 ROLLER SHADES

- A. General:
  1. Provide shade system components that are easy to remove or adjust without removal of mounted shade brackets.
  2. Provide shade system that operates smoothly when shades are raised or lowered.

3. Motorized Shades: Motor system housed inside roller tube, controlling shade movement via motor controls indicated; listed or recognized to UL 325.
  - a. Comply with NFPA 70.
  - b. Electrical Components: Listed, classified, and labeled as suitable for the purpose intended. Where applicable, system components to be FCC compliant.
  - c. Motors: Size and configuration as recommended by manufacturer for the type, size, and arrangement of shades to be operated; integrated into shade operating components and concealed from view; fully compatible with controls to be installed.

B. Roller Shades:

1. Description - Interior Roller Shades: Single roller, manually operated fabric window shade system complete with mounting brackets, roller tubes, hembars, hardware, and accessories.
  - a. Drop Position: Regular roll.
  - b. Roll Direction: Roll down, closed position is at window sill.
  - c. Mounting: Window jamb mounted- inside, between jambs.
  - d. Size: As indicated on drawings.
  - e. Fabric: As indicated under Shade Fabric article.
2. Brackets and Mounting Hardware: As recommended by manufacturer for mounting indicated and to accommodate shade fabric roll-up size and weight.
  - a. Material: Stamped steel.
3. Roller Tubes: As required for type of shade operation.
  - a. Material: Extruded aluminum, clear anodized finish.
  - b. Size: As recommended by manufacturer; selected for suitability for installation conditions, span, and weight of shades.
  - c. Fabric Attachment: Utilize extruded channel in tube to accept vinyl spline welded to fabric edge.
4. Hembars: Designed to maintain bottom of shade straight and flat.
  - a. Style: Full wrap fabric covered bottom bar, flat profile with heat sealed closed ends. Provide a clear plastic hem strip to protect fabric and facilitate raising and lowering shade.
5. Accessories:

- a. Fascia: Extruded aluminum, size as required to conceal shade mounting, attachable to brackets without exposed fasteners; fabric wrapped finish to match shade.
  - 1) Profile: Square.
- b. End Caps: Provide manufacturer's standard end caps to cover exposed ends of brackets.
- c. Ceiling Pockets with Prewired Raceway: UL 325 listed, extruded aluminum shade pocket with removable closure panel and ceiling tile support, for recess mounting in acoustical tile or drywall ceilings; size and configuration as indicated on drawings.
  - 1) Designed to accommodate installation of motor control and wiring accessories within pocket.
- d. Fasteners: Noncorrosive, and as recommended by shade manufacturer.

## 2.3 SHADE FABRIC

- A. Fabric for living areas: Non-flammable, color-fast, impervious to heat and moisture, and able to retain its shape under normal operation.
  - 1. Material: Woven polyester and PVC-coated polyester; 2x2 Thin Basketweave; vertical orientation.
  - 2. Material Certificates and Product Disclosures:
    - a. Low-Emitting Material Certification: Greenguard Gold certified and listed in UL (GGG).
    - b. Health Product Declaration (HPD): Complete, published declaration with full disclosure of known hazards.
  - 3. Performance Requirements:
    - a. Flammability: Pass NFPA 701 large and small tests.
    - b. Fungal Resistance: No growth when tested according to ASTM G21.
  - 4. Openness Factor: 3 percent .
  - 5. Roll Width: 98 inches.
  - 6. Color: As selected by Architect from manufacturer's full range of colors.
  - 7. Fabrication:
    - a. Fabric Orientation: Railroaded, fabric is turned 90 degrees off the roll.
    - b. If height of opening requires multiple panels of railroaded fabric, use battens at seams.
    - c. Battens: Full width of shade, enclose in welded shade fabric pocket.
- B. Fabric for bedrooms: Non-flammable, color-fast, impervious to heat and moisture, and able to retain its shape under normal operation.

1. Material: Woven polyester and PVC-coated polyeste; 2x2 Thin Basketweave; vertical orientation.
2. Material Certificates and Product Disclosures:
  - a. Low-Emitting Material Certification: Greenguard Gold certified and listed in UL (GGG).
  - b. Health Product Declaration (HPD): Complete, published declaration with full disclosure of known hazards.
3. Performance Requirements:
  - a. Flammability: Pass NFPA 701 large and small tests.
  - b. Fungal Resistance: No growth when tested according to ASTM G21.
4. Openness Factor: Less than 1 percent, translucent shades.
5. Roll Width: 98 inches.
6. Color: As selected by Architect from manufacturer's full range of colors.
7. Fabrication:
  - a. Fabric Orientation: Railroaded, fabric is turned 90 degrees off the roll.
  - b. If height of opening requires multiple panels of railroaded fabric, use battens at seams.
  - c. Battens: Full width of shade, enclose in welded shade fabric pocket.

## 2.4 MOTOR CONTROLS

- A. Unless specifically indicated to be excluded, provide all required equipment, conduit, boxes, wiring, connectors, hardware, supports, accessories, software, system programming, etc. as necessary for a complete operating system that provides the control intent indicated.
- B. Provide all components and connections necessary to interface with other systems as indicated.
- C. Digital Network Controls:
  1. Intelligent Motors and Devices: Identifiable over network without separate interface.
  2. Provide suitable interface modules as indicated or as required for connection to standard (nonintelligent) motors and devices.
  3. Capable of reprogrammed control without requiring wiring modifications.
  4. Capable of assigning shade motors to shade groups/sub-groups.
  5. Capable of storing programmable open and close limits and minimum of three intermediate preset stop positions for each shade.

6. Capable of aligning adjacent shades within accuracy of plus/minus 0.25 inch.
7. Provide 10 year nonvolatile power failure memory for system configuration settings.

D. Manual Controls:

1. Control Functions:
  - a. Open: Automatically open controlled shade(s) to fully open position when button is pressed.
  - b. Close: Automatically close controlled shade(s) to fully closed position when button is pressed.
  - c. Multiple Shade Groups: Provide individual controls for each shade group as indicated.
2. Wall Controls: Provided by shade manufacturer.
  - a. Finish: As specified in Section 26 27 26.
  - b. Button Engraving: Manufacturer's standard engraving, unless otherwise indicated.
3. Handheld Remote Controls: Battery-powered; wireless (radio frequency) or infrared; provided by shade manufacturer.
  - a. Wireless (Radio Frequency) Range: 30 feet.
  - b. Finish: Manufacturer's standard finish, unless otherwise indicated.

## 2.5 ROLLER SHADE FABRICATION

- A. Field measure finished openings prior to ordering or fabrication.
- B. Dimensional Tolerances: Fabricate shades to fit openings within specified tolerances.
  1. Vertical Dimensions: Fill openings from head to sill with 1/2 inch space between bottom bar and window stool.
  2. Horizontal Dimensions - Inside Mounting: Fill openings from jamb to jamb.
- C. At openings requiring continuous multiple shade units with separate rollers, locate roller joints at window mullion centers; butt rollers end-to-end.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Examine finished openings for deficiencies that may preclude satisfactory installation.
- B. Start of installation shall be considered acceptance of substrates.

### 3.2 PREPARATION

- A. Prepare surfaces using methods recommended by manufacturer for achieving best result for substrate under the project conditions.
- B. Coordinate with window installation and placement of concealed blocking to support shades.

### 3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions and approved shop drawings, using mounting devices as indicated.
- B. Replace shades that exceed specified dimensional tolerances at no extra cost to Owner.
- C. Adjust level, projection, and shade centering from mounting bracket. Verify there is no telescoping of shade fabric. Ensure smooth shade operation.

### 3.4 SYSTEM STARTUP

- A. Motorized Shade System: Provide services of a manufacturer's authorized representative to perform system startup.

### 3.5 CLEANING

- A. Clean soiled shades and exposed components as recommended by manufacturer.
- B. Replace shades that cannot be cleaned to "like new" condition.
- C. See Section 01 74 19 - Construction Waste Management and Disposal for additional requirements.

### 3.6 CLOSEOUT ACTIVITIES

- A. See Section 01 78 00 - Closeout Submittals, for closeout submittals.
- B. Demonstration: Demonstrate operation and maintenance of window shade system to Owner's personnel.

### 3.7 PROTECTION

- A. Protect installed products from subsequent construction operations.
- B. Touch-up, repair, or replace damaged products before Substantial Completion.

### 3.8 MAINTENANCE

- A. See Section 01 70 00 - Execution and Closeout Requirements, for additional requirements relating to maintenance service.

- B. Provide to Owner, a proposal as an alternate to the base bid, a separate renewable maintenance contract for the service and maintenance of a motorized shade system for one year from date of Substantial Completion. Include a complete description of preventive maintenance, systematic examination, adjustment, parts and labor, cleaning, and testing, with a detailed schedule.

END OF SECTION

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## SECTION 12 35 30 - RESIDENTIAL CASEWORK

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Kitchen cabinets.
- B. Movable and Stationary island cabinets
- C. Vanity cabinets.

#### 1.2 RELATED REQUIREMENTS

- A. Section 07 92 00 - Joint Sealants: Sealing joints between casework and countertops and adjacent walls, floors, and ceilings.
- B. Section 12 36 00 - Countertops.

#### 1.3 REFERENCE STANDARDS

- A. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix) 2017a.
- B. ANSI A135.4 - Basic Hardboard 2012 (R2020).
- C. ANSI A208.1 - American National Standard for Particleboard 2016.
- D. ANSI A208.2 - Medium Density Fiberboard (MDF) for Interior Applications 2016.
- E. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate 2014.
- F. HPVA HP-1 - American National Standard for Hardwood and Decorative Plywood 2016.
- G. KCMA A161.1 - Performance and Construction Standard for Kitchen and Vanity Cabinets 2017.
- H. NEMA LD 3 - High-Pressure Decorative Laminates 2005.

#### 1.4 SUBMITTALS

- A. See Section [CHOICE TEXT] for submittal procedures.
- B. Product Data: Provide component dimensions, configurations, construction details, and joint details.
- C. Certificate: Submit Kitchen Cabinet Manufacturers Association (KCMA) certificate showing conformance with KCMA A161.1.
- D. Shop Drawings: Indicate casework locations, elevations, clearances required, rough-in and anchor placement dimensions and tolerances.

- E. Cabinet Finish Sample: Submit two samples of each type of finish, 2 inches by 3 inches in size, illustrating color, texture, gloss, and wood species.
- F. Manufacturer's Qualification Statement.
- G. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

## 1.5 QUALITY ASSURANCE

- A. Manufacturer: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

## 1.6 MOCK-UP

- A. Refer to Section 014389 for Residential Unit Mockup requirements.
- B. Provide full size mock-up of casework base unit.
- C. Locate where directed.
- D. Mock-up may remain as part of the Work.

## 1.7 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective Work within a five year period after Date of Substantial Completion.

# PART 2 PRODUCTS

## 2.1 CABINETS

- A. Kitchen and Vanity Cabinets: Premanufactured and factory-finished, complying with construction and testing requirements in KCMA A161.1.
- B. Cabinet Box: Frameless construction.
  - 1. Side Panels: Particle or plywood.
    - a. Exposed Side Panel Finish: Wood veneer, coordinate with cabinet door and drawer color/finish.
  - 2. Back Panel: Plywood.
  - 3. Bottom (and Top) Panel: Plywood.
  - 4. Face Frame: Solid wood.
  - 5. Interior Cabinet Finish: Thermally fused laminate.

6. Exposed Panel Edges: Finish with manufacturer's standard edge banding, color coordinated with other exposed finishes.
- C. Cabinet Door/Drawer Configuration: Full overlay.
- D. Cabinet Doors:
  1. Style: TBD manufactured by [\_\_\_\_\_].
  2. Particle board or medium density fiberboard (MDF), wood veneer finish.
  3. Species: [\_\_\_\_\_.]
  4. Stain Color: [\_\_\_\_\_].
  5. Color: As selected from manufacturer's standard colors.
- E. Drawers:
  1. Plywood sides with dovetail joints, plywood bottom panel.
  2. Drawer Front: To match cabinet doors in style, material, and finish.
  3. Interior Finish: Manufacturer's standard.
- F. Shelves: Manufacturer's standard adjustable shelves and shelf supports.
- G. Cabinet Hardware: As selected from manufacturer's standard types, styles and finishes.
  1. Drawer and Cabinet Pulls: Continuous integrated aluminum edge pulls.
  2. Hinges: Manufacturer's standard self-closing concealed hinges.
  3. Drawer Slides: Manufacturer's standard self-closing drawer slides.
  4. Mobile Island Base: Stainless steel static and swivel casters with locking wheel.
- H. Countertops: As specified in Section 12 36 00.
- I. Bolts, Nuts, Washers and Screws: Of size and type to suit application.

## 2.2 MATERIALS

- A. Adhesives Used for Assembly: Comply with VOC requirements for adhesives and sealants as specified in Section 01 61 16.
- B. Wood-Based Materials:
  1. Solid Wood: Air-dried to 4.5 percent moisture content, then tempered to 6 percent moisture content before use.
  2. Composite Wood Panels: Containing no urea-formaldehyde resin binders.

- C. Solid Wood: Clear, dry, sound, plain sawn, selected for species grain and color, no defects.
- D. Hardwood Plywood: Veneer core; HPVA HP-1 Grade as indicated; same species as exposed solid wood, clear, compatible grain and color, no defects. Band exposed edges with solid wood of same species as veneer.
- E. Concealed Solid Wood or Plywood: Any species and without defects affecting strength or utility.
- F. Particleboard: Composed of wood chips, medium density, with waterproof resin binders; of grade to suit application; sanded faces; complying with ANSI A208.1.
- G. Medium Density Fiberboard (MDF): Composed of cellulosic fibers and resin cured under heat and pressure; grade to suite application; complying with ANSI A208.2.
- H. Hardboard: ANSI A135.4, Class 1, tempered.
- I. Thermally Fused Laminate (TFL): Melamine resin, NEMA LD 3, Type VGL laminate panels.
- J. Aluminum Components: Conforming to ASTM B209; All exposed interior and exterior surfaces to have AAMA 2604 high performance organic coating.

### 2.3 FABRICATION

- A. Shop assemble casework for delivery to site in units easily handled and to permit passage through building openings.
- B. Fabricate corners and joints without gaps.
- C. Fabricate each unit to be rigid and not dependent on adjacent units for rigidity.
- D. Provide cutouts for plumbing fixtures and appliances. Prime paint contact surfaces of cut edges.
- E. When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide trim for scribing and site cutting.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify adequacy of support framing.

### 3.2 INSTALLATION

- A. Install casework, components and accessories in accordance with manufacturer's instructions.
- B. Use anchoring devices to suit conditions and substrate materials encountered.
- C. Set casework items plumb and square, securely anchored to building structure.
- D. Carefully scribe casework abutting other components, with maximum gaps of 1/8 inch.

### 3.3 ADJUSTING

- A. Adjust doors, drawers, hardware, and other moving or operating parts to function smoothly.

### 3.4 CLEANING

- A. Clean casework, countertops, shelves, and hardware.

### 3.5 PROTECTION

- A. Do not permit finished casework to be exposed to continued construction activity.

END OF SECTION

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## SECTION 12 36 00 - COUNTERTOPS

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Countertops for architectural cabinet work.
- B. Countertops for manufactured casework.
- C. Wall-hung counters and vanity tops.

#### 1.2 RELATED REQUIREMENTS

- A. Section 06 41 00 - Architectural Wood Casework.
- B. Section 12 35 30 - Residential Casework.
- C. Section 22 40 00 - Plumbing Fixtures: Sinks.

#### 1.3 REFERENCE STANDARDS

- A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2021a.
- B. AWI (QCP) - Quality Certification Program Current Edition.
- C. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition 2014, with Errata (2016).
- D. ISFA 3-01 - Classification and Standards for Quartz Surfacing Material 2013.
- E. MIA (DSDM) - Dimensional Stone Design Manual, Version VIII 2016.
- F. PS 1 - Structural Plywood 2009 (Revised 2019).

#### 1.4 SUBMITTALS

- A. See Section 01 33 00 for submittal procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
  - 1. Preparation instructions and recommendations.
  - 2. Storage and handling requirements and recommendations.
  - 3. Specimen warranty.
- C. Shop Drawings: Complete details of materials and installation ; combine with shop drawings of cabinets and casework specified in other sections.
- D. Verification Samples: For each finish product specified, minimum size 6 inches square, representing actual product, color, and patterns.

- E. Sustainable Design Submittal: Documentation for sustainably harvested wood-based components.
- F. Test Reports: Chemical resistance testing, showing compliance with specified requirements.
- G. Certificate: Submit labels and certificates required by quality assurance and quality control programs.
- H. Installation Instructions: Manufacturer's installation instructions and recommendations.
- I. Maintenance Data: Manufacturer's instructions and recommendations for maintenance and repair of countertop surfaces.

## 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing work of the type specified in this section, with not less than three years of documented experience.
- B. Quality Certification:
  - 1. Comply with AWI (QCP) woodwork association quality certification service/program in accordance with requirements for work specified in this section: [www.awiqcp.org/#sle](http://www.awiqcp.org/#sle).
  - 2. Provide labels or certificates indicating that the installed work complies with AWI/AWMAC/WI (AWS) requirements for grade or grades specified.
  - 3. Provide designated labels on shop drawings as required by certification program.
  - 4. Provide designated labels on installed products as required by certification program.
  - 5. Submit certifications upon completion of installation that verifies this work is in compliance with specified requirements.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

## 1.7 FIELD CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

## PART 2 PRODUCTS

### 2.1 COUNTERTOPS

- A. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.

- B. Natural Quartz and Resin Composite Countertops: Sheet or slab of natural quartz and plastic resin over continuous substrate.
  - 1. Flat Sheet Thickness: 2 mm minimum.
  - 2. Natural Quartz and Resin Composite Sheets, Slabs and Castings: Complying with ISFA 3-01 and NEMA LD 3; orthophthalic polyester resin, mineral filler, and pigments; homogenous, non-porous and capable of being worked and repaired using standard woodworking tools; no surface coating; color and pattern consistent throughout thickness.
    - a. Factory fabricate components to the greatest extent practical in sizes and shapes indicated; comply with the MIA Dimension Stone Design Manual.
    - b. Surface Burning Characteristics: Flame spread index of 25, maximum; smoke developed index of 450, maximum; when tested in accordance with ASTM E84.
    - c. Finish on Exposed Surfaces: Polished.
    - d. Color and Pattern: As indicated on drawings.
  - 3. Other Components Thickness: 3/4 inch, minimum.
  - 4. Exposed Edge Treatment: Built up to minimum 1-1/4 inch thick; square edge; use marine edge at sinks.
  - 5. Back and End Splashes: Same sheet material, square top; minimum 4 inches high.

## 2.2 MATERIALS

- A. Plywood for Supporting Substrate: PS 1 Exterior Grade, A-C veneer grade, minimum 5-ply; minimum 3/4 inch thick; join lengths using metal splines.
- B. Adhesives: Chemical resistant waterproof adhesive as recommended by manufacturer of materials being joined.
- C. Joint Sealant: Mildew-resistant silicone sealant, white.

## 2.3 FABRICATION

- A. Fabricate tops and splashes in the largest sections practicable, with top surface of joints flush.
  - 1. Join lengths of tops using best method recommended by manufacturer.
  - 2. Fabricate to overhang fronts and ends of cabinets 1 inch except where top butts against cabinet or wall.
    - a. Rout a 1/8 inch drip groove at underside of exposed overlapping edges, set back 1/2 inch from face of edge.
  - 3. Prepare counters for undermount sinks as indicated.

4. Prepare all cutouts accurately to size; replace tops having improperly dimensioned or unnecessary cutouts or fixture holes.
- B. Provide back/end splash wherever counter edge abuts vertical surface unless otherwise indicated.
  1. Secure to countertop with concealed fasteners and with contact surfaces set in waterproof glue.
  2. Height: 4 inches, unless otherwise indicated.
- C. Wall-Mounted Counters: Provide skirts, aprons, brackets, and braces as indicated on drawings, finished to match.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- C. Verify that wall surfaces have been finished and mechanical and electrical services and outlets are installed in proper locations.

### 3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

### 3.3 INSTALLATION

- A. Securely attach countertops to cabinets using concealed fasteners. Make flat surfaces level; shim where required.
- B. Seal joint between back/end splashes and vertical surfaces.

### 3.4 TOLERANCES

- A. Variation From Horizontal: 1/8 inch in 10 feet, maximum.
- B. Offset From Wall, Countertops: 1/8 inch maximum; 1/16 inch minimum.
- C. Field Joints: 1/8 inch wide, maximum.

### 3.5 CLEANING

- A. Clean countertops surfaces thoroughly.

### 3.6 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION

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## SECTION 12 48 13 - ENTRANCE FLOOR MATS AND FRAMES

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Stainless steel entrance floor gratings.
- B. Recessed mat frames.

#### 1.2 SUBMITTALS

- A. See Section 01 33 00 for submittal procedures.
- B. Product Data: Provide data indicating properties of walk-off surfaces, component dimensions.
- C. Shop Drawings: Indicate dimensions and details for recessed frame.
  - 1. For recessed frames located within a dimensionally restricted area, show dimensions of space within which the frame will be installed.
- D. Maintenance Data: Include cleaning instructions, and stain removal procedures.

### PART 2 PRODUCTS

#### 2.1 ENTRANCE FLOOR GRILLES AND GRATINGS

- A. Entrance Floor Gratings: Recessed stainless steel bar grating with longitudinal bars running perpendicular to traffic flow and perimeter frame forming sides of recess; grating hinged for access to recess.
  - 1. Grating: Longitudinal bars 0.09 inch, nominal, in width, spaced at less than twice the bar width apart; cross bars set below for pronounced linear appearance.
  - 2. Grating Depth: 5/8 inch, nominal.
  - 3. Recess Depth Below Bottom of Grating: 1 inches.
  - 4. Length in Direction of Traffic Flow: as indicated on the drawings.
  - 5. Width Perpendicular to Traffic Flow: Full width of entrance door opening.
  - 6. Stainless Steel Angle Frame: 7/8 inch deep recess in Type 316 stainless steel with 1/8 inch exposed surface.
- B. Mounting: Top of non-resilient members level with adjacent floor.
- C. Structural Capacity: Capable of supporting a rolling load of 1000 pounds without permanent deformation or noticeable deflection.
- D. Vibration Resistant Fabrication: All members welded, riveted, or bolted; no snap or friction connections.

## 2.2 FABRICATION

- A. Construct recessed mat frames square, tight joints at corners, rigid. Coat surfaces with protective coating where in contact with cementitious materials.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify that floor opening for recessed frame is ready to receive work.

### 3.2 PREPARATION

- A. Remove and smooth any telegraphing irregularities in the substrate prior to installation of carpet mat.
- B. Vacuum clean floor recess.
- C. Allow unrolled grid and carpet mat to condition materials to the required temperature for 48 hours prior to installation.

### 3.3 INSTALLATION

- A. Install frames to achieve flush plane with finished floor surface in accordance with manufacturer's recommendations.
- B. Install walk-off surface in floor recess flush with finish floor after cleaning of finish flooring.

### 3.4 TOLERANCES

- A. Maximum Gap Formed at Recessed Frame from Grid Size: 1/4 inch.

### 3.5 CLEANING

- A. Clean the tread surface and recessed well as frequently as possible to reduce the effects of accumulated soiling that may hinder performance and lifetime.

### 3.6 PROTECTION

- A. After completing required frame installation and concrete work, provide temporary filler of plywood or fiberboard in recesses, and cover frames with plywood protective flooring. Maintain protection until construction traffic has ended and project is near time of substantial completion.
- B. Defer installation of floor grids and carpet mats until time of substantial completion of project.

END OF SECTION

## SECTION 12 93 13 - BICYCLE RACKS

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Bicycle racks.
- B. Bike Repair Station.

#### 1.2 REFERENCE STANDARDS

- A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2012.
- B. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2012.
- C. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2013.

#### 1.3 SUBMITTALS

- A. See Section 01 33 00 for general submittal procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
  - 1. Preparation instructions and recommendations.
  - 2. Storage and handling requirements and recommendations.
  - 3. Installation methods.
- C. Shop Drawings: Indicate size, shape, and dimensions, including clearances from adjacent walls, doors, and obstructions.
- D. Selection Samples: For each finish product specified, color chips representing manufacturer's full range of available colors and patterns.

#### 1.4 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Handle racks with sufficient care to prevent scratches and other damage to the finish.

### PART 2 PRODUCTS

#### 2.1 MANUFACTURERS

- A. Bicycle Racks: Basis of Design
  - 1. [Free Standing Bike Rack: Freestanding Teal-Tree G-Bike Rack as manufactured by Spire LLC.](#)

2. Provide systems indicated or approved equal. Refer to Section 01 25 00 regarding requirements for submittal and approval procedures for substitutions.

## 2.2 BICYCLE RACKS

A. Free Standing Bike Rack: System designed for free standing installation, 6 bike vertical storage capacity with adjustable mounting slots.

B. Bicycle Repair Station

1. **Dero Air Kit and Dero Fixit Rack bicycle repair stands manufactured by DERO BIKE RACK CO.**

2. Components:

- a. Main body: 6 x 3/16" tube.
- b. Bike Hanger: 1.5" sch. 40 pipe, 1/4" plate.
- c. Foot: 10" dia. x .25" plate.
- d. Tool tethers: 5/32" stainless steel cable.
- e. Manual air pump.

f. Hand tools included:

- 1) Philips and flat head screwdrivers
- 2) 2.5, 3, 4, 5, 6, 8mm Allen wrenches
- 3) Headset wrench
- 4) Pedal wrench
- 5) 8, 9, 10, 11mm box wrenches
- 6) Tire levers

C. Finish: Hot dipped galvanized finish after fabrication; with a powder coat finish standard with manufacturer; color as selected from manufacturer's standard finishes.

D. Materials:

1. Pipe: Carbon steel, ASTM A53/A53M, Schedule 40.
2. Tube: Carbon steel, ASTM A500/A500M, ASTM A513/A513M
3. Steel Pipe: ASTM A500/A500M
4. Steel Tube: ASTM A513/A513M, electric welded steel tubing.
5. Bar, Round and Flat, Carbon Steel, ASTM A36/A36M.

## 2.3 FINISHES

- A. Galvanized coating: ASTM A123/A123M; G60
- B. Powder coating: Rust inhibitor; Thermosetting TGIC polyester powder top coat, UV, chip, and flake resistant.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Examine surfaces to receive bicycle racks.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- C. Do not begin installation until unsatisfactory substrates have been properly repaired.

### 3.2 PREPARATION

- A. Ensure surfaces to receive bicycle racks are clean, flat, and level.

### 3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install bicycle racks level, plumb, square, and correctly located as indicated on the drawings.
- C. Surface Flange Installation: Anchor bicycle racks securely in place with 1/2 inch by 4 inch anchor bolts through flange holes.

### 3.4 CLEANING

- A. Clean installed work to like-new condition. Do not use cleaning materials or methods that could damage finish.

### 3.5 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

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## SECTION 14 21 00 - ELECTRIC TRACTION ELEVATORS

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

A. Complete electric traction elevator systems.

1. Passenger type.

B. Elevator Maintenance Contract.

#### 1.2 RELATED REQUIREMENTS

A. Section 03 30 00 - Cast-in-Place Concrete: Includes enclosed hoistway, elevator pit, grouting thresholds, and grouting hoistway entrance frames.

B. Section 04 20 00 - Unit Masonry: Masonry hoistway enclosure; building-in and grouting hoistway door frames.

C. Section 05 12 00 - Structural Steel Framing: Includes divider beams and overhead hoist beams.

D. Section 05 50 00 - Metal Fabrications: Includes elevator pit ladder and sill supports.

E. Section 07 84 00 - Firestopping: Fire rated sealant in hoistway.

F. Section 09 21 16 - Gypsum Board Assemblies: Gypsum shaft walls.

G. Section 09 65 00 - Resilient Flooring: Floor finish in car.

H. Section 09 68 13 - Tile Carpeting: Floor finish in car.

I. Section 21 13 00 - Fire-Suppression Sprinkler Systems: Sprinkler heads in hoistway.

J. Section 22 05 13 - Common Motor Requirements for Plumbing Equipment: Motor for sump pump in pit.

K. Section 22 30 00 - Plumbing Equipment: Pit drain.

L. Section 26 05 33.13 - Conduit for Electrical Systems:

M. Section 26 05 83 - Wiring Connections:

N. Section 28 46 00 - Fire Detection and Alarm:

#### 1.3 REFERENCE STANDARDS

A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials Current Edition.

B. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum 2014 (2015 Errata).

C. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design 2010.

- D. AISC 360 - Specification for Structural Steel Buildings 2016 (Revised 2021).
- E. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test 2015 (Reaffirmed 2020).
- F. ASME A17.1 - Safety Code for Elevators and Escalators Includes Requirements for Elevators, Escalators, Dumbwaiters, Moving Walks, Material Lifts, and Dumbwaiters with Automatic Transfer Devices 2019, with Errata (2021).
- G. ASME A17.2 - Guide for Inspection of Elevators, Escalators, and Moving Walks Includes Inspection Procedures for Electric Traction and Winding Drum Elevators, Hydraulic Elevators, Inclined Elevators, Limited-Use/Limited-Application Elevators, Private Residence Elevators, Escalators, Moving Walks, and Dumbwaiters 2020.
- H. ASTM A36/A36M - Standard Specification for Carbon Structural Steel 2019.
- I. ASTM A276/A276M - Standard Specification for Stainless Steel Bars and Shapes 2017.
- J. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar 2015.
- K. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable 2021a.
- L. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes 2021.
- M. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric) 2021.
- N. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass 2018.
- O. AWS D1.1/D1.1M - Structural Welding Code - Steel 2020.
- P. NEMA LD 3 - High-Pressure Decorative Laminates 2005.
- Q. NEMA MG 1 - Motors and Generators 2018.
- R. NFPA 13 - Standard for the Installation of Sprinkler Systems Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- S. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- T. NFPA 80 - Standard for Fire Doors and Other Opening Protectives 2019.
- U. PS 1 - Structural Plywood 2009 (Revised 2019).

## 1.4 ADMINISTRATIVE REQUIREMENTS

### A. Coordination:

1. Coordinate work with other installers to provide necessary conduits for proper installation of wiring, including but not limited to, the following:
  - a. Elevator pit for lighting and sump pump.
  - b. Automatic transfer switch from controller cabinet.
  - c. Fire alarm panel from controller cabinet.

### B. Preinstallation Meeting: Convene meeting at least one week prior to start of this work.

1. Review schedule of installation, proper procedures and conditions, and coordination with related work.
  2. Review use of elevator for construction purposes, hours of use, scheduling of use, cleanliness of car, employment of operator, and maintenance of system.
- C. Construction Use of Elevator: Provide designated elevator for transport of construction personnel and materials in compliance with ASME A17.1.
1. Enclose car with protective plywood on floor, walls, and ceiling.
  2. Provide temporary lighting.
  3. Provide control panel with manual and emergency operation.

## 1.5 SUBMITTALS

- A. See Section 01 33 00 - SUBMITTAL PROCEDURES , for submittal procedures.
- B. Product Data: Submit data on following items:
1. Signal and operating fixtures, operating panels, and indicators.
  2. Car design, dimensions, layout, and components.
  3. Car and hoistway door and frame details.
  4. Electrical characteristics and connection requirements.
- C. Shop Drawings: Include appropriate plans, elevations, sections, diagrams, and details on following items:
1. Elevator Equipment and Machines: Size and location of driving machines, power units, controllers, governors, and other components.

2. Hoistway Components: Size and location of car machine beams, guide rails, buffers, ropes, and other components.
  3. Rail bracket spacing; maximum loads imposed on guide rails requiring load transfer to building structural framing.
  4. Clearances and over-travel of car and counterweight.
  5. Locations in hoistway of traveling cables and connections for car lighting, telephone, and elevator control panels.
  6. Location and sizes of hoistway and car doors and frames.
  7. Interface with building security system.
  8. Electrical characteristics and connection requirements.
  9. Indicate arrangement of elevator equipment and allow for clear passage of equipment through access openings.
- D. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
- E. Initial Maintenance Contract.
- F. Maintenance Contract: Submit proposal to Owner for standard one year continuing maintenance contract agreement in accordance with ASME A17.1 and requirements as indicated, starting on date initial maintenance contract is scheduled to expire.
1. Indicate in proposal the services, obligations, conditions, and terms for agreement period and for renewal options.
- G. Operation and Maintenance Data:
1. Parts catalog with complete list of equipment replacement parts; identify each entry with equipment description and identifying code.
  2. Operation and maintenance manual.
  3. Schematic drawings of equipment, and wiring diagrams of installed electrical equipment with list of corresponding symbols to identify markings on machine room and hoistway apparatus.

## 1.6 QUALITY ASSURANCE

- A. Designer Qualifications: Design guide rails under direct supervision of a licensed Professional Structural Engineer experienced in design of this type of work and licensed in the State in which the Project is located.
- B. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum 15 years documented experience.

- C. Installer Qualifications: Supervisor along with trained elevator installation personnel on staff of elevator equipment manufacturer.
- D. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of type specified in this section.
- E. Products Requiring Fire Resistance Rating: Listed and classified by UL (DIR) or testing agency acceptable to authorities having jurisdiction.
- F. Products Requiring Electrical Connection: Listed and classified by UL (DIR) or testing agency acceptable to authorities having jurisdiction as suitable for the purpose indicated in construction documents.

## 1.7 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Provide manufacturer's warranty for elevator operating equipment and devices for one year from Date of Substantial Completion.

# PART 2 PRODUCTS

## 2.1 MANUFACTURERS

- A. **Basis of Design - Electric Traction Elevators:** Gen 2 series L; Otis Elevator.
- B. Other Acceptable Manufacturers - Electric Traction Elevators:
  - 1. **Kone Elevators; MonoSpace 700.**
- C. Substitutions: See Section 01 25 00 - Substitution Procedures for submittal and acceptance requirements.
  - 1. For any product not identified as Basis of Design, submit information as specified for substitutions.
- D. Products other than Basis of Design are subject to compliance with specified requirements and prior approval of Architect. By using products other than Basis of Design, the Contractor accepts responsibility for costs associated with any necessary modifications to related work, including any design fees.
- E. Source Limitations: Provide elevator and associated equipment and components produced by the same manufacturer as the other elevator equipment used for this project and obtained from a single supplier.

## 2.2 ELECTRIC TRACTION ELEVATORS

- A. Electric Traction Passenger Elevator, No. 1 and 2:
  - 1. Electric Traction Elevator Equipment:
    - a. Gearless Traction Machine: Single wrapped traction driving sheave, with dual brake.

2. Drive System:
  - a. Solid-state electronic device with alternating current (AC) with regenerative drive.
3. Operation Control Type:
  - a. Operation: Simplex Collective Operation: Using a microprocessor-based controller, operation shall be automatic by means of the car and hall buttons. If all calls in the system have been answered, the car shall park at the last landing served.
4. Service Control Types:
  - a. Standard service control. Provide restricted access at all levels of the residential elevators 1&2.
5. Interior Car Height: 117 inches.
6. Electrical Power: 480 volts; alternating current (AC); three phase; 60 Hz.
7. Rated Net Capacity: 3500 pounds.
8. Rated Speed: 350 to 500 feet per minute.
9. Hoistway Size: As indicated on drawings.
10. Interior Car Platform Size: As indicated on drawings.
11. Elevator Pit Depth: 60 inch.
12. Overhead Clearance at Top Floor: 151 inch.
13. Travel Distance: As indicated on drawings.
14. Number of Stops: 16.
15. Number of Openings: 16 Front.
16. Traction Machine Location: Top of hoistway shaft against wall.

### 2.3 COMPONENTS

- A. Elevator Equipment:
  1. Motors, Controllers, Controls, Buttons, Wiring, Devices, and Indicators: Comply with NFPA 70 requirements, and refer to Section 26 05 83 for additional requirements.
  2. Guide Rails, Cables, Counterweights, Sheaves, Buffers, Attachment Brackets and Anchors: Design criteria for components includes safety factors in accordance with applicable requirements of Elevator Code, ASME A17.1.
  3. Buffers:

- a. Oil type for elevators with speed greater than 200 feet per minute.
- 4. Lubrication Equipment:
  - a. Provide grease fittings for periodic lubrication of bearings.
  - b. Grease Cups: Automatic feed type.
  - c. Lubrication Points: Visible and easily accessible.
- B. Electrical Equipment:
  - 1. Motors: NEMA MG 1.
  - 2. Boxes, Conduit, Wiring, and Devices: Complying with NFPA 70 and in accordance with Sections 26 05 33.13 and 26 05 83.
  - 3. Sump Pump in Pit: Refer to Section 22 05 13.
  - 4. Spare Conductors: Provide ten percent in extra conductors and two pairs of shielded audio cables in traveling cables.
  - 5. Include wiring and connections to elevator devices remote from hoistway and between elevator machine room. Provide additional components and wiring to suit machine room layout. Refer to Section 26 05 83.

## 2.4 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with ASME A17.1, applicable local codes, and authorities having jurisdiction (AHJ).
- B. Accessibility Requirements: Comply with ADA Standards.
- C. Perform structural steel design, fabrication, and installation in accordance with AISC 360.
- D. Perform welding of steel in accordance with AWS D1.1/D1.1M.
- E. Fabricate and install door and frame assemblies in accordance with NFPA 80 and complying with requirements of authorities having jurisdiction (AHJ).
- F. Perform electrical work in accordance with NFPA 70.
- G. Comply with venting or pressurization of hoistway design in accordance with HVAC system requirements and authorities having jurisdiction (AHJ).
- H. Comply with fire protection sprinkler system of hoistway design in accordance with NFPA 13 requirements and authorities having jurisdiction (AHJ). Refer to Section 21 13 00.

## 2.5 OPERATION CONTROLS

- A. Car Operating Panel: A car operating panel shall be provided which contains all push buttons, key switches, and message indicators for elevator operation. The car operating panel shall have a stainless steel finish.
  - 1. The car operating panel shall contain a bank of round stainless steel, mechanical LED illuminated buttons, flush mounted to the panel and marked to correspond to the landings served.
  - 2. All buttons to have raised numerals and Braille markings with:
    - a. Raised markings and Braille to the left hand side of each push-button.
    - b. Car Position Indicator at the top of and integral to the car operating panel.
    - c. Door open and door close buttons.
    - d. Inspection key-switch.
    - e. Elevator Data Plate marked with elevator capacity and car number.
    - f. Help Button: The help button shall initiate two-way communication between the car and a location inside the building, switching over to another location if the call is unanswered, where personnel are available who can take the appropriate action. Visual indicators are provided for call initiation and call acknowledgement.
    - g. Landing Passing Signal: A chime bell shall sound in the car to signal that the car is either stopping at or passing a floor served by the elevator.
    - h. In car stop switch (toggle or key unless local code prohibits use)
    - i. Firefighter's hat (standard USA)
    - j. Firefighter's Phase II Key-switch (standard USA)
    - k. Call Cancel Button (standard USA)
- B. Elevator Controls: Provide landing operating panels and landing indicator panels.
  - 1. Comply with ADA Standards for elevator controls.
- C. Interconnect elevator control system with building security, fire alarm, card access, smoke alarm, and building management control systems.
- D. Door Operation Controls:
  - 1. Program door control to open doors automatically when car arrives at floor landing.
  - 2. Render "Door Close" button inoperative when car is standing at dispatch landing with doors open.

3. Door Safety Devices: Moveable, retractable safety edges, quiet in operation; equipped with photo-electric light rays.
- E. Lobby Monitoring Panel:
  1. Locate status indicator and control panel for each individual elevator and group of elevators as indicated on drawings.
  2. Mount panel in console as indicated on drawings.
  3. Etch face plate markings in panel, and fill with paint of contrasting color.
  4. Include direction indicator displaying landing "Up" and "Down" calls registered at each landing floor.
  5. Include position and motion display for direction of travel of each elevator; display appropriate graphic characters on non-glare screen; indicate position of cars at rest and in motion.

## 2.6 OPERATION CONTROL TYPE

- A. Selective Collective Automatic Operation Control: Applies to car in single elevator shaft.
  1. Refer to description provided in ASME A17.1.
  2. Automatic operation by means of one button in the car for each landing served and by "UP" and "DOWN" buttons at the landings.
  3. Stops are registered by momentary actuation of landing car buttons without consideration of the number of buttons actuated or the sequence buttons are actuated, but the stops are made in the order that landings are reached in each direction of travel.
  4. All "UP" landing calls are made when car is traveling in the up direction.
  5. All "DOWN" landing calls are made when car is traveling in the down direction.
  6. Uppermost and lowermost calls are answered as soon as they are reached without consideration of the car travel direction.
- B. Two-Car Selective Collective Automatic (Duplex Collective Automatic) Operation Control: Applies to cars in two elevator shafts.
  1. Park one car at main floor and designate other as free car, at landing last served or at a predetermined upper floor landing.
  2. Arrange free car to answer landing calls either above or below landing where car is standing except main floor and basement landing calls.
  3. When free car is answering calls, automatically start an alternate car to answer landing calls under any of the following conditions:

- a. Registration of up calls from landings below the free car while it is traveling up by alternate car below.
  - b. Registration of up or down calls from landings above the free car while it is traveling down by alternate car.
  - c. Free car fails to clear registered landing calls within 40 seconds, or to move alternate car in response to registered landing calls within this time frame.
4. Register and answer calls by momentary pressure on one or more car buttons; cause car to respond.
  5. Once started, either in response to car button calls, or to landing button calls, respond to calls registered for the direction of the traveling car in the order that landings are reached, regardless of sequence that calls were registered.
  6. Allow only one car to stop in response to any one landing call.
  7. Return first free car to main floor after answering landing calls.
  8. Should both cars finish their calls at main floor, designate one car as the free car.
  9. If no car buttons are pressed and car starts up in response to several landing down calls, proceed first to the highest landing down call, then reverse to collect other landing down calls. Collect up calls similarly when car starts down in response to such calls.
  10. If a car stops for a landing call, and car button matching direction the car was traveling is pressed within a predetermined time interval after a landing stop, proceed in the same direction regardless of other landing calls that are registered.
  11. If down landing buttons are pressed while car is traveling up, do not stop at those landings but allow those calls to remain registered for answering by the next down traveling car.
  12. After the highest car has responded to up landing calls, reverse car automatically and respond to down landing calls.
  13. When traveling down, a car will not respond to up calls. Allow those up calls to remain registered to be answered by next available car on an up trip.
  14. Include a time delay to hold car for an adjustable time interval at landings where stops are made to enable passengers to enter or leave the car. Cancel the time interval upon registration of a car call or pressure on the car door close button.
  15. Permit a registered car call to establish the direction of travel when a car has answered the farthest car call, even if other landing calls are registered.
  16. Answer calls to the basement landing with the car that is normally parked at the main floor unless the free car is at the basement.
  17. If a car is removed from service, the other car shall answer landing calls.

## 2.7 EMERGENCY POWER

- A. Set-up elevator operation to run with building emergency power supply when the normal building power supply fails, and in compliance with ASME A17.1 requirements.
- B. Building Emergency Power Supply: Supplied by backup generator; provide elevator system components as required for emergency power characteristics with phase rotation the same as for normal power.
  - 1. Provide transfer switches and auxiliary contacts.
  - 2. Install connections to power feeders.
- C. Emergency Lighting: Comply with ASME A17.1 elevator lighting requirements.
- D. Provide operational control circuitry for adapting the change from normal to emergency power.
- E. Upon transfer to emergency power, advance one elevator at a time to a pre-selected landing, stop car, open doors, disable operating circuits, and hold in standby condition.

## 2.8 MATERIALS

- A. Rolled Steel Sections, Shapes, Rods: ASTM A36/A36M.
- B. Steel Sheet: ASTM A1008/A1008M, Designation CS (commercial steel), with matte finish.
- C. Stainless Steel Sheet: ASTM A666, Type 304; No. 4 Brushed finish unless otherwise indicated.
- D. Stainless Steel Bars, Shapes and Moldings: ASTM A276/A276M, Type 304.
- E. Extruded Aluminum: ASTM B221 (ASTM B221M), natural anodized finish unless otherwise indicated.
- F. Plywood: PS 1, Structural I, Grade C-D or better, sanded.
- G. Tempered Glass: 3/8 inch minimum thickness, fully tempered in compliance with ASME A17.1, 16 CFR 1201, ANSI Z97.1, and ASTM C1048 tempered glass requirements.
- H. Resilient Flooring: Vinyl tile flooring, as specified in Section 09 65 00.
- I. Tile Carpet Flooring: As specified in Section 09 68 13.

## 2.9 CAR AND HOISTWAY ENTRANCES

- A. Elevator, No. 1 and 2:
  - 1. Car and Hoistway Entrances, Main Elevator Lobby:
    - a. Hoistway Fire Rating: 2 Hours.
    - b. Elevator Door Fire Rating: 1-1/2 Hours.
    - c. Framed Opening Finish and Material: Alkyd enamel on steel.

- 1) Provide a 12 inch high custom transom above door frame at Lobby and Penthouse floors.
- d. Car Door Material: Stainless steel, with rigid sandwich panel construction.
- e. Hoistway Door Material: Powder coat on steel, with rigid sandwich panel construction.
- f. Door Type: Double leaf.
- g. Door Width: 36 inch.
- h. Door Height: 84 inch.
- i. Sills: Extruded aluminum.
2. Car and Hoistway Entrances, Upper Floor Elevator Lobbies:
  - a. Hoistway Fire Rating: 2 Hours.
  - b. Elevator Door Fire Rating: 1-1/2 Hours.
  - c. Framed Opening Finish and Material: Alkyd enamel on steel.
  - d. Car Door Material: Powder coat on steel, with rigid sandwich panel construction.
  - e. Hoistway Door Material: Powder coat on steel, with rigid sandwich panel construction.
  - f. Door Type: Double leaf.
  - g. Paint Color: As indicated.
  - h. Door Width: 36 inch.
  - i. Door Height: 84 inch.
  - j. Sills: Extruded aluminum.
- B. Sills/Thresholds: Configure to align with frame return and coordinate with floor finish.
- C. Gasketing: Provide acoustic type gasketing at hoistway doors and frames to eliminate audible noise due to car activities in the hoistway, and air pressure differential between hoistway and landing floors.

## 2.10 CAR EQUIPMENT AND MATERIALS

- A. Elevator Car:
  1. Car Operating Panel: Provide main and auxiliary; flush-mounted applied face plate, with illuminated call buttons corresponding to floors served with "Door Open/Door Close" buttons, "Door Open" button, "Door Close" button, and alarm button.
    - a. Panel Material: Integral with front return; one per car.
    - b. Car Floor Position Indicator: Above door with illuminating position indicators.

2. Ventilation: Single speed fan with grille in ceiling.
  3. Flooring: Carpeting.
  4. Front Return Panel: Match material of car door.
  5. Door Wall: Plastic laminate on plywood.
  6. Side Walls: Plastic laminate on plywood.
  7. Rear Wall: Plastic laminate on plywood.
  8. Hand Rail: Aluminum, at three side walls. Provide open clearance space 1-1/2 inch (38 mm) wide to face of wall.
    - a. Aluminum Finish: Clear anodized.
  9. Ceiling:
- B. Car Accessories:
1. Certificate Frame: Stainless steel frame glazed with clear tempered glass, and attached with tamper-proof screws.
  2. Protective Pads at Residential Elevators only: Canvas cover, padded with impact-resistant fill material, sewn with piping edges; fire resistant in compliance with ASME A17.1; brass grommets for supports, covering side and rear walls and front return, with cut-out for control panel; provide one set for each elevator.
    - a. Color: Tan.
    - b. Provide at least 4 inch clearance from bottom of pad to finished floor.
    - c. Pad Supports: Stainless steel studs, and mounted from ceiling frame.

## 2.11 FINISHES

- A. Clear Anodized Finish: Class I, AAMA 611 AA-M12C22A41 Clear anodic coating with electrolytically deposited organic seal; not less than 0.7 mils, 0.0007 inch thick.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify existing conditions before starting this work.
- B. Verify that hoistway and pit are ready for work of this section.
- C. Verify hoistway shaft and openings are of correct size and within tolerance.
- D. Verify location and size of machine foundation and position of machine foundation bolts.

E. Verify that electrical power is available and of correct characteristics.

### 3.2 PREPARATION

- A. Arrange for temporary electrical power for installation work and testing of elevator components. Comply with requirements of Section 01 50 00 - Temporary Facilities and Controls.
- B. Maintain elevator pit excavation free of water.

### 3.3 INSTALLATION

- A. Coordinate this work with installation of hoistway wall construction.
- B. Install system components, and connect equipment to building utilities.
- C. Provide conduit, electrical boxes, wiring, and accessories. Refer to Sections 26 05 33.13 and 26 05 83.
- D. Mount machines and motors on vibration and acoustic isolators.
  1. Place on structural supports and bearing plates.
  2. Securely fasten to building supports.
  3. Prevent lateral displacement.
- E. Install hoistway, elevator equipment, and components in accordance with approved shop drawings.
- F. Install guide rails to allow for expansion and contraction movement of guide rails.
- G. Accurately machine and align guide rails, forming smooth joints with machined splice plates.
- H. Bolt brackets to inserts placed in concrete form work.
- I. Install hoistway door sills, frames, and headers in hoistway walls; grout sills in place, set hoistway floor entrances in alignment with car openings, and align plumb with hoistway.
- J. Fill hoistway door frames solid with grout in accordance with Section 04 20 00.
- K. Structural Metal Surfaces: Clean surfaces of rust, oil or grease; wipe clean with solvent; prime with two coats.
- L. Wood Surfaces not Exposed to Public View: Finish with one coat primer; one coat enamel.
- M. Adjust equipment for smooth and quiet operation.

### 3.4 TOLERANCES

- A. Guide Rail Alignment: Plumb and parallel to each other in accordance with ASME A17.1 and ASME A17.2.

- B. Car Movement on Aligned Guide Rails: Smooth movement, without any objectionable lateral or oscillating movement or vibration.

### 3.5 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for additional requirements.
- B. Testing and inspection by regulatory agencies certified in accordance with ASME QEI 1 will be performed at their discretion.
  - 1. Schedule tests with agencies and notify Owner and Architect.
  - 2. Obtain permits as required to perform tests.
  - 3. Document regulatory agency tests and inspections in accordance with requirements.
  - 4. Perform tests required by regulatory agencies.
  - 5. Furnish test and approval certificates issued by authorities having jurisdiction (AHJ).

### 3.6 ADJUSTING

- A. Adjust for smooth acceleration and deceleration of car to minimize passenger discomfort.
- B. Adjust with automatic floor leveling feature at each floor landing to reach 1/4 inch maximum from flush with sill.

### 3.7 CLEANING

- A. Remove protective coverings from finished surfaces.
- B. Clean surfaces and components in accordance with manufacturers written instructions.
- C. See Section 01 74 19 - Construction Waste Management and Disposal, for additional requirements.

### 3.8 CLOSEOUT ACTIVITIES

- A. See Section 01 78 00 - Closeout Submittals, for closeout submittals.
- B. See Section 01 79 00 - Demonstration and Training, for additional requirements.
- C. Demonstrate proper operation of equipment to Owner's designated representative.

### 3.9 PROTECTION

- A. Do not permit construction traffic within car after cleaning.
- B. Protect installed products until Date of Substantial Completion.
- C. Touch-up, repair, or replace damaged products and materials before Date of Substantial Completion.

### 3.10 MAINTENANCE

- A. Provide Initial Maintenance Contract of elevator system and components in accordance with ASME A17.1 and requirements as indicated for twelve months from Date of Substantial Completion.
- B. Perform maintenance contract services using competent and qualified personnel under the supervision and direct employ of the elevator manufacturer or installer.
- C. Maintenance contract services shall not be assigned or transferred to any agent or other entity without prior written consent of Owner.
- D. Examine system components periodically.
- E. Include systematic examination, adjustment, and lubrication of elevator equipment.
- F. Maintain and repair or replace parts, whenever required, using parts produced by original equipment manufacturer.
- G. Perform work without removing cars from use during peak traffic periods.
- H. Provide emergency call back service during regular working hours throughout period of this maintenance contract.
- I. Maintain an adequate stock of parts for replacement or emergency purposes, and have personnel available to ensure the fulfillment of this maintenance contract without unreasonable loss of time.

END OF SECTION

## SECTION 14 91 82 - TRASH CHUTE

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Gravity chutes for waste (trash, refuse) and recyclables.
- B. Chute maintenance.

#### 1.2 RELATED REQUIREMENTS

- A. Section 09 21 16 - Gypsum Board Assemblies: Acoustical seal at ceiling penetrations.
- B. Section 11 82 26 - Waste Compactors: Compactors and chute interlock controls.
- C. Section 21 13 00 - Fire-Suppression Sprinkler Systems: Connection to sprinklers inside chute.
- D. Section 22 10 05 - Plumbing Piping:
  - 1. Water piping connections to spray cleaning equipment.
- E. Section 26 27 17 - Equipment Wiring:
  - 1. Connection of control panels to 110 VAC electrical power.
  - 2. Wiring and conduit between control panels and controlled components.
  - 3. Wiring and conduit between discharge room spray cleaning switch and flushing spray head.

#### 1.3 REFERENCE STANDARDS

- A. NFPA 13 - Standard for the Installation of Sprinkler Systems; National Fire Protection Association; 2013.
- B. NFPA 82 - Standard on Incinerators and Waste and Linen Handling Systems and Equipment; National Fire Protection Association; 2014.

#### 1.4 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene 7 days before start of installation to review code requirements, manufacturer's recommendations, and related work.

#### 1.5 SUBMITTALS

- A. Refer to Section 01 33 00 for general submittal procedures.
- B. Catalog Cuts: provide catalog cuts showing all details of installation and assembly and all requirements for work by other trades.

- C. Product Data: Manufacturer's product specifications, standard details and recommendations for project conditions; indicate selected sizes and installation details specific to the project.
- D. Shop Drawings:
  - 1. Plans: Scale  $\frac{1}{4}$  inch to 1 foot; indicate locations, dimensions, and required associated construction activities.
  - 2. Elevations / Sections: Scale  $\frac{1}{4}$  inch to 1 foot; indicate locations, dimensions, and required associated required construction activities.
  - 3. Details: Scale  $\frac{1}{4}$  inch to 1 foot; indicate:
  - 4. Shop drawings specific to project conditions.
  - 5. Interface with adjacent construction.
  - 6. Dimensions and tolerances.
  - 7. Products required for installation of the trash chute, but not supplied by trash chute manufacturer.
- E. Test Reports: Submit for each test/inspection .
- F. Certificates: Certify that chute assembly meets or exceeds NFPA 82 and other specified requirements.
- G. Close-out Submittals: Refer to Section 01 78 00 for additional information.
  - 1. Operation and Maintenance Data:
  - 2. Manufacturer's printed Operational Manual.
  - 3. Warranty Documents: Issued and executed by the manufacturer and installer of the system.

## 1.6 QUALITY ASSURANCE

- A. See Section 01 40 00 for additional requirements.
- B. Products Requiring Electrical Connection: Listed and classified by UL as suitable for the purpose specified and indicated.
- C. Qualifications:
  - 1. Manufacturer: Minimum five (5) years documented experience-producing products specified in this section.
  - 2. Installer: Approved by the Manufacturer, and having a minimum of five (5) years experience.

## 1.7 WARRANTY

- A. Manufacturer's warranty: Furnish manufacturer's standard five (5) year warranty from date of installation. Warranty shall apply to defects in product workmanship and material only.

## PART 2 - PRODUCTS

### 2.1 PRODUCTS:

A. Basis of Design: Trash Chutes as manufactured by CHUTES International Manufacturing.

B. Acceptable Manufacturers:

1. Century Chute.

2. Wilkinson Hi-rise.

C. Provide as indicated or approved equal; refer to Section 01 25 00 regarding submittal and approval procedures for proposed substitutions.

### 2.2 COMPONENTS:

A. Trash chute: 30 inch diameter of U.S. # 16 gauge Aluminized steel as manufactured by CHUTES International Manufacturing.

B. Doors: 15 inches wide x 18 inches high, hand operated hopper type intake doors, self-closing, bottom hinged with 1-1/2 hour “UL” label; maximum 30 minute, 250° F temperature rise. Stainless steel with No. 3 type finish. ADA compliant lever handle with 2 keys. Only intake door on the market with BOTH front, back and skirt with stainless steel panels. Better looking, longer lasting, easier cleaning, low maintenance.

C. Discharge: Open-end “Accordion Damper Assembly”, “UL” labeled, interlocking type blades held open by fusible link assembly for automatic closing with heat rising above 165° F.

D. Vent: Full diameter vent extending 3 feet (per NFPA Code 82; 2009) above roof with hinged metal safety cap.

E. Floor Frames: Standard floor frames are 1-1/2 inch x 1-1/2 inch x 3/16 inch steel angles.

F. Standard Accessories:

1. Disinfecting and sanitizing unit.

2. Sound Isolation:

a. Factory spray coat chute with sound dampening material such as Daubert 932 sound coat vibrations dampening compound.

b. 3/4 inch rubber or neoprene isolation pads with at least 0.2 percent static deflection by Korfund or Mason Industries (model ND) or approved equal.

c. Sound insulation: 2 inch fiberglass insulation blankets, unfaced.

d. Sound dampening materials shall meet the fire code. Provide a visco-elastic material that is trowel applied . Acceptable manufacturers are Kinetics or approved equal.

3. Automatic on-off sprinklers: 0.5 inch NPT sprinkler and 0.75 inch NPT flushing head above top intake. Provide additional 0.5 inch sprinkler heads at alternate intake floors as required by NFPA Code 82.
  4. Smoke detectors and Heat detectors tied into the Building Fire Alarm system specified in Section 28 31 11.
- G. Trash Chute Roof Vent: As detailed on drawings:
1. Extend to 4 feet above roof level.
  2. Provide full diameter screened vent area.
  3. Metal explosion-release, safety, weather cap.
  4. Roof Vent Flashing: Flashing collar, compatible with chute metal.

## 2.3 FABRICATION

- A. The trash chute shall be fully factory assembled and all joints, except those required separating the sections for shipment and installation shall be welded or lock-seamed tight.
- B. Bolt the floor intake doors in place on throats formed into the chute.
- C. Flash all chute sections inside the sections below.
- D. Bolts, clips, or other projections inside the chute are prohibited.
- E. Pre-position support frames to assure proper intake levels and provide an expansion joint in the chute between all support joints.
- F. Reinforce discharge offsets, where required, and separately support chutes in the impact area.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verification of conditions: Area in which system is to be located is correct size and location, and is prepared for installation of trash chute and components.
- B. Beginning construction activities of this section before unacceptable conditions have been corrected is prohibited.
- C. Verify and record chute alignment with installer immediately following installation.

### 3.2 COORDINATION

- A. Complete chute installation and testing before completion of enclosing construction.
- B. Coordinate sprinkler and spray cleaning devices with size, location and installation of service utilities.

C. Sequence installation to ensure utility connections are achieved in an orderly and expeditious manner.

### 3.3 INSTALLATION

- A. Install chutes and equipment in accordance with NFPA 82 requirements and manufacturer's instructions.
- B. Maintain fire-resistive capacity of enclosing walls.
- C. Install chute plumb and without offsets or obstructions that might prevent free fall of materials, except where indicated on drawings. Maintain at least a 2 inch gap between the chute and container.
- D. Anchor securely in manner required to withstand impact and weight of materials in chute.
- E. Wrap chute and intake throats with insulation, securing without compressing insulation.
- F. Install sound dampening material on all outside surfaces of the trash chute.
- G. Provide isolation pads to connect the trash chute to the building at each floor.
- H. Leave a 1/2 inch gap between the trash room ceiling and chute; seal between the chute and slab using two layers of gypsum board acoustical sealant between the gypsum board and slab.
- I. Provide an angled deflector in the trash room to prevent trash dropping directly into the trash bins. Coat the deflector panel with sound damping coating and apply a 1 inch thick neoprene sound pad over the panel.
- J. Install roof vent flange to roof deck prior to installation of roofing.
- K. Install counterflashing after roofing installation.
- L. Provide door closers and rubber bumpers on the trash chute doors to prevent door slamming.
- M. Adjust doors and other operating components for smooth operation.

### 3.4 FIELD QUALITY CONTROL

- A. See Section 01 40 00 for additional requirements.
- B. Notify Owner at least 7 days prior to testing.
- C. Place bagged material of expected size in chute to verify free fall.
- D. Test all components for proper operation.
  - 1. Operate doors, locks, and interlocks.
  - 2. Operate spray cleaning devices.
  - 3. Simulate fire conditions inside chute to verify sprinkler and detector operation.

### 3.5 CLEANING

- A. After completion of enclosing walls, clean exposed chute components; do not remove testing agency labels.

### 3.6 DEMONSTRATION

- A. Arrange demonstration of system operation, conducted by manufacturer's representative, to Owner's maintenance personnel.

### 3.7 MAINTENANCE

- A. See Section 01 70 00 - Execution and Closeout Requirements, for additional requirements relating to maintenance service.
- B. Provide service and maintenance of facility chute and equipment for one year from Date of Substantial Completion.

END OF SECTION

## **SECTION 210513 - COMMON MOTOR REQUIREMENTS FOR FIRE SUPPRESSION EQUIPMENT**

### **PART 1 - GENERAL**

#### **1.1 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.

#### **1.2 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 NEMA MG 1 unless otherwise indicated.
- B. Retain paragraph below if severe-duty motors are required.
- C. Comply with IEEE 841 for severe-duty motors.

#### **2.2 MOTOR CHARACTERISTICS**

- A. Duty: Continuous duty at ambient temperature of 104 deg F 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.

#### **2.3 POLYPHASE MOTORS**

- A. Description: NEMA MG 1, Design B, medium induction motor.

- B. See "Energy Considerations" Article in the Evaluations for discussion of motor efficiencies.
- C. Efficiency: Energy efficient, as defined in NEMA MG 1.
- D. Service Factor: 1.15.
- E. Multispeed Motors: Variable torque.
  - 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.
- F. Multispeed Motors: Separate winding for each speed.
- G. Rotor: Random-wound, squirrel cage.
- H. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
- I. Temperature Rise: Match insulation rating.
- J. Insulation: Class F.
- K. 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.
- L. 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.

## 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 Used)



## **SECTION 210517 - SLEEVES AND SLEEVE SEALS FOR FIRE-SUPPRESSION PIPING**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

**A.** Section Includes:

1. Sleeves.
2. Stack-sleeve fittings.
3. Sleeve-seal systems.
4. Sleeve-seal fittings.
5. Grout.

#### **1.2 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 A53, Schedule 40, with plain ends and welded steel collar; zinc coated.
- C.** Galvanized-Steel-Pipe Sleeves: ASTM A 53, Type E, Grade B, Schedule 40, zinc coated, with plain ends.
- D.** PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.
- E.** Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- F.** Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.
- G.** Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.

#### **2.2 STACK-SLEEVE FITTINGS**

- A.** Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Smith, Jay R. Mfg. Co.
  2. Zurn Specification Drainage Operation; Zurn Plumbing Products Group.
- 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 available manufacturers offering products that may be incorporated into the Work include, but are not limited to, 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: Stainless steel 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 one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
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, Grade B, post-hardening and volume-adjusting, dry, hydraulic-Sleeves and Sleeve Seals for Fire Suppression Piping

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.

## 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.
- E. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials.

### 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 Sleeves and Sleeve Seals for Fire Suppression Piping

sleeve and pipe or pipe insulation.

2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing.
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.

- B. Fire-Barrier Penetrations: Maintain indicated fire rating of floors at pipe penetrations. Seal pipe penetrations with firestop materials.

### **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:
    - a. Piping Smaller Than NPS 6: Galvanized-steel wall sleeves-seal fittings material.
    - b. Piping NPS 6 and Larger: Galvanized-steel wall sleeves material.
  2. Exterior Concrete Walls below Grade:
    - a. Piping Smaller than NPS 6 Galvanized-steel-pipe sleeves with sleeve-seal system-Sleeves and Sleeve Seals for Fire Suppression Piping

seal fittings material.

- 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
- b. Piping NPS 6 and Larger: Galvanized-steel-pipe sleeves with sleeve-seal system material.
  - 1) 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:
  - a. Piping Smaller Than NPS 6: Cast-iron wall sleeves with sleeve-seal system-seal fittings material.
    - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
  - b. Piping NPS 6 and Larger: Cast-iron wall sleeves with sleeve-seal system fittings material.
    - 1) 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:
  - a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves material.
  - b. Piping NPS 6 and Larger: Galvanized-steel-pipe sleeves material.
5. Interior Partitions:
  - a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves material.
  - b. Piping NPS 6 and larger: Galvanized-steel-sheet sleeves material.



## SECTION 210518 - ESCUTCHEONS FOR FIRE-SUPPRESSION PIPING

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Escutcheons.
2. Floor plates.

#### 1.2 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 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 brass finish and with concealed hinge and setscrew.
- E. Split-Plate, Stamped-Steel Type: With chrome-plated finish, concealed hinge, and spring-clip fasteners.

#### 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.

### 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. Chrome-Plated Piping: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
  - c. Insulated Piping: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge.
  - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
  - e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge.
  - f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
  - g. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge.
  - h. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass or split-casting brass type with polished -brass.
  - i. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type [or split-plate, stamped-steel type with concealed hinge.
  - j. Bare Piping in Equipment Rooms: One-piece, cast-brass or split-casting brass type with polished-brass finish.
  - k. Bare Piping in Equipment Rooms: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge.
- 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.

### 3.2 FIELD QUALITY CONTROL

- A. Replace broken and damaged escutcheons and floor plates using new materials.



## **SECTION 210529 - HANGERS AND SUPPORTS FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

**A. Section Includes:**

- 1.** Metal pipe hangers and supports.
- 2.** Trapeze pipe hangers.
- 3.** Thermal-hanger shield inserts.
- 4.** Fastener systems.
- 5.** Pipe positioning systems.

**B. Related Sections:**

- 1.** Section 055000 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.

#### **1.2 DEFINITIONS**

**A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.**

#### **1.3 PERFORMANCE REQUIREMENTS**

**A. Delegated Design:** Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional Architect, 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.

#### **1.4 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 Architect responsible for their preparation.
  - 1. Detail fabrication and assembly of trapeze hangers.
  - 2. Design Calculations: Calculate requirements for designing trapeze hangers.

## **1.5 INFORMATIONAL SUBMITTALS**

- A.** Welding certificates.

## **1.6 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: Pre galvanized 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:**

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: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 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. Paint Coating: Epoxy.
9. Plastic Coating: Epoxy.

## 2.4 THERMAL-HANGER SHIELD INSERTS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  1. 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.
- 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, zinc-coated 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 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.

## **2.7 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.

- B.** Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, non-shrink and nonmetallic grout; suitable for interior and exterior applications.

- 1.** Properties: Non-staining, 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 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 Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.
- 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.
- 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.
5. 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.
- 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 Section 099113 "Exterior Painting."
- 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 copper-plated pipe hangers and attachments for copper piping and tubing.

- G. Use padded hangers for piping that is subject to scratching.
- H. Use thermal-hanger shield inserts for insulated piping and tubing.
- I. 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 non-insulated or insulated, stationary pipes.
  2. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
  3. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
  4. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
  5. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of non-insulated, stationary pipes NPS 3/4 to NPS 8.
  6. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of non-insulated, stationary pipes NPS 1/2 to NPS 8.
  7. Adjustable Band Hangers (MSS Type 9): For suspension of non-insulated, stationary pipes NPS 1/2 to NPS 8.
  8. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of non-insulated, stationary pipes NPS 1/2 to NPS 8.
  9. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of non-insulated, stationary pipes NPS 3/8 to NPS 8.
  10. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
  11. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
- J. 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.

- K. 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.
- L. 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-joist 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. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
  14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
  15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- M. 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.
- N. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- O. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
- P. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.
- Q. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.



## **SECTION 210548.13 - VIBRATION CONTROLS FOR FIRE-SUPPRESSION 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. Pipe-riser resilient supports.
5. Resilient pipe guides.
6. Elastomeric hangers.

- B. Related Requirements:

1. Section 220548.13 "Vibration Controls for Plumbing Piping and Equipment" for devices for plumbing 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. Delegated-Design Submittal: For each vibration isolation device.

1. Include design calculations for selecting vibration isolators.

#### **1.4 INFORMATIONAL SUBMITTALS**

- A.** Coordination Drawings: Show coordination of vibration isolation device installation for fire-suppression 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 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 ELASTOMERIC ISOLATION PADS**

- A.** Elastomeric Isolation Pads:
  - 1.** Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a.** Ace Mountings Co., Inc.
    - b.** Kinetics Noise Control, Inc.
    - c.** Mason Industries, Inc.
  - 2.** Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.
  - 3.** Size: Factory or field cut to match requirements of supported equipment.
  - 4.** Pad Material: Oil and water resistant with elastomeric properties.
  - 5.** Surface Pattern: Waffle pattern.
  - 6.** Infused nonwoven cotton or synthetic fibers.
  - 7.** Load-bearing metal plates adhered to pads.
  - 8.** Sandwich-Core Material: Resilient and elastomeric.
    - a.** Surface Pattern: Waffle pattern.
    - b.** Infused nonwoven cotton or synthetic fibers.

## **2.2 ELASTOMERIC ISOLATION MOUNTS**

- A.** Double-Deflection, Elastomeric Isolation Mounts:
- 1.** Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a.** Ace Mountings Co., Inc.
    - b.** Kinetics Noise Control, Inc.
    - c.** Mason Industries, Inc.
  - 2.** 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.
  - 3.** Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

## **2.3 RESTRAINED ELASTOMERIC ISOLATION MOUNTS**

- A.** Restrained Elastomeric Isolation Mounts:
- 1.** Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a.** Ace Mountings Co., Inc.
    - b.** Kinetics Noise Control, Inc.
    - c.** Mason Industries, Inc.
  - 2.** 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.

## **2.4 PIPE-RISER RESILIENT SUPPORTS**

- A. Description: All-directional, acoustical pipe anchor consisting of two steel tubes separated by a minimum 1/2-inch- thick neoprene.
  - 1. Vertical-Limit Stops: Steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions.
  - 2. Maximum Load Per Support: 500 psig on isolation material providing equal isolation in all directions.

## **2.5 RESILIENT PIPE GUIDES**

- A. Description: Telescopic arrangement of 2 steel tubes or post and sleeve arrangement separated by a minimum 1/2-inch- thick neoprene.
  - 1. Factory-Set Height Guide with Shear Pin: Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

## **2.6 ELASTOMERIC HANGERS**

- A. Elastomeric Mount in a Steel Frame with Upper and Lower Steel Hanger Rods:
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Ace Mountings Co., Inc.
    - b. Kinetics Noise Control, Inc.
    - c. Mason Industries, Inc.
  - 2. 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.
  - 3. Dampening Element: Molded, oil-resistant rubber, neoprene, or other elastomeric material with a projecting bushing for the underside opening preventing steel to steel contact.

## **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 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.
- B. Installation of vibration isolators must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.



## **SECTION 210553 - IDENTIFICATION FOR FIRE SUPPRESSION PIPING AND EQUIPMENT**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

**A.** Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.
4. Stencils.
5. Valve tags.
6. Warning tags.

#### **1.2 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 and the proposed content for each label.
- D.** Valve Schedules: Valve numbering scheme.

#### **1.3 CLOSEOUT SUBMITTALS**

- A.** Maintenance Data: For each piping system to include in maintenance manuals.

### **PART 2 - PRODUCTS**

#### **2.1 EQUIPMENT LABELS**

**A.** Metal Labels for Equipment:

1. Material and Thickness: Brass, 0.032 inch thick, with predrilled holes for attachment hardware.
2. Letter Color: Red.
3. Background Color: White.

4. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
5. 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-fourths the size of principal lettering.
6. Fasteners: Stainless-steel rivets.
7. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

## 2.2 WARNING SIGNS AND LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, with predrilled holes for attachment hardware.
- B. Letter Color: Red.
- C. Background Color: White.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. 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-fourths the size of principal lettering.
- G. Fasteners: Stainless-steel self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. 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; 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 inches high.
- E.** Pipe-Label Colors:
  - 1.** Background Color: Red.
  - 2.** Letter Color: White.

## 2.4 STENCILS

- A.** Stencils: Prepared with letter sizes according to ASME A13.1 for piping; and minimum letter height of 3/4 inch for access panel and door labels, equipment labels, and similar operational instructions.
  - 1.** Stencil Material: Brass material.
  - 2.** Stencil Paint: Exterior, gloss, alkyd enamel black 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.

## 2.5 VALVE TAGS

- A.** Valve Tags: Stamped or engraved with 1-inch letters for piping-system abbreviation and 1-inch numbers.
  - 1.** Tag Material: Brass, 0.032 inch thick, with predrilled holes for attachment hardware.
  - 2.** Fasteners: Brass hook and a brass window sash chain.
  - 3.** Valve-Tag Color: conform to ASA A 13.1 as required by Hyatt.
  - 4.** Letter Color: conform to ASA A 13.1 as required by Hyatt.
- 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. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
  - 1. Size: Approximately 4 by 7 inches.
  - 2. Fasteners: Brass grommet and wire.
  - 3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
  - 4. Color: 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 LABEL INSTALLATION

- 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 or permanently fasten labels on each major item of mechanical equipment.
- D. Locate equipment labels where accessible and visible.
- E. Piping Color-Coding: Painting of piping as per Hyatt building standard.
- F. 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.
- G. 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. 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.

### **3.3 VALVE-TAG INSTALLATION**

- A. Install tags on valves and control devices in piping systems. List tagged valves in a valve-tag schedule.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and with captions similar to those indicated in "Valve-Tag Size and Shape" Subparagraph below:
  1. Valve-Tag Size and Shape:
    - a. Fire-Suppression Standpipe: 2 inches round.
    - b. Wet-Pipe Sprinkler System: 2 inches round...
    - c. Dry-Pipe Sprinkler System: 2 inches round...

### **3.4 WARNING-TAG INSTALLATION**

- A. Write required message on, and attach warning tags to, equipment and other items where required.



## **SECTION 211100 - FACILITY FIRE SUPPRESSION WATER SERVICE PIPING**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A.** Section includes fire-suppression water-service piping and related components outside the building and service entrance piping through wall into the building.
- B.** Utility-furnished products include water meters that will be furnished to the site, ready for installation.
- C.** Related Sections:
  - 1.** Section 211200 "Fire-Suppression Standpipes" for fire-suppression standpipes inside the building.
  - 2.** Section 211313 "Wet-Pipe Sprinkler Systems" for wet-pipe fire-suppression sprinkler systems inside the building.
  - 3.** Section 211316 "Dry-Pipe Sprinkler Systems" for dry-pipe fire-suppression sprinkler systems inside the building.
  - 4.** Section 213113 "Electric-Drive, Centrifugal Fire Pumps" for fire pumps, pressure-maintenance pumps, and controllers.

#### **1.2 ACTION SUBMITTALS**

- A.** Product Data: For each type of product indicated.
- B.** Shop Drawings:
  - 1.** Detail precast concrete vault assemblies and indicate dimensions, method of field assembly, and components.
  - 2.** Wiring Diagrams: For power, signal, and control wiring.

#### **1.3 INFORMATIONAL SUBMITTALS**

- A.** Coordination Drawings: For piping and specialties including relation to other services in same area, drawn to scale. Show piping and specialty sizes and valves, meter and specialty locations, and elevations.
- B.** Field quality-control reports.

#### **1.4 QUALITY ASSURANCE**

- A.** Regulatory Requirements:

1. Comply with requirements of utility company supplying water. Include tapping of water mains and backflow prevention.
  2. Comply with standards of authorities having jurisdiction for fire-suppression water-service piping, including materials, hose threads, installation, and testing.
- B. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- 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 the "Approval Guide," published by FM Global, or UL's "Fire Protection Equipment Directory" for fire-service-main products.
- E. NFPA Compliance: Comply with NFPA 24 for materials, installations, tests, flushing, and valve and hydrant supervision for fire-suppression water-service piping.

## 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Preparation for Transport: Prepare valves, including fire hydrants, according to the following:
1. Ensure that valves are dry and internally protected against rust and corrosion.
  2. Protect valves against damage to threaded ends and flange faces.
  3. Set valves in best position for handling. Set valves closed to prevent rattling.
- B. During Storage: Use precautions for valves, including fire hydrants, according to the following:
1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.
  2. Protect from weather. Store indoors and maintain temperature higher than ambient dew point temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary.
- C. Handling: Use sling to handle valves and fire hydrants if size requires handling by crane or lift. Rig valves to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.
- D. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.
- E. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.
- F. Protect flanges, fittings, and specialties from moisture and dirt.
- G. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.

## 1.6 COORDINATION

- A. Coordinate connection to water main with utility company.

## PART 2 - PRODUCTS

### 2.1 COPPER TUBE AND FITTINGS

- A. Soft Copper Tube: ASTM B 88, Type L, water tube, annealed temper.
- B. Hard Copper Tube: ASTM B 88, Type L, water tube, drawn temper.
- C. Copper, Solder-Joint Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint pressure type. Furnish only wrought-copper fittings if indicated.
- D. Copper, Pressure-Seal Fittings:
  - 1. Manufacturers: Subject to compliance with requirements, provide products available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Viega; Plumbing & Heating Systems.
  - 2. Standard: UL 213.
  - 3. NPS 2 and Smaller: Wrought-copper fitting with EPDM O-ring seal in each end.
  - 4. NPS 2-1/2 to NPS 4: Bronze fitting with stainless-steel grip ring and EPDM O-ring seal in each end.
- E. Bronze Flanges: ASME B16.24, Class 150, with solder-joint end. Furnish Class 300 flanges if required to match piping.
- F. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

### 2.2 DUCTILE-IRON PIPE AND FITTINGS

- A. Grooved-Joint, Ductile-Iron Pipe: AWWA C151, with cut, rounded-grooved ends.
- B. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell and plain spigot end.
- C. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint bell and plain spigot end.
- D. Grooved-End, Ductile-Iron Pipe Appurtenances:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- a. Anvil International, Inc.
  - b. Shurjoint Piping Products.
  - c. Star Pipe Products.
  - d. Victaulic Company.
2. Grooved-End, Ductile-Iron Fittings: ASTM A 47, malleable-iron castings or ASTM A 536, ductile-iron castings with dimensions matching pipe.
  3. Grooved-End, Ductile-Iron-Piping Couplings: AWWA C606, for ductile-iron-pipe dimensions. Include ferrous housing sections, gasket suitable for water, and bolts and nuts.
- E. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
1. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.
- F. Push-on-Joint, Ductile-Iron Fittings: AWWA C153, ductile-iron compact pattern.
1. Gaskets: AWWA C111, rubber.
- G. Flanges: ASME B16.1, Class 125, cast iron.

### **2.3 SPECIAL PIPE FITTINGS**

**A. Ductile-Iron Flexible Expansion Joints:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. EBAA Iron, Inc.
  - b. ROMAC Industries Inc.
  - c. Star Pipe Products.
2. Description: Compound, ductile-iron fitting with combination of flanged and mechanical-joint ends complying with AWWA C110 or AWWA C153. Include two gasketed ball-joint sections and one or more gasketed sleeve sections. Assemble components for offset and expansion indicated. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.
3. Pressure Rating: 100 psig minimum.

**B. Ductile-Iron Deflection Fittings:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. EBAA Iron, Inc.
2. Description: Compound, ductile-iron coupling fitting with sleeve and one or two flexing sections for up to 15-degree deflection, gaskets, and restrained-joint ends complying with AWWA C110 or AWWA C153. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.
3. Pressure Rating: 100 psig minimum.

#### **2.4 ENCASEMENT FOR PIPING**

- A. Standard: ASTM A 674 or AWWA C105.
- B. Material: Linear High-density, cross-laminated PE film of 0.004-inch minimum thickness.
- C. Form: Sheet.
- D. Color: Black.

#### **2.5 JOINING MATERIALS**

- A. Gaskets for Ferrous Piping and Copper-Alloy Tubing: ASME B16.21, asbestos free.
- B. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series.
- C. Bonding Adhesive for Fiberglass Piping: As recommended by fiberglass piping manufacturer.

#### **2.6 PIPING SPECIALTIES**

- A. Transition Fittings: Manufactured fitting or coupling same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.
- B. Tubular-Sleeve Pipe Couplings:
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Cascade Waterworks Manufacturing.
    - b. Dresser, Inc.; Dresser Piping Specialties.
    - c. Ford Meter Box Company, Inc. (The); Pipe Products Division.
    - d. JCM Industries.
    - e. ROMAC Industries Inc.

- f. Smith-Blair, Inc.; a Sensus company.
  - g. Viking Johnson.
2. Description: Metal, bolted, sleeve-type, reducing or transition coupling, with center sleeve, gaskets, end rings, and bolt fasteners, and with ends of same sizes as piping to be joined.
  3. Standard: AWWA C219.
  4. Center-Sleeve Material: Manufacturer's standard.
  5. Gasket Material: Natural or synthetic rubber.
  6. Pressure Rating: 150 psig minimum.
  7. Metal Component Finish: Corrosion-resistant coating or material.

## 2.7 CORPORATION VALVES AND CURB VALVES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  1. Amcast Industrial Corporation.
  2. Ford Meter Box Company, Inc. (The); Pipe Products Division.
  3. Jones, James Company.
  4. Master Meter, Inc.
  5. McDonald, A. Y. Mfg. Co.
  6. Mueller Co.; Water Products Division.
  7. Red Hed Manufacturing & Supply.
- B. Corporation Valves: Comply with AWWA C800. Include saddle and valve compatible with tapping machine and manifold.
  1. Service Saddle: Copper alloy with seal and AWWA C800, threaded outlet for corporation valve.
  2. Corporation Valve: Bronze body and ground-key plug, with AWWA C800, threaded inlet and outlet matching service piping material.
  3. Manifold: Copper fitting with two to four inlets as required, with ends matching corporation valves and outlet matching service piping material.

- C. Curb Valves: Comply with AWWA C800 for high-pressure service-line valves. Valve has bronze body, ground-key plug or ball, wide tee head, and inlet and outlet matching service piping material.
- D. Service Boxes for Curb Valves: Similar to AWWA M44 requirements for cast-iron valve boxes. Include cast-iron telescoping top section of length required for depth of burial of valve, plug with lettering "WATER," and bottom section with base that fits over curb valve and with a barrel approximately 3 inches in diameter.
  - 1. Shutoff Rods: Steel; with tee-handle with one pointed end, stem of length to operate deepest buried valve, and slotted end matching curb valve.
- E. Meter Valves: Comply with AWWA C800 for high-pressure service-line valves. Include angle- or straight-through-pattern bronze body, ground-key plug or ball, and wide tee head, with inlet and outlet matching service piping material.

## 2.8 GATE VALVES

- A. AWWA Gate Valves:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. American AVK Company; Valves & Fittings Division.
    - b. American Cast Iron Pipe Company; American Flow Control Division.
    - c. American Cast Iron Pipe Company; Waterous Company Subsidiary.
    - d. American R/D.
    - e. Clow Valve Company; a division of McWane, Inc.
    - f. Crane Co.; Crane Valve Group; Stockham Division.
    - g. East Jordan Iron Works, Inc.
    - h. Kennedy Valve; a division of McWane, Inc.
    - i. M&H Valve Company; a division of McWane, Inc.
    - j. Mueller Co.; Water Products Division.
    - k. NIBCO INC.
    - l. Tyler Pipe; a division of McWane, Inc.; Utilities Division.
    - m. U.S. Pipe.
  - 2. 200-psig, AWWA, Iron, Non-rising-Stem, Metal-Seated Gate Valves:

- a. Description: Gray- or ductile-iron body and bonnet; with cast-iron or bronze double-disc gate, bronze gate rings, bronze stem, and stem nut.
  - b. Standard: AWWA C500.
  - c. Pressure Rating: 200 psig.
  - d. End Connections: Mechanical joint.
  - e. Interior Coating: Complying with AWWA C550.
3. 200-psig, AWWA, Iron, Non-rising-Stem, Resilient-Seated Gate Valves:
- a. Description: Gray- or ductile-iron body and bonnet; with bronze or gray- or ductile-iron gate, resilient seats, bronze stem, and stem nut.
  - b. Standard: AWWA C509.
  - c. Pressure Rating: 200 psig.
  - d. End Connections: Mechanical or push-on joint.
  - e. Interior Coating: Complying with AWWA C550.
4. 250-psig, AWWA, Iron, Non-rising-Stem, Resilient-Seated Gate Valves:
- a. Description: Ductile-iron body and bonnet; with bronze or ductile-iron gate, resilient seats, bronze stem, and stem nut.
  - b. Standard: AWWA C509.
  - c. Pressure Rating: 250 psig.
  - d. End Connections: Mechanical or push-on joint.
  - e. Interior Coating: Complying with AWWA C550.
5. 200-psig, AWWA, Iron, OS&Y, Metal-Seated Gate Valves:
- a. Description: Cast- or ductile-iron body and bonnet; with cast-iron double disc, bronze disc and seat rings, and bronze stem.
  - b. Standard: AWWA C500.
  - c. Pressure Rating: 200 psig.
  - d. End Connections: Flanged or grooved.
6. 200-psig, AWWA, Iron, OS&Y, Resilient-Seated Gate Valves:

- a. Description: Cast- or ductile-iron body and bonnet; with bronze, gray-iron, or ductile-iron gate; resilient seats; and bronze stem.
  - b. Standard: AWWA C509.
  - c. Pressure Rating: 200 psig.
  - d. End Connections: Flanged or grooved.
7. 250-psig, AWWA, Iron, OS&Y, Resilient-Seated Gate Valves:
- a. Description: Cast- or ductile-iron body and bonnet; with bronze, gray-iron, or ductile-iron gate; resilient seats; and bronze stem.
  - b. Standard: AWWA C509.
  - c. Pressure Rating: 200 psig.
  - d. End Connections: Flanged or grooved.
8. Class 125, Bronze, Non-rising-Stem Gate Valves:
- a. Description: Class 125, Type 1; bronze with solid wedge and malleable-iron handwheel.
  - b. Standard: MSS SP-80.
  - c. Pressure Rating: 200 psig.
  - d. End Connections: Solder joint or threaded.
- B. UL-Listed or FM-Approved Gate Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- a. American AVK Company; Valve & Fittings Division.
  - b. American Cast Iron Pipe Company; American Flow Control Division.
  - c. American Cast Iron Pipe Company; Waterous Company Subsidiary.
  - d. Clow Valve Company; a division of McWane, Inc.
  - e. Crane Co.; Crane Valve Group; Jenkins Valves.
  - f. Crane Co.; Crane Valve Group; Stockham Division.
  - g. East Jordan Iron Works, Inc.

- h. Hammond Valve.
    - i. Kennedy Valve; a division of McWane, Inc.
    - j. M&H Valve Company; a division of McWane, Inc.
    - k. Milwaukee Valve Company.
    - l. Mueller Co.; Water Products Division.
    - m. NIBCO INC.
    - n. Shurjoint Piping Products.
    - o. Troy Valve; a division of Penn-Troy Manufacturing, Inc.
    - p. Tyco Fire & Building Products LP.
    - q. United Brass Works, Inc.
    - r. U.S. Pipe.
    - s. Watts Water Technologies, Inc.
  - 2. 175-psig, UL-Listed or FM-Approved, Iron, Nonrising-Stem Gate Valves:
    - a. Description: Iron body and bonnet, bronze seating material, and inside screw.
    - b. Standards: UL 262 and "Approval Guide," published by FM Global, listing.
    - c. Pressure Rating: 175 psig minimum.
    - d. End Connections: Mechanical or push-on joint.
    - e. Indicator-Post Flange: Include on valves used with indicator posts.
  - 3. 250-psig, UL-Listed or FM-Approved, Iron, Non-rising-Stem Gate Valves:
    - a. Description: Iron body and bonnet, bronze seating material, and inside screw.
    - b. Standards: UL 262 and "Approval Guide," published by FM Global, listing.
    - c. Pressure Rating: 250 psig minimum.
    - d. End Connections: Mechanical or push-on joint.
    - e. Indicator-Post Flange: Include on valves used with indicator posts.
  - 4. 175-psig, UL-Listed or FM-Approved, Iron, OS&Y, Gate Valves:
    - a. Description: Iron body and bonnet and bronze seating material.

- b. Standards: UL 262 and "Approval Guide," published by FM Global, listing.
  - c. Pressure Rating: 175 psig minimum.
  - d. End Connections: Flanged or grooved.
- 5. 250-psig, UL-Listed or FM-Approved, Iron, OS&Y Gate Valves:
  - a. Description: Iron body and bonnet and bronze seating material.
  - b. Standards: UL 262 and "Approval Guide," published by FM Global, listing.
  - c. Pressure Rating: 250 psig minimum.
  - d. End Connections: Flanged or grooved.
- 6. UL-Listed or FM-Approved, OS&Y Bronze, Gate Valves:
  - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - 1) Crane Co.; Crane Valve Group; Crane Valves.
    - 2) Crane Co.; Crane Valve Group; Stockham Division.
    - 3) Milwaukee Valve Company.
    - 4) NIBCO INC.
    - 5) United Brass Works, Inc.
  - b. Description: Bronze body and bonnet and bronze stem.
  - c. Standards: UL 262 and "Approval Guide," published by FM Global, listing.
  - d. Pressure Rating: 175 psig minimum.
  - e. End Connections: Threaded.

## 2.9 GATE VALVE ACCESSORIES AND SPECIALTIES

### A. Tapping-Sleeve Assemblies:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. American Cast Iron Pipe Company; Waterous Company Subsidiary.
  - b. Clow Valve Company; a division of McWane, Inc.

- c. East Jordan Iron Works, Inc.
  - d. Flowserve.
  - e. Kennedy Valve; a division of McWane, Inc.
  - f. M&H Valve Company; a division of McWane, Inc.
  - g. Mueller Co.; Water Products Division.
  - h. U.S. Pipe.
2. Description: Sleeve and valve compatible with drilling machine.
  3. Standard: MSS SP-60.
  4. Tapping Sleeve: Cast-iron, ductile-iron, or stainless-steel, two-piece bolted sleeve with flanged outlet for new branch connection. Sleeve shall match size and type of pipe material being tapped and have recessed flange for branch valve.
  5. Valve: AWWA, cast-iron, non-rising-stem, metal -seated gate valve with one raised-face flange mating tapping-sleeve flange.
- B.** Valve Boxes: Comply with AWWA M44 for cast-iron valve boxes. Include top section, adjustable extension of length required for depth of burial of valve, plug with lettering "WATER," and bottom section with base that fits over valve and with a barrel approximately 5 inches in diameter.
1. Operating Wrenches: Steel; with tee-handle with one pointed end, stem of length to operate deepest buried valve, and socket matching valve operating nut.
- C.** Indicator Posts:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. American AVK Company; Valves & Fittings Division.
    - b. American Cast Iron Pipe Company; American Flow Control Division.
    - c. American Cast Iron Pipe Company; Waterous Company Subsidiary.
    - d. Clow Valve Company; a division of McWane, Inc.
    - e. Crane Co.; Crane Valve Group; Stockham Division.
    - f. Kennedy Valve; a division of McWane, Inc.
    - g. Mueller Co.; Water Products Division.

- h. NIBCO INC.
- i. Tyco Fire & Building Products LP.
- 2. Description: Vertical-type, cast-iron body with operating wrench, extension rod, and adjustable cast-iron barrel of length required for depth of burial of valve.
- 3. Standards: UL 789 and "Approval Guide," published by FM Global, listing.

## 2.10 BUTTERFLY VALVES

### A. AWWA Butterfly Valves:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. DeZurik/Copes-Vulcan; a unit of SPX Corporation.
  - b. Milliken Valve Company.
  - c. Mosser Valve; a division of Olson Technologies, Inc.
  - d. Mueller Co.; Water Products Division.
  - e. Pratt, Henry Company.
  - f. Val-Matic Valve & Manufacturing Corp.
- 2. Description: Rubber seated.
- 3. Standard: AWWA C504.
- 4. Body Material: Cast or ductile iron.
- 5. Body Type: Wafer.
- 6. Pressure Rating: 150 psig.

### B. UL Butterfly Valves:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Kennedy Valve; a division of McWane, Inc.
  - b. Milwaukee Valve Company.
  - c. Mueller Co.; Water Products Division.

- d. NIBCO INC.
  - e. Pratt, Henry Company.
2. Description: Metal on resilient material seating.
  3. Standards: UL 1091 and "Approval Guide," published by FM Global, listing.
  4. Body Material: Cast or ductile iron.
  5. Body Type: Wafer.
  6. Pressure Rating: 175 psig.

## 2.11 CHECK VALVES

### A. AWWA Check Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. American AVK Company; Valves & Fittings Division.
  - b. American Cast Iron Pipe Company; American Flow Control Division.
  - c. APCO Willamette Valve and Primer Corporation.
  - d. Clow Valve Company; a division of McWane, Inc.
  - e. Crane Co.; Crane Valve Group; Crane Valves.
  - f. Crane Co.; Crane Valve Group; Stockham Division.
  - g. Kennedy Valve; a division of McWane, Inc.
  - h. M&H Valve Company; a division of McWane, Inc.
  - i. Mueller Co.; Water Products Division.
  - j. NIBCO INC.
  - k. Watts Water Technologies, Inc.
2. Description: Swing-check type with resilient seat; with interior coating according to AWWA C550 and ends to match piping.
3. Standard: AWWA C508.
4. Pressure Rating: 175 psig.

### B. UL-Listed or FM-Approved Check Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. American Cast Iron Pipe Company; Waterous Company Subsidiary.
  - b. Clow Valve Company; a division of McWane, Inc.
  - c. Crane Co.; Crane Valve Group; Stockham Division.
  - d. Globe Fire Sprinkler Corporation.
  - e. Kennedy Valve; a division of McWane, Inc.
  - f. Kidde Fire Fighting.
  - g. Matco-Norca.
  - h. Mueller Co.; Water Products Division.
  - i. NIBCO INC.
  - j. Reliable Automatic Sprinkler Co., Inc.
  - k. Tyco Fire & Building Products LP.
  - l. United Brass Works, Inc.
  - m. Victaulic Company.
  - n. Viking Corporation.
  - o. Watts Water Technologies, Inc.
2. Description: Swing-check type with pressure rating, rubber-face checks unless otherwise indicated, and ends matching piping.
3. Standards: UL 312 and "Approval Guide," published by FM Global, listing.
4. Pressure Rating: 175 psig.

## 2.12 DETECTOR CHECK VALVES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  1. Ames Fire & Waterworks; a division of Watts Water Technologies, Inc.
  2. Badger Meter, Inc.

3. FEBCO; SPX Valves & Controls.
  4. Globe Fire Sprinkler Corporation.
  5. Kennedy Valve; a division of McWane, Inc.
  6. Mueller Co.; Hersey Meters Division.
  7. Victaulic Company.
  8. Viking Corporation.
  9. Watts Water Technologies, Inc.
- B. Description: Galvanized cast-iron body, bolted cover with air-bleed device for access to internal parts, and flanged ends. Include one-piece bronze disc with bronze bushings, pivot, and replaceable seat. Include threaded bypass taps in inlet and outlet for bypass meter connection. Set valve to allow minimal water flow through bypass meter when major water flow is required.
- C. Standards: UL 312 and "Approval Guide," published by FM Global, listing.
- D. Pressure Rating: 175 psig.
- E. Water Meter: AWWA C700, disc type, at least one-fourth size of detector check valve. Include meter, bypass piping, gate valves, check valve, and connections to detector check valve.

## 2.13 WATER METERS

- A. Water meters will be furnished by utility company.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. AMCO Water Metering Systems.
  2. Badger Meter, Inc.
  3. Carlon Meter.
  4. Hays Fluid Controls.
  5. McCrometer.
  6. Mueller Co.; Hersey Meters Division.
  7. Neptune Technology Group Inc.
  8. Sensus Metering Systems.

**C. Displacement-Type Water Meters:**

1. Description: With bronze main case.
2. Standard: AWWA C700.
3. Registration: Flow in gallons.

**D. Turbine-Type Water Meters:**

1. Standard: AWWA C701.
2. Registration: Flow in gallons.

**E. Compound-Type Water Meters:**

1. Standard: AWWA C702.
2. Registration: Flow in gallons.

**F. Remote Registration System:**

1. Description: Utility company's standard; direct-reading type. Include meter modified with signal-transmitting assembly, low-voltage connecting wiring, and remote register assembly.
2. Standard: AWWA C706.
3. Registration: Flow in gallons.

**G. Remote Registration System:**

1. Description: Utility company's standard; encoder type. Include meter modified with signal-transmitting assembly, low-voltage connecting wiring, and remote register assembly.
2. Standard: AWWA C707.
3. Registration: Flow in gallons.
4. Data-Acquisition Units: Comply with utility company's requirements for type and quantity.
5. Visible Display Units: Comply with utility company's requirements for type and quantity.

**2.14 DETECTOR-TYPE WATER METERS**

- A. Manufacturers:** Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Badger Meter, Inc.
2. Mueller Co.; Hersey Meters Division.
3. Neptune Technology Group Inc.
4. Sensus Metering Systems.

**B. AWWA, Detector Check Water Meters:**

1. Description: Main line, turbine meter with second meter on bypass.
2. Standard: AWWA C703.
3. Registration: Flow in gallons.
4. Pressure Rating: 150 psig.
5. Bypass Meter: AWWA C701, turbine-type, bronze case.
  - a. Size: At least one-half nominal size of main-line meter.

**C. Fire-Protection, Detector Check Water Meters:**

1. Description: Main-line turbine meter with strainer and second meter on bypass.
2. Standards: UL's "Fire Protection Equipment Directory" listing and "Approval Guide," published by FM Global, listing.
3. Registration: Flow in gallons.
4. Pressure Rating: 175 psig minimum.
5. Bypass Meter: AWWA C701, turbine-type, bronze case.
  - a. Size: At least NPS 2.

**D. Remote Registration System:**

1. Description: Utility company's standard; direct-reading type. Include meter modified with signal-transmitting assembly, low-voltage connecting wiring, and remote register assembly.
2. Standard: AWWA C706.
3. Registration: Flow in gallons.

**E. Remote Registration System:**

1. Description: Utility company's standard; encoder type. Include meter modified with signal-transmitting assembly, low-voltage connecting wiring, and remote register assembly.
2. Standard: AWWA C707.
3. Registration: Flow in gallons.
4. Data-Acquisition Units: Comply with utility company's requirements for type and quantity.
5. Visible Display Units: Comply with utility company's requirements for type and quantity.

## 2.15 PRESSURE-REDUCING VALVES

### A. Water Regulators:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Cash Acme; a division of The Reliance Worldwide Corporation.
  - b. Conbraco Industries, Inc.; Apollo Valves.
  - c. Honeywell Water Controls.
  - d. Watts Water Technologies, Inc.
  - e. Zurn Plumbing Products Group; Wilkins Water Control Products Division.
2. Standard: ASSE 1003.
3. Pressure Rating: Initial pressure of 150 psig.
4. Design Outlet Pressure Setting: 175 psig.
5. Body Material: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and NPS 3.
6. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and NPS 3.

### B. Water Control Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. CLA-VAL Automatic Control Valves.

- b. Flomatic Corporation.
  - c. OCV Control Valves.
  - d. Watts Regulator Company; Ames Fluid Control Systems.
  - e. Watts Regulator Company; Watts ACV Division.
  - f. Zurn Plumbing Products Group; Wilkins Water Control Products Division.
2. Description: Pilot-operation, diaphragm-type, single-seated main water control valve with AWWA C550 or FDA-approved, interior epoxy coating. Include small pilot control valve, restrictor device, specialty fittings, and sensor piping.
  3. Pressure Rating: Initial pressure of 150 psig minimum.
  4. Main Valve Body: Cast or ductile iron with AWWA C550 or FDA-approved, interior epoxy coating; or stainless-steel body.
    - a. Size: NPS 6.
    - b. Pattern: Globe-valve design.
    - c. Trim: Stainless steel.
  5. Design Flow Rate: 750 gpm.
  6. Design Inlet Pressure: 52 psig.
  7. Design Outlet Pressure Setting: 175 psig.
  8. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.

## 2.16 BACKFLOW PREVENTERS

### A. Reduced-Pressure-Principle Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Ames Fire & Waterworks; a division of Watts Water Technologies, Inc.
  - b. Conbraco Industries, Inc.; Apollo Valves.
  - c. FEBCO; SPX Valves & Controls.
  - d. Flomatic Corporation.
  - e. Watts Water Technologies, Inc.

- f. Zurn Plumbing Products Group; Wilkins Water Control Products Division.
  2. Standard: ASSE 1013.
  3. Operation: Continuous-pressure applications.
  4. Pressure Loss: 12 psig maximum, through middle one-third of flow range.
  5. Size: NPS 6.
  6. Design Flow Rate: 750 gpm.
  7. Selected Unit Flow Range Limits: 750 - 1000 gpm.
  8. Pressure Loss at Design Flow Rate: 2 psig for NPS 2 and smaller; 12 psig for NPS 2-1/2 and larger.
  9. Body Material: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or stainless steel for NPS 2-1/2 and larger.
  10. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
  11. Configuration: Designed for horizontal, straight through configuration flow.
  12. Accessories:
    - a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 and smaller; OS&Y gate type with flanged ends on inlet and outlet of NPS 2-1/2 and larger.
    - b. Air-Gap Fitting: ASME A112.1.2, matching backflow preventer connection.
- B. Double-Check, Backflow-Prevention Assemblies:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Ames Fire & Waterworks; a division of Watts Water Technologies, Inc.
    - b. Conbraco Industries, Inc.; Apollo Valves.
    - c. FEBCO; SPX Valves & Controls.
    - d. Flomatic Corporation.
    - e. Watts Water Technologies, Inc.
    - f. Zurn Plumbing Products Group; Wilkins Water Control Products Division.
  2. Standard: ASSE 1015.

3. Operation: Continuous-pressure applications unless otherwise indicated.
4. Pressure Loss: 5 psig maximum, through middle one-third of flow range.
5. Size: NPS 6.
6. Design Flow Rate: 750 gpm.
7. Selected Unit Flow Range Limits: 750 - 1000 gpm.
8. Pressure Loss at Design Flow Rate: 2 psig for NPS 2 and smaller; 12 psig for NPS 2-1/2 and larger.
9. Body Material: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
10. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
11. Configuration: Designed for horizontal, straight through configuration flow.
12. Accessories: Ball valves with threaded ends on inlet and outlet of NPS 2 and smaller; OS&Y gate valves with flanged ends on inlet and outlet of NPS 2-1/2 and larger.

C. Reduced-Pressure-Detector, Fire-Protection Backflow Preventer Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Ames Fire & Waterworks; a division of Watts Water Technologies, Inc.
  - b. Conbraco Industries, Inc.; Apollo Valves.
  - c. FEBCO; SPX Valves & Controls.
  - d. Watts Water Technologies, Inc.
  - e. Zurn Plumbing Products Group; Wilkins Water Control Products Division.
2. Standards: ASSE 1047 and UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 12 psig maximum, through middle one-third of flow range.
5. Size: NPS 6.
6. Design Flow Rate: 750 gpm.
7. Selected Unit Flow Range Limits: 750 - 1000 gpm.

8. Pressure Loss at Design Flow Rate: 12 psig.
9. Body Material: Cast iron with interior lining complying with AWWA C550 or that is FDA approved.
10. End Connections: Flanged.
11. Configuration: Designed for horizontal, straight through configuration flow.
12. Accessories:
  - a. Valves: UL 262, "Approval Guide," published by FM Global, listing; OS&Y gate type with flanged ends on inlet and outlet.
  - b. Air-Gap Fitting: ASME A112.1.2, matching backflow preventer connection.
  - c. Bypass: With displacement-type water meter, shutoff valves, and reduced-pressure backflow preventer.

**D. Double-Check, Detector-Assembly Backflow Preventers:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Ames Fire & Waterworks; a division of Watts Water Technologies, Inc.
  - b. Conbraco Industries, Inc.; Apollo Valves.
  - c. FEBCO; SPX Valves & Controls.
  - d. Watts Water Technologies, Inc.
  - e. Zurn Plumbing Products Group; Wilkins Water Control Products Division.
2. Standards: ASSE 1048 and UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 5 psig maximum, through middle one-third of flow range.
5. Size: NPS 6.
6. Design Flow Rate: 750 gpm.
7. Selected Unit Flow Range Limits: 750 - 1000 gpm.
8. Pressure Loss at Design Flow Rate: 12 psig.

9. Body Material: Cast iron with interior lining complying with AWWA C550 or that is FDA approved.
10. End Connections: Flanged.
11. Configuration: Designed for horizontal, straight through configuration flow.
12. Accessories:
  - a. Valves: UL 262, "Approval Guide," published by FM Global, listing, approved; OS&Y gate type with flanged ends on inlet and outlet.
  - b. Bypass: With displacement-type water meter, shutoff valves, and reduced-pressure backflow preventer.

**E. Backflow Preventer Test Kits:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Conbraco Industries, Inc.; Apollo Valves.
  - b. FEBCO; SPX Valves & Controls.
  - c. Flomatic Corporation.
  - d. Watts Water Technologies, Inc.
  - e. Zurn Plumbing Products Group; Wilkins Water Control Products Division.
2. Description: Factory calibrated, with gages, fittings, hoses, and carrying case with test-procedure instructions.

**2.17 WATER METER BOXES**

- A. Description: Cast-iron body and cover for disc-type water meter, with lettering "WATER METER" on cover; and with slotted, open-bottom base section of length to fit over service piping.
  1. Option: Base section may be cast-iron, PVC, clay, or other pipe.
- B. Description: Cast-iron body and double cover for disc-type water meter, with lettering "WATER METER" on top cover; and with separate inner cover; air space between covers; and slotted, open-bottom base section of length to fit over service piping.
- C. Description: Polymer-concrete body and cover for disc-type water meter, with lettering "WATER" on cover; and with slotted, open-bottom base section of length to fit over service piping. Include vertical and lateral design loadings of 15,000 lb minimum over 10 by 10 inches square.

## 2.18 PROTECTIVE ENCLOSURES

### A. Freeze-Protection Enclosures:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. AquaShield.
  - b. BF Products.
  - c. DekoRRa Products LLC.
  - d. Dunco Manufacturing, Inc.
  - e. G&C Enclosures.
  - f. Hot Box, Inc.
  - g. HydroCowl, Inc.
  - h. Piedmont Well Covers, Inc.
  - i. Watts Water Technologies, Inc.
2. Description: Insulated enclosure designed to protect aboveground water piping, equipment, or specialties from freezing and damage, with heat source to maintain minimum internal temperature of 40 deg F when external temperatures reach as low as minus 34 deg F.
3. Standard: ASSE 1060.
4. Class I: For equipment or devices other than pressure or atmospheric vacuum breakers.
5. Class I-V: For pressure or atmospheric vacuum breaker equipment or devices. Include drain opening in housing.
  - a. Housing: Reinforced aluminum housing construction.
    - 1) Size: Of dimensions indicated but not less than those required for access and service of protected unit.
    - 2) Drain opening for units with drain connection.
    - 3) Access doors with locking devices.
    - 4) Insulation inside housing.
    - 5) Anchoring devices for attaching housing to concrete base.

- b. Electric heating cable or heater with self-limiting temperature control.

## 2.19 FIRE-DEPARTMENT CONNECTIONS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Elkhart Brass Mfg. Company, Inc.
  - 2. Fire-End & Croker Corporation.
  - 3. Guardian Fire Equipment, Inc.
  - 4. Kidde Fire Fighting.
  - 5. Potter Roemer.
  - 6. Reliable Automatic Sprinkler Co., Inc.
- B. Description: Sidewall mounting, with cast-bronze body, thread inlets according to NFPA 1963 and matching local fire-department hose threads, and threaded bottom outlet. Include lugged caps, gaskets, and chains; lugged swivel connection and drop clapper for each hose-connection inlet; with brass sleeve; and round escutcheon plate.
- C. Standard: UL 405.
- D. Connections: Two NPS 2-1/2 inlets and one NPS 4 outlet.
- E. Finish Including Sleeve: Polished chrome plated.
- F. Escutcheon Plate Marking: "AUTO SPKR & STANDPIPE."

## 2.20 ALARM DEVICES

- A. General: UL 753 and "Approval Guide," published by FM Global, listing, of types and sizes to mate and match piping and equipment.
- B. Water-Flow Indicators: Vane-type water-flow detector, rated for 250-psig working pressure; designed for horizontal or vertical installation; with two single-pole, double-throw circuit switches to provide 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 when cover is removed.
- C. Supervisory Switches: Single pole, double throw; designed to signal valve in other than fully open position.
- D. Pressure Switches: Single pole, double throw; designed to signal increase in pressure.

## PART 3 - EXECUTION

### 3.1 PIPING INSTALLATION

- A. Water-Main Connection: Arrange with water utility company for tap of size and in location indicated in water main.
- B. Water-Main Connection: Tap water main according to requirements of water utility company and of size and in location indicated.
- C. Make connections larger than NPS 2 with tapping machine according to the following:
  1. Install tapping sleeve and tapping valve according to MSS SP-60.
  2. Install tapping sleeve on pipe to be tapped. Position flanged outlet for gate valve.
  3. Use tapping machine compatible with valve and tapping sleeve; cut hole in main. Remove tapping machine and connect water-service piping.
  4. Install gate valve onto tapping sleeve. Comply with MSS SP-60. Install valve with stem pointing up and with valve box.
- D. Make connections NPS 2 and smaller with drilling machine according to the following:
  1. Install service-saddle assemblies and corporation valves in size, quantity, and arrangement required by utility company's standards.
  2. Install service-saddle assemblies on water-service pipe to be tapped. Position outlets for corporation valves.
  3. Use drilling machine compatible with service-saddle assemblies and corporation valves. Drill hole in main. Remove drilling machine and connect water-service piping.
  4. Install corporation valves into service-saddle assemblies.
  5. Install manifold for multiple taps in water main.
  6. Install curb valve in water-service piping with head pointing up and with service box.
- E. Comply with NFPA 24 for fire-service-main piping materials and installation.
- F. Install copper tube and fittings according to CDA's "Copper Tube Handbook."
  1. Install encasement for tubing according to ASTM A 674 or AWWA C105.
- G. Install ductile-iron, water-service piping according to AWWA C600 and AWWA M41.
  1. Install encasement for piping according to ASTM A 674 or AWWA C105.
- H. Install PE pipe according to ASTM D 2774 and ASTM F 645.

- I. Install PVC, AWWA pipe according to ASTM F 645 and AWWA M23.
- J. Install fiberglass AWWA pipe according to AWWA M45.
- K. Install piping by tunneling or jacking, or combination of both, under streets and other obstructions that cannot be disturbed.
- L. Extend fire-suppression water-service piping and connect to water-supply source and building fire-suppression water-service piping systems at locations and pipe sizes indicated.
  - 1. Terminate fire-suppression water-service piping at building wall until building-water-piping systems are installed. Terminate piping with caps, plugs, or flanges as required for piping material. Make connections to building's fire-suppression water-service piping systems when those systems are installed.
- M. Install underground piping with restrained joints at horizontal and vertical changes in direction. Use restrained-joint piping, thrust blocks, anchors, tie-rods and clamps, and other supports.
- N. Comply with requirements in Section 211200 "Fire-Suppression Standpipes," Section 211313 "Wet-Pipe Sprinkler Systems," and Section 211316 "Dry-Pipe Sprinkler Systems" for fire-suppression-water piping inside the building.
- O. Comply with requirements in Section 221116 "Domestic Water Piping" for potable-water piping inside the building.
- 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."

### 3.2 JOINT CONSTRUCTION

- A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure rating same as or higher than systems pressure rating for aboveground applications unless otherwise indicated.
- B. Install unions adjacent to each valve in tubing NPS 2 and smaller.
- C. Install flanges, flange adaptors, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
- D. Ream ends of tubes and remove burrs.
- E. Remove scale, slag, dirt, and debris from outside and inside of pipes, tubes, and fittings before assembly.

- F. Copper-Tubing, Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" Chapter.
- G. Copper-Tubing, Pressure-Sealed Joints: Use proprietary crimping tool and procedure recommended by copper, pressure-seal-fitting manufacturer.
- H. Ductile-Iron Piping, Gasketed Joints for Fire-Service-Main Piping: UL 194.
- I. Ductile-Iron Piping, Grooved Joints: Cut-groove pipe. Assemble joints with grooved-end, ductile-iron-piping couplings, gaskets, lubricant, and bolts.
- J. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with bolts according to ASME B31.9.
- K. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
- L. PVC Piping Gasketed Joints: Use joining materials according to AWWA C900. Construct joints with elastomeric seals and lubricant according to ASTM D 2774 or ASTM D 3139.
- M. Fiberglass Piping Bonded Joints: Use adhesive and procedure recommended by piping manufacturer.
- N. Dissimilar Materials Piping Joints: Use adapters compatible with both piping materials, with OD, and with system working pressure.
- O. Do not use flanges or unions for underground piping.

### 3.3 ANCHORAGE INSTALLATION

- A. Anchorage, General: Install water-distribution piping with restrained joints. Anchorages and restrained-joint types that may be used include the following:
  1. Concrete thrust blocks.
  2. Locking mechanical joints.
  3. Set-screw mechanical retainer glands.
  4. Bolted flanged joints.
  5. Heat-fused joints.
  6. Pipe clamps and tie rods.
- B. Install anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches in fire-suppression water-service piping according to NFPA 24 and the following:
  1. Gasketed-Joint, Ductile-Iron, Water-Service Piping: According to AWWA C600.
  2. Gasketed-Joint, PVC Water-Service Piping: According to AWWA M23.

3. Bonded-Joint Fiberglass, Water-Service Piping: According to AWWA M45.

- C. Apply full coat of asphalt or other acceptable corrosion-resistant material to surfaces of installed ferrous anchorage devices.

### **3.4 VALVE INSTALLATION**

- A. AWWA Gate Valves: Comply with AWWA C600 and AWWA M44. Install each underground valve with stem pointing up and with valve box.
- B. AWWA Valves Other Than Gate Valves: Comply with AWWA C600 and AWWA M44.
- C. UL-Listed or FM-Approved Gate Valves: Comply with NFPA 24. Install each underground valve and valves in vaults with stem pointing up and with vertical cast-iron indicator post.
- D. UL-Listed or FM-Approved Valves Other Than Gate Valves: Comply with NFPA 24.
- E. MSS Valves: Install as component of connected piping system.
- F. Corporation Valves and Curb Valves: Install each underground curb valve with head pointed up and with service box.

### **3.5 DETECTOR CHECK VALVE INSTALLATION**

- A. Install in vault or aboveground.
- B. Install for proper direction of flow. Install bypass with water meter, gate valves on each side of meter, and check valve downstream from meter.

### **3.6 WATER METER INSTALLATION**

- A. Install water meters, piping, and specialties according to utility company's written instructions.
- B. Water Meters: Install [compound] [turbine]-type water meters NPS 3 and larger in meter vaults. Include shutoff valves on water meter inlets and outlets, and include valved bypass around meters. Support meters, valves, and piping on brick or concrete piers.
- C. Water Meters: Install detector-type water meters in meter vault according to AWWA M6. Include shutoff valves on water meter inlets and outlets, and include full-size valved bypass around meters. Support meters, valves, and piping on brick or concrete piers.

### **3.7 ROUGHING-IN FOR WATER METERS**

- A. Rough-in piping and specialties for water meter installation according to utility company's written instructions.

### **3.8 BACKFLOW PREVENTER INSTALLATION**

- A. Install backflow preventers of type, size, and capacity indicated. Include valves and test cocks. Install according to requirements of plumbing and health department and authorities having jurisdiction.

- B. Do not install backflow preventers that have relief drain in vault or in other spaces subject to flooding.
- C. Do not install bypass piping around backflow preventers.

### **3.9 WATER METER BOX INSTALLATION**

- A. Install water meter boxes in paved areas flush with surface.

### **3.10 CONCRETE VAULT INSTALLATION**

- A. Install precast concrete vaults according to ASTM C 891.

### **3.11 PROTECTIVE ENCLOSURE INSTALLATION**

- A. Install concrete base level and with top approximately 2 inches above grade.
- B. Install protective enclosure over valves and equipment.
- C. Anchor protective enclosure to concrete base.

### **3.12 FIRE-DEPARTMENT CONNECTION INSTALLATION**

- A. Install ball drip valves at each check valve for fire-department connection to mains.

### **3.13 ALARM DEVICE INSTALLATION**

- A. General: Comply with NFPA 24 for devices and methods of valve supervision. Underground valves with valve box do not require supervision.
- B. Supervisory Switches: Supervise valves in open position.
  - 1. Valves: Grind away portion of exposed valve stem. Bolt switch, with plunger in stem depression, to OS&Y gate-valve yoke.
  - 2. Indicator Posts: Drill and thread hole in upper-barrel section at target plate. Install switch, with toggle against target plate, on barrel of indicator post.
- C. Locking and Sealing: Secure unsupervised valves as follows:
  - 1. Valves: Install chain and padlock on open OS&Y gate valve.
  - 2. Post Indicators: Install padlock on wrench on indicator post.
- D. Pressure Switches: Drill and thread hole in exposed barrel of fire hydrant. Install switch.
- E. Water-Flow Indicators: Install in water-service piping in vault. Select indicator with saddle and vane matching pipe size. Drill hole in pipe, insert vane, and bolt saddle to pipe.
- F. Connect alarm devices to building's fire-alarm system. Wiring and fire-alarm devices are specified in Section 283111 "Digital, Addressable Fire-Alarm System."

### **3.14 CONNECTIONS**

- A.** Connect fire-suppression water-service piping to utility water main. Use tapping sleeve and tapping valve service clamp and corporation valve.
- B.** Connect fire-suppression water-service piping to interior fire-suppression piping.

### **3.15 FIELD QUALITY CONTROL**

- A.** Use test procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described below.
- B.** Piping Tests: Conduct piping tests before joints are covered and after concrete thrust blocks have hardened sufficiently. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water.
- C.** Hydrostatic Tests: Test at not less than one-and-one-half times the working pressure for two hours.
  - 1.** Increase pressure in 50-psig increments and inspect each joint between increments. Hold at test pressure for one hour; decrease to 0 psig. Slowly increase again to test pressure and hold for one more hour. Maximum allowable leakage is 2 quarts per hour per 100 joints. Remake leaking joints with new materials and repeat test until leakage is within allowed limits.
- D.** Prepare test and inspection reports.

### **3.16 IDENTIFICATION**

- A.** Permanently attach equipment nameplate or marker indicating plastic fire-suppression water-service piping or fire-suppression water-service piping with electrically insulated fittings, on main electrical meter panel. Comply with requirements for identifying devices in Section 220553 "Identification for Plumbing Piping and Equipment."

### **3.17 CLEANING**

- A.** Clean and disinfect fire-suppression water-service piping as follows:
  - 1.** Purge new piping systems and parts of existing systems that have been altered, extended, or repaired before use.
  - 2.** Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in NFPA 24 for flushing of piping. Flush piping system with clean, potable water until dirty water does not appear at points of outlet.
  - 3.** Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in AWWA C651 or do as follows:

- a. Fill system or part of system with water/chlorine solution containing at least 50 ppm of chlorine; isolate and allow to stand for 24 hours.
  - b. Drain system or part of system of previous solution and refill with water/chlorine solution containing at least 200 ppm of chlorine; isolate and allow to stand for three hours.
  - c. After standing time, flush system with clean, potable water until no chlorine remains in water coming from system.
  - d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedure if biological examination shows evidence of contamination.
- B. Prepare reports of purging and disinfecting activities.

### **3.18 PIPING SCHEDULE**

- A. Underslab fire-suppression water-service piping NPS 2 and smaller shall be soft copper tube, ASTM B 88, Type L, solder-joint fittings; and brazed copper, pressure-seal fittings; and pressure-sealed joints.
- B. Underslab fire-suppression water-service piping NPS 3 and NPS 4 shall be one of the following:
  1. Hard copper tube, ASTM B 88, Type L; wrought-copper, solder-joint fittings; and brazed copper, pressure-seal fittings; and pressure-sealed joints.
  2. Grooved-end, ductile-iron pipe; grooved-end, ductile-iron pipe appurtenances; and grooved joints.
  3. Mechanical-joint, ductile-iron pipe; mechanical-joint, ductile- or gray-iron, standard-pattern or ductile-iron, compact-pattern fittings; glands, gaskets, and bolts; and restrained, gasketed joints.
  4. Push-on-joint, ductile-iron pipe; push-on-joint, ductile-iron compact-pattern fittings; and restrained, gasketed joints.
- C. Underslab fire-suppression water-service piping NPS 6 to NPS 12 shall be one of the following:
  1. Grooved-end, ductile-iron pipe; grooved-end, ductile-iron pipe appurtenances; and grooved joints.
  2. Mechanical-joint, ductile-iron pipe; mechanical-joint, ductile- or gray-iron, standard-pattern or ductile-iron, compact-pattern fittings; glands, gaskets, and bolts; and restrained, gasketed joints.
  3. Push-on-joint, ductile-iron pipe; push-on-joint, ductile-iron compact-pattern fittings; and restrained, gasketed joints.

### 3.19 VALVE SCHEDULE

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
- B. Underground fire-suppression water-service shutoff valves NPS 2 and smaller shall be corporation valves or curb valves with ends compatible with piping.
- C. Meter box fire-suppression water-service shutoff valves NPS 2 and smaller shall be meter valves.
- D. Standard-pressure, aboveground fire-suppression water-service shutoff valves NPS 3 and larger shall be[ one of] the following:
  1. 200-psig, AWWA, iron, OS&Y, metal resilient-seated gate valves.
  2. 250-psig, AWWA, iron, OS&Y, resilient-seated gate valves.
  3. 175-psig, UL-listed or FM-approved, iron, OS&Y gate valves.
  4. AWWA or UL-listed or FM approved butterfly valves.
- E. Fire-suppression water-service check valves NPS 3 and larger shall be one of the following:
  1. AWWA or UL-listed or FM-approved check valves.
  2. UL-listed or FM-approved detector check valves.

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## **SECTION 211200 - FIRE SUPPRESSION STANDPIPES**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

**A. Section Includes:**

1. Pipes, fittings, and specialties.
2. Fire-protection valves.
3. Hose connections.
4. Hose stations.
5. Monitors.
6. Fire-department connections.
7. Alarm devices.
8. Manual control stations.
9. Control panels.
10. Pressure gages.

**B. Related Sections:**

1. Section 211313 "Wet-Pipe Sprinkler Systems" for wet-pipe sprinkler piping.
2. Section 211316 "Dry-Pipe Sprinkler Systems" for dry-pipe sprinkler piping.
3. Section 213113 "Electric-Drive, Centrifugal Fire Pumps" for fire pumps, pressure-maintenance pumps, and fire-pump controllers.
4. Section 283111 "Digital, Addressable Fire-Alarm System" for alarm devices not specified in this Section.

#### **1.2 DEFINITIONS**

- A. High-Pressure Standpipe Piping:** Fire-suppression standpipe piping designed to operate at working pressure higher than standard 175 psig, but not higher than 250 psig.
- B. Standard-Pressure Standpipe Piping:** Fire-suppression standpipe piping designed to operate at working pressure 175 psig maximum.

#### **1.3 SYSTEM DESCRIPTIONS**

- A. Automatic Wet-Type, Class I Standpipe System:** Includes NPS 2-1/2 hose connections. Has open water-supply valve with pressure maintained and is capable of supplying water demand.

- B. Automatic Dry-Type, Class I Standpipe System: Includes NPS 2-1/2 hose connections. Has open water-supply valve and dry-pipe valve with standpipes containing compressed air. Opening fire-hose valve releases compressed air and permits water pressure to open dry-pipe valve. Water then flows into standpipes.

#### **1.4 PERFORMANCE REQUIREMENTS**

- A. Standard-Pressure, Fire-Suppression Standpipe System Component: Listed for 175-psig minimum working pressure.
- B. High-Pressure, Fire-Suppression Standpipe System Component: Listed for 250-psig minimum working pressure.
- C. Delegated Design: Design fire-suppression standpipes, including comprehensive engineering analysis by a qualified professional Engineer, using performance requirements and design criteria indicated.
- D. Fire-suppression standpipe design shall be approved by authorities having jurisdiction.
  - 1. Minimum residual pressure at each hose-connection outlet is as follows:
    - a. NPS 2-1/2 Hose Connections: 100 psig.
  - 2. Maximum residual pressure at required flow at each hose-connection outlet is as follows unless otherwise indicated:
    - a. NPS 1-1/2 Hose Connections: 100 psig.

#### **1.5 ACTION SUBMITTALS**

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: For fire-suppression standpipes. Include plans, elevations, sections, details, and attachments to other work.
  - 1. Wiring Diagrams: For power, signal, and control wiring.
- C. Delegated-Design Submittal: For standpipe 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.

## **1.6 INFORMATIONAL SUBMITTALS**

- A.** Coordination Drawings: Fire-suppression standpipes, 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. Storm and Sanitary piping.
- B.** Qualification Data: For qualified Installer and professional Engineer.
- C.** Approved Standpipe Drawings: Working plans, prepared according to NFPA 14, 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 14. Include "Contractor's Material and Test Certificate for Aboveground Piping" and "Contractor's Material and Test Certificate for Underground Piping."
- G.** Field quality-control reports.

## **1.7 CLOSEOUT SUBMITTALS**

- A.** Operation and Maintenance Data: For fire-suppression standpipes specialties to include in emergency, operation, and maintenance manuals.

## **1.8 QUALITY ASSURANCE**

- A.** Installer Qualifications:

1. Installer's responsibilities include designing, fabricating, and installing fire-suppression standpipes 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 Architect.
- B. Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.
- 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. NFPA Standards: Fire-suppression standpipe equipment, specialties, accessories, installation, and testing shall comply with NFPA 14, "Installation of Standpipe and Hose Systems."

## PART 2 - PRODUCTS

### 2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, and fitting materials, and for joining methods for specific services, service locations, and pipe sizes.

### 2.2 STEEL PIPE AND FITTINGS

- A. Standard Weight, Galvanized and Black-Steel Pipe: ASTM A 53 Type E, Grade B. Pipe ends may be factory or field formed to match joining method.
- B. Standard-Weight, Galvanized and Black-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, seamless steel pipe with threaded ends.
- C. Malleable- or Ductile-Iron Unions: UL 860.
- D. Cast-Iron Flanges: ASME B16.1, Class 125.
- E. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.

F. Steel Welding Fittings: ASTM A 234 and ASME B16.9.

G. Grooved-Joint, Steel-Pipe Appurtenances:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Anvil International, Inc.
  - b. Corcoran Piping System Co.
  - c. National Fittings, Inc.
  - d. Shurjoint Piping Products.
  - e. Tyco Fire & Building Products LP.
  - f. Victaulic Company.
2. Pressure Rating: 175 psig minimum.
3. Galvanized, Grooved-End Fittings for Steel Piping: ASTM A 47, 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.

## 2.3 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick.

1. Class 125, Cast-Iron Flanges and Class 150, Bronze Flat-Face Flanges: Full-face gaskets.
2. Class 250, Cast-Iron Flanges and Class 300, Steel Raised-Face Flanges: Ring-type gaskets.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

C. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

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.

## 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.
3. Minimum Pressure Rating for High-Pressure Piping: 250 psig.

**B. Ball Valves:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Anvil International, Inc.
  - b. Victaulic Company.
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: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 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: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 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: Lug or wafer.
6. End Connections: Grooved.

E. Check Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. AFAC Inc.
  - b. American Cast Iron Pipe Company; Waterous Company Subsidiary.
  - c. Anvil International, Inc.
  - d. Clow Valve Company; a division of McWane, Inc.
  - e. Crane Co.; Crane Valve Group; Crane Valves.
  - f. Crane Co.; Crane Valve Group; Jenkins Valves.
  - g. Crane Co.; Crane Valve Group; Stockham Division.
  - h. Fire-End & Croker Corporation.
  - i. Fire Protection Products, Inc.
  - j. Fivalco Inc.
  - k. Globe Fire Sprinkler Corporation.
  - l. Groeniger & Company.
  - m. Kennedy Valve; a division of McWane, Inc.
  - n. Matco-Norca.
  - o. Metraflex, Inc.
  - p. Milwaukee Valve Company.
  - q. Mueller Co.; Water Products Division.
  - r. NIBCO INC.
  - s. Potter Roemer.
  - t. Reliable Automatic Sprinkler Co., Inc.
  - u. Shurjoint Piping Products.
  - v. Tyco Fire & Building Products LP.
  - w. United Brass Works, Inc.
  - x. Venus Fire Protection Ltd.
  - y. Victaulic Company.
  - z. Viking Corporation.
  - aa. 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: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 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: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 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.
  - 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: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 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: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 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.
- 3. Pressure Rating: 250 psig minimum.
- 4. Body Material: Cast iron with indicator post flange.
- 5. Stem: Non-rising.
- 6. End Connections: Flanged or grooved.

## 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.

**B. Angle Valves:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Fire Protection Products, Inc.
  - b. United Brass Works, Inc.

**C. Ball Valves:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Affiliated Distributors.
  - b. Anvil International, Inc.
  - c. Barnett.
  - d. Conbraco Industries, Inc.; Apollo Valves.
  - e. Fire-End & Croker Corporation.
  - f. Fire Protection Products, Inc.
  - g. Flowserve.
  - h. FNW.
  - i. Jomar International, Ltd.
  - j. Kennedy Valve; a division of McWane, Inc.
  - k. Kitz Corporation.
  - l. Legend Valve.
  - m. Metso Automation USA Inc.
  - n. Milwaukee Valve Company.
  - o. NIBCO INC.
  - p. Potter Roemer.
  - q. Red-White Valve Corporation.
  - r. Southern Manufacturing Group.
  - s. Stewart, M. A. and Sons Ltd.
  - t. Tyco Fire & Building Products LP.
  - u. Victaulic Company.
  - v. Watts Water Technologies, Inc.

**D. Globe Valves:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Fire Protection Products, Inc.
  - b. United Brass Works, Inc.

**E. Plug Valves:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Southern Manufacturing Group.

## 2.6 SPECIALTY VALVES

### A. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating:
  - a. Standard-Pressure Piping Specialty Valves: 175 psig minimum.
  - b. High-Pressure Piping Specialty Valves: 250 psig minimum.
3. Body Material: Cast or ductile iron.
4. Size: Same as connected piping.
5. End Connections: Flanged or grooved.

### B. Alarm Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. AFAC Inc.
  - b. Globe Fire Sprinkler Corporation.
  - c. Reliable Automatic Sprinkler Co., Inc.
  - d. Tyco Fire & Building Products LP.
  - e. Venus Fire Protection Ltd.
  - f. Victaulic Company.
  - g. Viking Corporation.
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.

### C. Dry-Pipe Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. AFAC Inc.
  - b. Globe Fire Sprinkler Corporation.
  - c. Reliable Automatic Sprinkler Co., Inc.

- d. Tyco Fire & Building Products LP.
- e. Venus Fire Protection Ltd.
- f. Victaulic Company.
- g. Viking Corporation.
- 2. Standard: UL 260.
- 3. Design: Differential-pressure type.
- 4. Include UL 1486, quick-opening devices, trim sets for air supply, drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line attachment.
- 5. Air-Pressure Maintenance Device:
  - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - 1) AFAC Inc.
    - 2) Globe Fire Sprinkler Corporation.
    - 3) Reliable Automatic Sprinkler Co., Inc.
    - 4) Tyco Fire & Building Products LP.
    - 5) Venus Fire Protection Ltd.
    - 6) Victaulic Company.
    - 7) Viking Corporation.
  - b. Standard: UL 260.
  - c. Type: Automatic device to maintain minimum air pressure in piping.
  - d. Include shutoff valves to permit servicing without shutting down sprinkler piping, bypass valve for quick filling, pressure regulator or switch to maintain pressure, strainer, pressure ratings with 14- to 60-psig adjustable range, and 175-psig outlet pressure.
- 6. Air Compressor:
  - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - 1) Gast Manufacturing Inc.
    - 2) General Air Products, Inc.
    - 3) Viking Corporation.
  - b. Standard: UL's "Fire Protection Equipment Directory" listing.
  - c. Motor Horsepower: Fractional.
  - d. Power: 120-V ac, 60 Hz, single phase.

**D. Pressure-Reducing Valves:**

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 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. Potter Roemer.
- h. Tyco Fire & Building Products LP.
- i. Wilson & Cousins Inc.
- j. Zurn Plumbing Products Group; Wilkins Water Control Products Division.
- 2. UL 668 hose valve, with integral UL 1468 reducing device.
- 3. Pressure Rating: 300 psig minimum.
- 4. Material: Brass or bronze.
- 5. Inlet: Female pipe threads.
- 6. Outlet: Threaded with or without adapter having male hose threads.
- 7. Pattern: gate.
- 8. Finish: Rough brass.

**E. Automatic (Ball Drip) Drain Valves:**

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. AFAC Inc.
  - b. Reliable Automatic Sprinkler Co., Inc.
  - c. 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. Adjustable-Valve Hose Connections:**

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 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. Potter Roemer.
  - h. Tyco Fire & Building Products LP.
  - i. Wilson & Cousins Inc.
  - j. Zurn Plumbing Products Group; Wilkins Water Control Products Division.

2. Standard: UL 668 hose valve, with integral UL 1468 reducing or restricting pressure-control device, for connecting fire hose.
3. Pressure Rating: 300 psig minimum.
4. Material: Brass or bronze.
5. Size: NPS 2-1/2, as indicated.
6. Inlet: Female pipe threads.
7. Outlet: Male hose threads with lugged cap, gasket, and chain. Include hose valve threads according to NFPA 1963 and matching local fire-department threads.
8. Pattern: gate.
9. Pressure-Control Device Type: Pressure regulating.
10. Design Outlet Pressure Setting: 100 psi.
11. Finish: Rough brass.

**B. Nonadjustable-Valve Hose Connections:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 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. Kennedy Valve; a division of McWane, Inc.
  - h. Mueller Co.; Water Products Division.
  - i. NIBCO INC.
  - j. Potter Roemer.
  - k. Tyco Fire & Building Products LP.
  - l. Wilson & Cousins Inc.
2. Standard: UL 668 hose valve for connecting fire hose.
3. Pressure Rating: 300 psig minimum.
4. Material: Brass or bronze.
5. Size: NPS 2-1/2, as indicated.
6. Inlet: Female pipe threads.
7. Outlet: Male hose threads with lugged cap, gasket, and chain. Include hose valve threads according to NFPA 1963 and matching local fire-department threads.
8. Pattern: gate.
9. Finish: Rough brass.

**2.8 FIRE-DEPARTMENT CONNECTIONS**

**A. Exposed-Type, Fire-Department Connection:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 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 lagged swivel connections, and check devices or clappers.
7. Caps: Brass, lagged type, with gasket and chain.
8. Escutcheon Plate: Round, brass, wall type.
9. Outlet: Back, with pipe threads.
10. Number of Inlets: Two.
11. Escutcheon Plate Marking: Similar to "AUTO SPKR & STANDPIPE."
12. Finish: Polished chrome plated.
13. Outlet Size: NPS 4.

B. Flush-Type, Fire-Department Connection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 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 lagged swivel connections, and check devices or clappers.
7. Caps: Brass, lagged type, with gasket and chain.
8. Escutcheon Plate: Rectangular, brass, wall type.
9. Outlet: With pipe threads.

10. Body Style: Horizontal.
11. Number of Inlets: Two.
12. Outlet Location: Back.
13. Escutcheon Plate Marking: Similar to "AUTO SPKR & STANDPIPE."
14. Finish: Polished chrome plated.
15. Outlet Size: NPS 4.

## 2.9 ALARM DEVICES

- A. Alarm-device types shall match piping and equipment connections.
- B. Electrically Operated Alarm Bell:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Fire-Lite Alarms, Inc.; a Honeywell company.
    - b. Notifier; a Honeywell company.
    - c. Potter Electric Signal Company.
  2. Standard: UL 464.
  3. Type: Vibrating, metal alarm bell.
  4. Size: 6-inch diameter.
  5. Finish: Red-enamel factory finish, suitable for outdoor use.
- C. Water-Flow Indicators:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. ADT Security Services, Inc.
    - b. McDonnell & Miller; ITT Industries.
    - c. Potter Electric Signal Company.
    - d. System Sensor; a Honeywell company.
    - e. Viking Corporation.
    - f. Watts Industries (Canada) Inc.
  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.

**D. Pressure Switches:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. AFAC Inc.
  - b. Barksdale, Inc.
  - c. Detroit Switch, Inc.
  - d. Potter Electric Signal Company.
  - e. System Sensor; a Honeywell company.
  - f. Tyco Fire & Building Products LP.
  - g. United Electric Controls Co.
  - h. Viking Corporation.
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.

**E. Valve Supervisory Switches:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Fire-Lite Alarms, Inc.; a Honeywell company.
  - b. Kennedy Valve; a division of McWane, Inc.
  - c. Potter Electric Signal Company.
  - d. System Sensor; a Honeywell company.
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.

## **2.10 MANUAL CONTROL STATIONS**

- A. Description: UL listed or FM approved, 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.

## **2.11 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. Panels contain power supply; battery charger; standby batteries; field-wiring terminal strip; electrically supervised solenoid valves and polarized fire-alarm bell; lamp test facility; single-pole, double-throw auxiliary alarm contacts; and rectifier.

1. Panels: UL listed and FM approved when used with thermal detectors and Class A detector circuit wiring. Electrical characteristics are 120-V ac, 60 Hz, with 24-V dc rechargeable batteries.
2. 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.
3. 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.

## 2.12 PRESSURE GAGES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  1. AMETEK; U.S. Gauge Division.
  2. Ashcroft Inc.
  3. Brecco Corporation.
  4. WIKA Instrument Corporation.
- 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. Water System Piping Gage: Include "WATER" or "AIR/WATER" label on dial face.
- F. Air System Piping Gage: Include retard feature and "AIR" or "AIR/WATER" label on dial face.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Perform fire-hydrant flow test according to NFPA 14 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.
- B. Report test results promptly and in writing.

### 3.2 EXAMINATION

- A. Examine roughing-in for hose connections and stations to verify actual locations of piping connections before installation.
- B. Examine walls and partitions for suitable thickness, fire- and smoke-rated construction, framing for hose-station cabinets, and other conditions where hose connections and stations are to be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.3 SERVICE-ENTRANCE PIPING

- A. Connect fire-suppression standpipe piping to water-service piping at service entrance into building. Comply with requirements for exterior piping in Section 211100 "Facility Fire-Suppression Water-Service Piping."
- B. Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories at connection to fire-suppression water-service piping. Comply with requirements for backflow preventers in Section 211100 "Facility Fire-Suppression Water-Service Piping."
- C. Install shutoff valve, check valve, pressure gage, and drain at connection to water service.

### 3.4 PIPING INSTALLATION

- A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.
  - 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.
- B. Piping Standard: Comply with requirements in NFPA 14 for installation of fire-suppression standpipe piping.
- C. Install listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- D. Install drain valves on standpipes. Extend drain piping to outside of building.
- E. Install automatic (ball drip) drain valves to drain piping between fire-department connections and check valves. Drain to floor drain or outside building.
- F. Install alarm devices in piping systems.
- G. Install hangers and supports for standpipe system piping according to NFPA 14. Comply with requirements in NFPA 13 for hanger materials.
- H. Install pressure gages on riser or feed main 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 will not be subject to freezing.
  - I. Drain dry-type standpipe system piping.
  - J. Pressurize and check dry-type standpipe system piping and air-pressure maintenance devices.
  - K. Fill wet-type standpipe system piping with water.

- L. Install electric heating cables and pipe insulation on wet-type, fire-suppression standpipe piping in areas subject to freezing. Comply with requirements for heating cables in Section 210533 "Heat Tracing for Fire-Suppression Piping" and for piping insulation in Section 210700 "Fire-Suppression Systems Insulation."
- M. Connect compressed-air supply to dry-pipe sprinkler piping.
- N. Connect air compressor to the following piping and wiring:
  - 1. Pressure gages and controls.
  - 2. Electrical power system.
  - 3. Fire-alarm devices, including low-pressure alarm.
- O. 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."
- P. 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."
- Q. 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. 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.
- I. 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.
- 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.
- K. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" Chapter.
- L. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

### **3.6 VALVE AND SPECIALTIES INSTALLATION**

- A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 14 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. General Requirements: Install in vertical position for proper direction of flow, in main supply to system.
  - 2. Alarm Valves: Install bypass check valve and retarding chamber drain-line connection.
  - 3. Dry-Pipe and Deluge Valves: Install trim sets for air supply, drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line attachment.
    - a. Install air compressor and compressed-air supply piping.
    - b. Air-Pressure Maintenance Device: Install shutoff valves to permit servicing without shutting down sprinkler system; bypass valve for quick system filling; pressure regulator or switch to maintain system pressure; strainer; pressure ratings with 14- to 60-psig adjustable range; and 175-psig maximum inlet pressure.
    - c. Install compressed-air supply piping from building's compressed-air piping system.

### **3.7 HOSE-CONNECTION INSTALLATION**

- A. Install hose connections adjacent to standpipes.
- B. Install freestanding hose connections for access and minimum passage restriction.

### **3.8 MONITOR INSTALLATION**

- A. Install monitors on standpipe piping.

### **3.9 FIRE-DEPARTMENT CONNECTION INSTALLATION**

- A. Install wall-type, fire-department connections.
- B. 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 14.
- 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 tests and inspections.
- B. Tests and Inspections:
  - 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 standpipe systems according to NFPA 14, "System Acceptance" Chapter.
  - 4. Energize circuits to electrical equipment and devices.
  - 5. Start and run air compressors.
  - 6. Coordinate with fire-alarm tests. Operate as required.
  - 7. Coordinate with fire-pump tests. Operate as required.
  - 8. Verify that equipment hose threads are same as local fire-department equipment.
- C. Fire-suppression standpipe system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

### **3.12 DEMONSTRATION**

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain specialty valves.

### 3.13 PIPING SCHEDULE

- A. Piping between Fire-Department Connections and Check Valves: Galvanized, standard-weight steel pipe with threaded ends; cast-iron threaded fittings joints.
- B. Standard-pressure, wet-type, fire-suppression standpipe piping, NPS 8 and smaller, shall be one of the following:
  1. Standard-weight, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
  2. Standard-weight or Schedule 30, black-steel pipe with cut- or roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
  3. Standard-weight or Schedule 30, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
  4. Standard-weight or Schedule 30, black-steel pipe with plain ends; steel welding fittings; and welded joints.
- C. High-pressure, wet-type, fire-suppression standpipe piping, NPS 4 and smaller, shall be one of the following:
  1. Standard-weight, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
  2. Standard-weight or Schedule 30, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
  3. Standard-weight or Schedule 30, black-steel pipe with cut-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
  4. Standard-weight or Schedule 30, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
  5. Standard-weight or Schedule 30, black-steel pipe with plain ends; steel welding fittings; and welded joints.
- D. Standard-pressure, dry-type, fire-suppression standpipe piping, NPS 8 and smaller, shall be one of the following:
  1. Standard-weight or Schedule 30, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
  2. Standard-weight or Schedule 30, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.



## **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. Fire-protection valves.
3. Fire-department connections.
4. Sprinklers.
5. Alarm devices.
6. Manual control stations.
7. Control panels.
8. Pressure gages.

- B. Related Sections:

1. Section 211200 "Fire-Suppression Standpipes" for standpipe piping.
2. Section 211316 "Dry-Pipe Sprinkler Systems" for dry-pipe sprinkler piping.
3. Section 213113 "Electric-Drive, Centrifugal Fire Pumps" for fire pumps, pressure-maintenance pumps, and fire-pump controllers.

#### **1.3 DEFINITIONS**

- A. Standard-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure of 175 psig maximum.

#### **1.4 SYSTEM DESCRIPTIONS**

- A. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to water supply through alarm valve. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts fusible link or destroys frangible device. Hose connections are included if indicated.

## 1.5 PERFORMANCE REQUIREMENTS

- A. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.
- B. Delegated Design: Design sprinkler system(s), including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- C. Sprinkler system design shall be approved by authorities having jurisdiction.
  - 1. Margin of Safety for Available Water Flow and Pressure: 20 percent, including losses through water-service piping, valves, and backflow preventers.
  - 2. Sprinkler Occupancy Hazard Classifications:
    - a. Automobile Parking Areas: Ordinary Hazard, Group 1.
    - b. Building Service Areas: Ordinary Hazard, Group 1.
    - c. Electrical Equipment Rooms: Ordinary Hazard, Group 1.
    - d. General Storage Areas: Ordinary Hazard, Group 1.
    - e. Office and Public Areas: Light Hazard.
    - f. Residential Living Areas: Light Hazard.
  - 3. Minimum Density for Automatic-Sprinkler Piping Design:
    - a. Residential (Dwelling) Occupancy: 0.05 gpm over 400-sq. ft. area.
    - b. Light-Hazard Occupancy: 0.10 gpm over 1500-sq. ft. area.
    - c. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft. area.
  - 4. Maximum Protection Area per Sprinkler: Per UL listing.
  - 5. Maximum Protection Area per Sprinkler:
  - 6. Total Combined Hose-Stream Demand Requirement: According to NFPA 13 or by the authority having jurisdiction.

## 1.6 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. LEED Submittal:
  - 1. Product Data for Credit EQ 4.1: For solvent cements and adhesive primers, including printed statement of VOC content and chemical components.
- C. Shop Drawings: For wet-pipe sprinkler systems. Include plans, elevations, sections, details, and attachments to other work.

1. Wiring Diagrams: For power, signal, and control wiring.
- D. Delegated-Design Submittal: For 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.
- E. 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. Items penetrating finished ceiling include the following:
    - a. Lighting fixtures.
    - b. Air outlets and inlets.
- F. Qualification Data: For qualified Installer.
- G. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.
- H. Welding certificates.
- I. Fire-hydrant flow test report.
- J. 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."
- K. Field quality-control reports.
- L. Operation and Maintenance Data: For sprinkler specialties to include in emergency, operation, and maintenance manuals.

## 1.7 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 engineer.
- B. Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.
- 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. NFPA Standards: Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:
  - 1. NFPA 13, "Installation of Sprinkler Systems."
  - 2. NFPA 24, "Installation of Private Fire Service Mains and Their Appurtenances."

## **1.8 COORDINATION**

- A. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

## **1.9 EXTRA MATERIALS**

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 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.

## **PART 2 - PRODUCTS**

### **2.1 PIPING MATERIALS**

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, and fitting materials, and for joining methods for specific services, service locations, and pipe sizes.

### **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; 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. Schedule 10, Black-Steel Pipe: ASTM A 135 or ASTM A 795/A 795M, Schedule 10 in NPS 5 and smaller; and NFPA 13-specified wall thickness in NPS 6 to NPS 10, plain end.
- D. Galvanized- and Black-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, standard-weight, seamless steel pipe with threaded ends.
- E. Galvanized and Uncoated, Steel Couplings: ASTM A 865, threaded.
- F. Galvanized and Uncoated, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.
- G. Malleable- or Ductile-Iron Unions: UL 860.
- H. Cast-Iron Flanges: ASME 16.1, Class 125.
- I. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.
- J. Steel Welding Fittings: ASTM A 234/A 234M and ASME B16.9.
- K. Grooved-Joint, Steel-Pipe Appurtenances:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Anvil International, Inc.
    - b. Corcoran Piping System Co.
    - c. National Fittings, Inc.
    - d. Shurjoint Piping Products.
    - e. Tyco Fire & Building Products LP.
    - f. Victaulic Company.
  - 2. Pressure Rating: 175 psig minimum.
  - 3. Galvanized and Uncoated, 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.
- L. Steel Pressure-Seal Fittings: UL 213, FM-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 one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Victaulic Company.

## 2.3 CPVC PIPE AND FITTINGS

- A. CPVC Pipe: ASTM F 442/F 442M and UL 1821, SDR 13.5, for 175-psig rated pressure at 150 deg F, with plain ends. Include "LISTED" and "CPVC SPRINKLER PIPE" markings.
- B. CPVC Fittings: UL listed or FM approved, for 175-psig rated pressure at 150 deg F, socket type. Include "LISTED" and "CPVC SPRINKLER FITTING" markings.
  1. NPS 3/4 to NPS 1-1/2: ASTM F 438 and UL 1821, Schedule 40, socket type.
  2. NPS 2 to NPS 3: ASTM F 439 and UL 1821, Schedule 80, socket type.
  3. CPVC-to-Metal Transition Fittings: CPVC, one piece, with dimensions equivalent to pipe; one end with threaded brass insert, and one socket end.
  4. CPVC-to-Metal Transition Unions: CPVC, with dimensions equivalent to pipe; one end with threaded brass insert, and one socket end.
  5. Flanges: CPVC, one or two pieces.

## 2.4 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free.
  1. Class 125, Cast-Iron Flanges and Class 150, Bronze Flat-Face Flanges: Full-face gaskets.
  2. Class 250, Cast-Iron Flanges and Class 300, Steel Raised-Face Flanges: Ring-type gaskets.
- B. Metal, Pipe-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 general-duty brazing unless otherwise indicated.
- 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. Solvent Cements for Joining CPVC Piping and Tubing: ASTM F 493, solvent cement recommended by pipe and fitting manufacturer, and made for joining CPVC sprinkler pipe and fittings. Include cleaner or primer recommended by pipe and fitting manufacturer.

1. Use solvent cement that has a VOC content of 490 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  2. Use adhesive primer that has a VOC content of 650 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- F. Plastic, Pipe-Flange Gasket, and Bolts and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

## **2.5 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: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Anvil International, Inc.
  - b. Victaulic Company.
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: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 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: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 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: Lug or wafer.
6. End Connections: Grooved.

**E. Check Valves:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. AFAC Inc.
  - b. American Cast Iron Pipe Company; Waterous Company Subsidiary.
  - c. Anvil International, Inc.
  - d. Clow Valve Company; a division of McWane, Inc.
  - e. Crane Co.; Crane Valve Group; Crane Valves.
  - f. Crane Co.; Crane Valve Group; Jenkins Valves.
  - g. Crane Co.; Crane Valve Group; Stockham Division.
  - h. Fire-End & Croker Corporation.
  - i. Fire Protection Products, Inc.
  - j. Fivalco Inc.
  - k. Globe Fire Sprinkler Corporation.
  - l. Groeniger & Company.
  - m. Kennedy Valve; a division of McWane, Inc.
  - n. Matco-Norca.
  - o. Metraflex, Inc.
  - p. Milwaukee Valve Company.
  - q. Mueller Co.; Water Products Division.

- r. NIBCO INC.
  - s. Potter Roemer.
  - t. Reliable Automatic Sprinkler Co., Inc.
  - u. Shurjoint Piping Products.
  - v. Tyco Fire & Building Products LP.
  - w. United Brass Works, Inc.
  - x. Venus Fire Protection Ltd.
  - y. Victaulic Company.
  - z. Viking Corporation.
  - aa. 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: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 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: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 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.
  - 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: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - 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.

## 2.6 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.

### B. Angle Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Fire Protection Products, Inc.
  - b. United Brass Works, Inc.

### C. Ball Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Affiliated Distributors.
  - b. Anvil International, Inc.
  - c. Barnett.
  - d. Conbraco Industries, Inc.; Apollo Valves.
  - e. Fire-End & Croker Corporation.
  - f. Fire Protection Products, Inc.
  - g. Flowserve.
  - h. FNW.
  - i. Jomar International, Ltd.
  - j. Kennedy Valve; a division of McWane, Inc.
  - k. Kitz Corporation.
  - l. Legend Valve.
  - m. Metso Automation USA Inc.
  - n. Milwaukee Valve Company.
  - o. NIBCO INC.
  - p. Potter Roemer.
  - q. Red-White Valve Corporation.
  - r. Southern Manufacturing Group.
  - s. Stewart, M. A. and Sons Ltd.
  - t. Tyco Fire & Building Products LP.
  - u. Victaulic Company.
  - v. Watts Water Technologies, Inc.

**D. Globe Valves:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Fire Protection Products, Inc.
  - b. United Brass Works, Inc.

**E. Plug Valves:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Southern Manufacturing Group.

**2.7 SPECIALTY VALVES**

**A. General Requirements:**

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating:
  - a. Standard-Pressure Piping Specialty Valves: 175 psig minimum.
3. Body Material: Cast or ductile iron.
4. Size: Same as connected piping.
5. End Connections: Flanged or grooved.

**B. Automatic (Ball Drip) Drain Valves:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. AFAC Inc.
  - b. Reliable Automatic Sprinkler Co., Inc.
  - c. 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.

## 2.8 FIRE-DEPARTMENT CONNECTIONS

### A. Flush-Type, Fire-Department Connection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 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. Body Style: Horizontal.
11. Number of Inlets: Two.
12. Escutcheon Plate Marking: Similar to "AUTO SPKR & STANDPIPE."
13. Finish: Polished chrome plated
14. Outlet Size: NPS 6.

## 2.9 SPRINKLER SPECIALTY PIPE FITTINGS

### A. Branch Outlet Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Anvil International, Inc.
  - b. National Fittings, Inc.
  - c. Shurjoint Piping Products.
  - d. Tyco Fire & Building Products LP.

- e. 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-T 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.
- B. Flow Detection and Test Assemblies:**
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. AGF Manufacturing Inc.
    - b. Reliable Automatic Sprinkler Co., Inc.
    - c. Tyco Fire & Building Products LP.
    - d. Victaulic Company.
  - 2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
  - 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.
- C. Branch Line Testers:**
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Elkhart Brass Mfg. Company, Inc.
    - b. Fire-End & Croker Corporation.
    - c. Potter Roemer.
  - 2. Standard: UL 199.
  - 3. Pressure Rating: 175 psig.
  - 4. Body Material: Brass.
  - 5. Size: Same as connected piping.
  - 6. Inlet: Threaded.
  - 7. Drain Outlet: Threaded and capped.

8. 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 available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. AGF Manufacturing Inc.
  - b. Triple R Specialty.
  - c. Tyco Fire & Building Products LP.
  - d. Victaulic Company.
  - e. Viking Corporation.
2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
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 one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. CECA, LLC.
  - b. Corcoran Piping System Co.
  - c. Merit Manufacturing; a division of Anvil International, Inc.
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.
8. Size: Same as connected piping, for sprinkler.

## 2.10 SPRINKLERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. AFAC Inc.
2. Globe Fire Sprinkler Corporation.
3. Reliable Automatic Sprinkler Co., Inc.
4. Tyco Fire & Building Products LP.
5. Venus Fire Protection Ltd.
6. Victaulic Company.
7. Viking Corporation.

**B. General Requirements:**

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating for Residential Sprinklers: 175 psig maximum.
3. Pressure Rating for Automatic Sprinklers: 175 psig minimum.

**C. 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.

**D. Open Sprinklers with Heat-Responsive Element Removed: UL 199.**

**1. Characteristics:**

- a. Nominal 1/2-inch Orifice: With Discharge Coefficient K between 5.3 and 5.8.
- b. Nominal 17/32-inch Orifice: With Discharge Coefficient K between 7.4 and 8.2.

**E. Sprinkler Finishes:**

1. Chrome plated.
2. Bronze.
3. Concealer White

**F. 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, one piece, flat.
2. Sidewall Mounting: Chrome-plated steel, one piece, flat.

**G. Sprinkler Guards:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Reliable Automatic Sprinkler Co., Inc.
  - b. Tyco Fire & Building Products LP.
  - c. Victaulic Company.
  - d. Viking Corporation.
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. Electrically Operated Alarm Bell:
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Fire-Lite Alarms, Inc.; a Honeywell company.
    - b. Notifier; a Honeywell company.
    - c. Potter Electric Signal Company.
  2. Standard: UL 464.
  3. Type: Vibrating, metal alarm bell.
  4. Size: As required by local authority having jurisdiction.
  5. Finish: Red-enamel factory finish, suitable for outdoor use.
- C. Pressure Switches:
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. AFAC Inc.
    - b. Barksdale, Inc.
    - c. Detroit Switch, Inc.
    - d. Potter Electric Signal Company.
    - e. System Sensor; a Honeywell company.
    - f. Tyco Fire & Building Products LP.
    - g. United Electric Controls Co.
    - h. Viking Corporation.

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.
- D. Valve Supervisory Switches:**
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Fire-Lite Alarms, Inc.; a Honeywell company.
    - b. Kennedy Valve; a division of McWane, Inc.
    - c. Potter Electric Signal Company.
    - d. System Sensor; a Honeywell company.
  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.

## **2.12 MANUAL CONTROL STATIONS**

- A.** Description: UL listed or FM approved, 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.

## **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. Panels contain power supply; battery charger; standby batteries; field-wiring terminal strip; electrically supervised solenoid valves and polarized fire-alarm bell; lamp test facility; single-pole, double-throw auxiliary alarm contacts; and rectifier.
1. Panels: UL listed and FM approved when used with thermal detectors and Class A detector circuit wiring. Electrical characteristics are 120-V ac, 60 Hz, with 24-V dc rechargeable batteries.
  2. 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.
  3. 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.

## **2.14 PRESSURE GAGES**

- A.** Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. AMETEK; U.S. Gauge Division.
  - 2. Ashcroft, Inc.
  - 3. Brecco Corporation.
  - 4. WIKA Instrument Corporation.
- 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.** Water System Piping Gage: Include "WATER" or "AIR/WATER" label on dial face.
- F.** Air System Piping Gage: Include retard feature and "AIR" or "AIR/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."

- B. Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories indicated at connection to water-service piping. Install shutoff valve, check valve, pressure gage, and drain at connection to water service.

### 3.3 PIPING INSTALLATION

- A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.
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.
- B. Piping Standard: Comply with requirements for installation of sprinkler piping in NFPA 13.
- C. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- D. Install unions adjacent to each valve in pipes NPS 2 and smaller.
- E. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
- F. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.
- G. Install sprinkler piping with drains for complete system drainage.
- H. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.
- I. 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.
- J. Install alarm devices in piping systems.
- K. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13.
- L. 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 will not be subject to freezing.

- M. Fill sprinkler system piping with water.
- N. Install electric heating cables and pipe insulation on sprinkler piping in areas subject to freezing.
- O. 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."
- P. 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."
- Q. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 210518 "Escutcheons for Fire-Suppression Piping."

### 3.4 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. 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.
- I. 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.
- J. 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.
- K. Steel-Piping, Pressure-Sealed Joints: Join Schedule 5 steel pipe and steel pressure-seal fittings with tools recommended by fitting manufacturer.
- L. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" Chapter.
- M. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.
- N. Plastic-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. Apply primer.
  2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.

### **3.5 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. General Requirements: Install in vertical position for proper direction of flow, in main supply to system.
  2. Alarm Valves: Include bypass check valve and retarding chamber drain-line connection.

3. Deluge Valves: Install in vertical position, in proper direction of flow, and in main supply to deluge system. Install trim sets for drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line attachment.

### **3.6 SPRINKLER INSTALLATION**

- A. Install sprinklers in suspended ceilings in center of narrow dimension of acoustical ceiling panels.
- B. Install dry-type sprinklers with water supply from heated space. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing.
- C. Install sprinklers into flexible, sprinkler hose fittings and install hose into bracket on ceiling grid.

### **3.7 FIRE-DEPARTMENT CONNECTION INSTALLATION**

- A. Install wall-type, fire-department connections.
- B. Install automatic (ball drip) drain valve at each check valve for fire-department connection.

### **3.8 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."

### **3.9 FIELD QUALITY CONTROL**

- A. Perform tests and inspections.
- B. Tests and Inspections:
  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.
- C. Sprinkler piping system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

### **3.10 CLEANING**

- A. Clean dirt and debris from sprinklers.
- B. Remove and replace sprinklers with paint other than factory finish.

### **3.11 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. Copper-tube, extruded-tee connections may be used for tee branches in copper tubing instead of specified copper fittings. Branch-connection joints must be brazed.
- D. CPVC pipe; Schedule 40 CPVC fittings; and solvent-cemented joints may be used for light-hazard and residential occupancies.
- E. Standard-pressure, wet-pipe sprinkler system, NPS 8 and smaller, shall be one of the following:
1. Standard-weight or Schedule 30, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
  2. Standard-weight or Schedule 30, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
  3. Standard-weight or Schedule 30, black-steel pipe with plain ends; uncoated, plain-end-pipe fittings; and twist-locked joints.
  4. Standard-weight or Schedule 30, galvanized-steel pipe with plain ends; galvanized, plain-end-pipe fittings; and twist-locked joints.
  5. Standard-weight or Schedule 30, black-steel pipe with cut- or roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

6. Standard-weight or Schedule 30, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
7. Standard-weight or Schedule 30, black-steel pipe with plain ends; steel welding fittings; and welded joints.

### **3.12 SPRINKLER SCHEDULE**

**A.** Use sprinkler types in subparagraphs below for the following applications:

1. Rooms without Ceilings: Upright sprinklers.
2. Rooms with Suspended Ceilings: Concealed sprinklers.
3. Wall Mounting: Sidewall sprinklers.
4. Spaces Subject to Freezing: Upright sprinklers.

**B.** Provide sprinkler types in subparagraphs below with finishes indicated.

1. Concealed Sprinklers: Rough brass, with factory-painted white cover plate.
2. Recessed Sprinklers: Bright chrome, with bright chrome escutcheon.
3. 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.



## SECTION 211316 - DRY PIPE SPRINKLER SYSTEMS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Pipes, fittings, and specialties.
2. Fire-protection valves.
3. Fire-department connections.
4. Sprinkler specialty pipe fittings.
5. Sprinklers.
6. Alarm devices.
7. Manual control stations.
8. Control panels.
9. Pressure gages.

B. Related Sections:

1. Section 211200 "Fire-Suppression Standpipes" for standpipe piping.
2. Section 211313 "Wet-Pipe Sprinkler Systems" for wet-pipe sprinkler piping.
3. Section 213113 "Electric-Drive, Centrifugal Fire Pumps" for fire pumps, pressure-maintenance pumps, and fire-pump controllers.
4. Section 283111 "Digital, Addressable Fire-Alarm System" for alarm devices not specified in this Section.

#### 1.2 DEFINITIONS

- A. Standard-Pressure Sprinkler Piping: Dry-pipe sprinkler system piping designed to operate at working pressure 175 psig maximum.

#### 1.3 SYSTEM DESCRIPTIONS

- A. Dry-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing compressed air. Opening of sprinklers releases compressed air and permits water pressure to

open dry-pipe valve. Water then flows into piping and discharges from sprinklers that are open.

#### **1.4 PERFORMANCE REQUIREMENTS**

- A. Standard-Pressure Piping System Component:** Listed for 175-psig minimum working pressure.
- B. Delegated Design:** Design sprinkler system(s), including comprehensive engineering analysis by a qualified professional Architect, using performance requirements and design criteria indicated.
- C. Sprinkler system design shall be approved by authorities having jurisdiction.**
  - 1. Margin of Safety for Available Water Flow and Pressure:** 10 percent, including losses through water-service piping, valves, and backflow preventers.
  - 2. Sprinkler Occupancy Hazard Classifications:**
    - a. Automobile Parking Areas: Ordinary Hazard, Group 1.
    - b. Building Service Areas: Ordinary Hazard, Group 1.
    - c. Electrical Equipment Rooms: Ordinary Hazard, Group 1.
    - d. General Storage Areas: Ordinary Hazard, Group 1.
    - e. Mechanical Equipment Rooms: Ordinary Hazard, Group 1.
    - f. Office and Public Areas: 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. Extra-Hazard, Group 1 Occupancy: 0.30 gpm over 2500-sq. ft. area.
    - e. Extra-Hazard, Group 2 Occupancy: 0.40 gpm over 2500-sq. ft. area.
    - f. Special Occupancy Hazard: As determined by authorities having jurisdiction.
  - 4. Maximum Protection Area per Sprinkler:** Per UL listing.
  - 5. Maximum Protection Area per Sprinkler:**

- a. Office Spaces: 120 sq. ft. dimension.
  - b. Storage Areas: 130 sq. ft. dimension.
  - c. Mechanical Equipment Rooms: 130 sq. ft. dimension.
  - d. Electrical Equipment Rooms: 130 sq. ft. dimension.
  - 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 requirement.
  - b. Ordinary-Hazard Occupancies: 250 gpm for 60 to 90 minutes requirement.
  - c. Extra-Hazard Occupancies: 500 gpm for 90 to 120 minutes requirement.

## 1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: For dry-pipe sprinkler systems. Include plans, elevations, sections, details, and attachments to other work.
  - 1. Wiring Diagrams: For power, signal, and control wiring.
- C. Delegated-Design Submittal: For 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.

## 1.6 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. Items penetrating finished ceiling including the following:
    - a. Lighting fixtures.
    - b. Air outlets and inlets.

**5. Storm and sanitary sewer**

- B.** Qualification Data: For qualified Installer and professional Architect.
- 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.** Fire-hydrant flow test report.
- E.** 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."
- F.** Field quality-control reports.

**1.7 CLOSEOUT SUBMITTALS**

- A.** Operation and Maintenance Data: For sprinkler specialties 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.** 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.

**1.9 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 Architect.
- 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.** NFPA Standards: Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:

1. NFPA 13, "Installation of Sprinkler Systems."
2. NFPA 24, "Installation of Private Fire Service Mains and Their Appurtenances."

## **1.10 COORDINATION**

- A. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

## **PART 2 - PRODUCTS**

### **2.1 PIPING MATERIALS**

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, and fitting materials, and joining methods for specific services, service locations, and pipe sizes.

### **2.2 STEEL PIPE AND FITTINGS**

- A. Standard Weight, Galvanized-Steel Pipe: ASTM A 53Type E, Grade B. Pipe ends may be factory or field formed to match joining method.
- B. Schedule 30, Galvanized-Steel Pipe: ASTM A 135; ASTM A 795Type 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-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, standard-weight, seamless steel pipe with threaded ends.
- D. Galvanized, Steel Couplings: ASTM A 865, threaded.
- E. Galvanized, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.
- F. Malleable- or Ductile-Iron Unions: UL 860.
- G. Cast-Iron Flanges: ASME B16.1, Class 125.
- H. Plain-End-Pipe Fittings: UL 213, ductile-iron body with retainer lugs that require one-quarter turn or screwed retainer pin to secure pipe in fitting.
  - I. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Anvil International, Inc.
    - b. Shurjoint Piping Products.
- I. Grooved-Joint, Steel-Pipe Appurtenances:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Anvil International, Inc.
  - b. Corcoran Piping System Co.
  - c. National Fittings, Inc.
  - d. Shurjoint Piping Products.
  - e. Tyco Fire & Building Products LP.
  - f. Victaulic Company.
2. Pressure Rating: 175 psig minimum.
3. Galvanized, 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.

### **2.3 PIPING JOINING MATERIALS**

- A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free.
  1. Class 125, Cast-Iron and Class 150, Bronze Flat-Face Flanges: Full-face gaskets.
  2. Class 250, Cast-Iron and Class 300, Raised-Face Flanges: Ring-type gaskets.
- B. Metal, Pipe-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 general-duty brazing unless otherwise indicated.

### **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: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- a.** Anvil International, Inc.
- b.** Victaulic Company.

**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: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- 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: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- 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: Lug or wafer.
  6. End Connections: Grooved.

**E. Check Valves:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. AFAC Inc.
  - b. American Cast Iron Pipe Company; Waterous Company Subsidiary.
  - c. Anvil International, Inc.
  - d. Clow Valve Company; a division of McWane, Inc.
  - e. Crane Co.; Crane Valve Group; Crane Valves.
  - f. Crane Co.; Crane Valve Group; Jenkins Valves.
  - g. Crane Co.; Crane Valve Group; Stockham Division.
  - h. Fire-End & Croker Corporation.
  - i. Fire Protection Products, Inc.
  - j. Fivalco Inc.

- k. Globe Fire Sprinkler Corporation.
- l. Groeniger & Company.
- m. Kennedy Valve; a division of McWane, Inc.
- n. Matco-Norca.
- o. Metraflex, Inc.
- p. Milwaukee Valve Company.
- q. Mueller Co.; Water Products Division.
- r. NIBCO INC.
- s. Potter Roemer.
- t. Reliable Automatic Sprinkler Co., Inc.
- u. Shurjoint Piping Products.
- v. Tyco Fire & Building Products LP.
- w. United Brass Works, Inc.
- x. Venus Fire Protection Ltd.
- y. Victaulic Company.
- z. Viking Corporation.
- aa. 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: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- 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: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 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.
  - 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: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 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 visual indicating device.

**I. NRS Gate Valves:**

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 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.
- 3. Pressure Rating: 250 psig minimum.
- 4. Body Material: Cast iron with indicator post flange.
- 5. Stem: Nonrising.
- 6. End Connections: Flanged or grooved.

**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.

**B. Angle Valves:**

**1.** Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- a. Fire Protection Products, Inc.
- b. United Brass Works, Inc.

**C. Ball Valves:**

**1.** Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- a. Affiliated Distributors.
- b. Anvil International, Inc.
- c. Barnett.
- d. Conbraco Industries, Inc.; Apollo Valves.
- e. Fire-End & Croker Corporation.
- f. Fire Protection Products, Inc.
- g. Flowserve.
- h. FNW.
- i. Jomar International, Ltd.
- j. Kennedy Valve; a division of McWane, Inc.
- k. Kitz Corporation.
- l. Legend Valve.
- m. Metso Automation USA Inc.
- n. Milwaukee Valve Company.
- o. NIBCO INC.
- p. Potter Roemer.
- q. Red-White Valve Corporation.
- r. Southern Manufacturing Group.

- s. Stewart, M. A. and Sons Ltd.
- t. Tyco Fire & Building Products LP.
- u. Victaulic Company.
- v. Watts Water Technologies, Inc.

**D. Globe Valves:**

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Fire Protection Products, Inc.
  - b. United Brass Works, Inc.

**E. Plug Valves:**

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Southern Manufacturing Group.

**2.6 SPECIALTY VALVES**

**A. General Requirements:**

- 1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
- 2. Pressure Rating:
  - a. Standard-Pressure Piping Specialty Valves: 175 psig minimum.
  - b. High-Pressure Piping Specialty Valves: 250 psig minimum.
- 3. Body Material: Cast or ductile iron.
- 4. Size: Same as connected piping.
- 5. End Connections: Flanged or grooved.

**B. Dry-Pipe Valves:**

- 1.** Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a.** AFAC Inc.
  - b.** Globe Fire Sprinkler Corporation.
  - c.** Reliable Automatic Sprinkler Co., Inc.
  - d.** Tyco Fire & Building Products LP.
  - e.** Venus Fire Protection Ltd.
  - f.** Victaulic Company.
  - g.** Viking Corporation.
- 2.** Standard: UL 260
- 3.** Design: Differential-pressure type.
- 4.** Include UL 1486, quick-opening devices, trim sets for air supply, drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line attachment.
- 5.** Air-Pressure Maintenance Device:
  - a.** Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - 1) AFAC Inc.
    - 2) Globe Fire Sprinkler Corporation.
    - 3) Reliable Automatic Sprinkler Co., Inc.
    - 4) Tyco Fire & Building Products LP.
    - 5) Venus Fire Protection Ltd.
    - 6) Victaulic Company.
    - 7) Viking Corporation.
  - b.** Standard: UL 260.
  - c.** Type: Automatic device to maintain minimum air pressure in piping.

- d. Include shutoff valves to permit servicing without shutting down sprinkler piping, bypass valve for quick filling, pressure regulator or switch to maintain pressure, strainer, pressure ratings with 14- to 60-psig adjustable range, and 175-psig outlet pressure.

**6. Air Compressor:**

- a. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1) Gast Manufacturing Inc.
  - 2) General Air Products, Inc,
  - 3) Viking Corporation.
- b. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
- c. Motor Horsepower: Fractional.

**C. Automatic (Ball Drip) Drain Valves:**

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. AFAC Inc.
  - b. Reliable Automatic Sprinkler Co., Inc.
  - c. 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 SPRINKLER SPECIALTY PIPE FITTINGS**

- A. General Requirements for Dry-Pipe-System Fittings: UL listed for dry-pipe service.
- B. Branch Outlet Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Anvil International, Inc.
  - b. National Fittings, Inc.
  - c. Shurjoint Piping Products.
  - d. Tyco Fire & Building Products LP.
  - e. 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-T 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.

C. Flow Detection and Test Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. AGF Manufacturing Inc.
  - b. Reliable Automatic Sprinkler Co., Inc.
  - c. Tyco Fire & Building Products LP.
  - d. Victaulic Company.
2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
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.

**D. Branch Line Testers:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Elkhart Brass Mfg. Company, Inc.
  - b. Fire-End & Croker Corporation.
  - c. Potter Roemer.
2. Standard: UL 199.
3. Pressure Rating: 175 psig minimum.
4. Body Material: Brass.
5. Size: Same as connected piping.
6. Inlet: Threaded.
7. Drain Outlet: Threaded and capped.
8. Branch Outlet: Threaded, for sprinkler.

**E. Sprinkler Inspector's Test Fittings:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. AGF Manufacturing Inc.
  - b. Triple R Specialty.
  - c. Tyco Fire & Building Products LP.
  - d. Victaulic Company.
  - e. Viking Corporation.

2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
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.

**F. Adjustable Drop Nipples:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. CECA, LLC.
  - b. Corcoran Piping System Co.
  - c. Merit Manufacturing; a division of Anvil International, Inc.
2. Standard: UL 1474.
3. Pressure Rating: 250 psig minimum.
4. Body Material: Steel pipe with EPDM O-ring seals.
5. Size: Same as connected piping.
6. Length: Adjustable.
7. Inlet and Outlet: Threaded.

**G. Flexible, Sprinkler Hose Fittings:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Fivalco Inc.
  - b. FlexHead Industries, Inc.
  - c. Gateway Tubing, Inc.
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.

## 2.8 SPRINKLERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  1. Globe Fire Sprinkler Corporation.
  2. Reliable Automatic Sprinkler Co., Inc.
  3. Tyco Fire & Building Products LP.
  4. Victaulic Company.
  5. Viking Corporation.
- B. General Requirements:
  1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
  2. Pressure Rating for Residential Sprinklers: 175 psig maximum.
  3. Pressure Rating for Automatic Sprinklers: 175 psig minimum.
  4. Pressure Rating for High-Pressure Automatic Sprinklers: 250 psig minimum.
- C. Automatic Sprinklers with Heat-Responsive Element:
  1. Nonresidential Applications: UL 199.
  2. Residential Applications: UL 1626.
  3. 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.
- D. Sprinkler Finishes:
  1. Bronze.
- E. Special Coatings:

1. Wax.

2. Lead.

3. Corrosion-resistant paint.

**F.** 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, one piece, flat, with 1-inch vertical adjustment.

2. Sidewall Mounting: Chrome-plated steel, one piece, flat.

**G.** Sprinkler Guards:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Reliable Automatic Sprinkler Co., Inc.

b. Tyco Fire & Building Products LP.

c. Victaulic Company.

d. Viking Corporation.

2. Standard: UL 199.

3. Type: Wire cage with fastening device for attaching to sprinkler.

## **2.9 ALARM DEVICES**

**A.** Alarm-device types shall match piping and equipment connections.

**B.** Electrically Operated Alarm Bell:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Fire-Lite Alarms; a Honeywell company.

b. Notifier; a Honeywell company.

c. Potter Electric Signal Company.

2. Standard: UL 464.

3. Type: Vibrating, metal alarm bell.
4. Size: 6-inch minimum diameter.
5. Finish: Red-enamel factory finish, suitable for outdoor use.

**C. Pressure Switches:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. AFAC Inc.
  - b. Barksdale, Inc.
  - c. Detroit Switch, Inc.
  - d. Potter Electric Signal Company.
  - e. System Sensor; a Honeywell company.
  - f. Tyco Fire & Building Products LP.
  - g. United Electric Controls Co.
  - h. Viking Corporation.
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.

**D. Valve Supervisory Switches:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Fire-Lite Alarms; a Honeywell company.
  - b. Kennedy Valve; a division of McWane, Inc.
  - c. Potter Electric Signal Company.
  - d. System Sensor; a Honeywell company.

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.

## 2.10 MANUAL CONTROL STATIONS

- A. Description: UL listed or FM Global approved, 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.

## 2.11 CONTROL PANELS

- A. Description: Single-area, two-area, or single-area cross-zoned type control panel as indicated, including NEMA ICS 6, Type 1 enclosure, detector, alarm, and solenoid-valve circuitry for operation of deluge valves. Panels contain power supply; battery charger; standby batteries; field-wiring terminal strip; electrically supervised solenoid valves and polarized fire-alarm bell; lamp test facility; single-pole, double-throw auxiliary alarm contacts; and rectifier.
1. Panels: UL listed and FM Global approved when used with thermal detectors and Class A detector circuit wiring. Electrical characteristics are 120-V ac, 60 Hz, with 24-V dc rechargeable batteries.
  2. 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.
  3. 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.

## 2.12 PRESSURE GAGES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. AMETEK, Inc.; U.S. Gauge Division.
  2. Ashcroft, Inc.
  3. Brecco Corporation.

4. WIKA Instrument Corporation.
- 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. Water System Piping Gage: Include "WATER" or "AIR/WATER" label on dial face.
- F. Air System Piping Gage: Include retard feature and "AIR" or "AIR/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 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 in Section 211100 "Facility Fire-Suppression Water-Service Piping" for backflow preventers.
- C. Install shutoff valve, check valve, pressure gage, and drain at connection to water service.

### 3.3 PIPING INSTALLATION

- A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.
  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.
- B. Piping Standard: Comply with requirements in NFPA 13 for installation of sprinkler piping.
- C. Install seismic restraints on piping. Comply with requirements in NFPA 13 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 valves to drain piping between fire-department connections and check valves. Drain to floor drain or to outside building.
- K. Connect compressed-air supply to dry-pipe sprinkler piping.
- L. Connect air compressor to the following piping and wiring:
  - 1. Pressure gages and controls.
  - 2. Electrical power system.
  - 3. Fire-alarm devices, including low-pressure alarm.
- M. Install alarm devices in piping systems.
- N. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements in NFPA 13 for hanger materials.
- O. 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 will not be subject to freezing.
- P. Drain dry-pipe sprinkler piping.
- Q. Pressurize and check dry-pipe sprinkler system piping and air-pressure maintenance devices.
- R. 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."

- S. 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."
- T. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 210518 "Escutcheons for Fire-Suppression Piping."

### 3.4 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, 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.
- J. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

### **3.5 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. General Requirements: Install in vertical position for proper direction of flow, in main supply to system.
  - 2. Dry-Pipe: Install trim sets for air supply, drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line attachment.
    - a. Install air compressor and compressed-air supply piping.
    - b. Air-Pressure Maintenance Device: Install shutoff valves to permit servicing without shutting down sprinkler system; bypass valve for quick system filling; pressure regulator or switch to maintain system pressure; strainer; pressure ratings with 14- to 60-psig adjustable range; and 175-psig maximum inlet pressure.
    - c. Install compressed-air supply piping from building's compressed-air piping system.

### **3.6 SPRINKLER INSTALLATION**

- A. Install sprinklers in suspended ceilings in center of narrow dimension of acoustical ceiling panels.
- B. Install dry-type sprinklers with water supply from heated space. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing.
- C. Install sprinklers into flexible, sprinkler hose fittings and install hose into bracket on ceiling grid.

### **3.7 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."

### **3.8 FIELD QUALITY CONTROL**

- A.** Perform tests and inspections.
- B.** Tests and Inspections:
  - 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.** Start and run air compressors.
  - 6.** Coordinate with fire-alarm tests. Operate as required.
  - 7.** Coordinate with fire-pump tests. Operate as required.
  - 8.** Verify that equipment hose threads are same as local fire-department equipment.
- C.** Sprinkler piping system will be considered defective if it does not pass tests and inspections.
- D.** Prepare test and inspection reports.

### **3.9 CLEANING**

- A.** Clean dirt and debris from sprinklers.
- B.** Remove and replace sprinklers with paint other than factory finish.

### **3.10 DEMONSTRATION**

- A.** Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain specialty valves.

### **3.11 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 joints.
- B.** Sprinkler specialty fittings may be used, downstream of control valves, instead of specified fittings.

- C. Standard-pressure, dry-pipe sprinkler system, NPS 8 and smaller pipe size range, shall be one of the following:
1. Standard-weight, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
  2. Standard-weight, galvanized-steel pipe with plain ends; plain-end-pipe fittings; and twist-locked joints.
  3. Standard-weight, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

### **3.12 SPRINKLER SCHEDULE**

- A. Use sprinkler types in subparagraphs below for the following applications:
1. Rooms without Ceilings: Upright sprinklers.
  2. Rooms with Suspended Ceilings: Dry pendent, and concealed sprinklers.
  3. Wall Mounting: Dry sidewall sprinklers.
- 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. 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.

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## **SECTION 213113 - ELECTRIC-DRIVE, CENTRIFUGAL FIRE PUMPS**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Split-case fire pumps.
  - 2. Fire-pump accessories and specialties.

#### **1.2 PERFORMANCE REQUIREMENTS**

- A. Pump Equipment, Accessory, and Specialty Pressure Rating: 175 psig minimum unless higher pressure rating is indicated.

#### **1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, performance curves, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: For fire pumps, motor drivers, and fire-pump accessories and specialties. 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.

#### **1.4 INFORMATIONAL SUBMITTALS**

- A. Product Certificates: For each fire pump, from manufacturer.
- B. Source quality-control reports.
- C. Field quality-control reports.

#### **1.5 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For fire pumps to include in operation and maintenance manuals.

#### **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.** NFPA Compliance: Comply with NFPA 20, "Installation of Stationary Pumps for Fire Protection."

## 1.7 COORDINATION

- A.** Coordinate sizes and locations of concrete bases with actual equipment provided.

## PART 2 - PRODUCTS

### 2.1 GENERAL REQUIREMENTS FOR CENTRIFUGAL FIRE PUMPS

- A.** Description: Factory-assembled and -tested fire-pump and driver unit.
- B.** Base: Fabricated and attached to fire-pump and driver unit with reinforcement to resist movement of pump when base is anchored to building substrate.
- C.** Finish: Red paint applied to factory-assembled and -tested unit before shipping.

### 2.2 HORIZONTALLY MOUNTED, SINGLE-STAGE, SPLIT-CASE FIRE PUMPS

- A.** Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. A-C Fire Pump Systems; a business of ITT Industries.
  2. Corcoran Piping System Co.
  3. Patterson Pump Company; a subsidiary of the Gorman-Rupp Company.
  4. PACO Pumps; Grundfos Pumps Corporation, U.S.A.
  5. Peerless Pump, Inc.
  6. Pentair Pump Group; Aurora Pump.
  7. Reddy-Buffaloes Pump Company.
  8. Ruhrpumpen, Inc.
  9. S.A. Armstrong Limited.
- B.** Pump:
1. Standard: UL 448, for split-case pumps for fire service.
  2. Casing: Axially split case, cast iron with ASME B16.1 pipe-flange connections.
  3. Impeller: Cast bronze, statically and dynamically balanced, and keyed to shaft.
  4. Wear Rings: Replaceable bronze.

5. Shaft and Sleeve: Steel shaft with bronze sleeve.
    - a. Shaft Bearings: Grease-lubricated ball bearings in cast-iron housing.
    - b. Seals: Stuffing box with minimum of four rings of graphite-impregnated braided yarn and bronze packing gland.
  6. Mounting: Pump and driver shafts are horizontal, with pump and driver on same base.
- C. Coupling: Flexible and capable of absorbing torsional vibration and shaft misalignment. Include metal coupling guard.
- D. Driver:
1. Standard: UL 1004A.
  2. Type: Electric motor; NEMA MG 1, polyphase Design B.
- E. Capacities and Characteristics: Refer to Equipment Schedule.

### **2.3 FIRE-PUMP ACCESSORIES AND SPECIALTIES**

- A. Automatic Air-Release Valves: Comply with NFPA 20 for installation in fire-pump casing.
- B. Circulation Relief Valves: UL 1478, brass, spring loaded; for installation in pump discharge piping.
- C. Relief Valves:
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. BERMAD Control Valves.
    - b. CLA-VAL Automatic Control Valves.
    - c. Kunkle Valve; a part of Tyco International Ltd.
    - d. OCV Control Valves.
    - e. Watts Regulator Company; a division of Watts Water Technologies, Inc.
    - f. Zurn Plumbing Products Group; Wilkins Water Control Products.
  2. Description: UL 1478, bronze or cast iron, spring loaded; for installation in fire-suppression water-supply piping.
- D. Inlet Fitting: Eccentric tapered reducer at pump suction inlet.
- E. Outlet Fitting: Concentric tapered reducer at pump discharge outlet.

**F.** Discharge Cone: Closed type.

**G.** Hose Valve Manifold Assembly:

1. Standard: Comply with requirements in NFPA 20.
2. Header Pipe: ASTM A 53/A 53M, Schedule 40, galvanized steel with ends threaded according to ASME B1.20.1.
3. Header Pipe Fittings: ASME B16.4, galvanized cast-iron threaded fittings.
4. Automatic Drain Valve: UL 1726.
5. Manifold:
  - a. Test Connections: Comply with UL 405 except provide outlets without clappers instead of inlets.
  - b. Body: Flush type, brass or ductile iron, with number of outlets required by NFPA 20.
  - c. Nipples: ASTM A 53/A 53M, Schedule 40, galvanized-steel pipe with ends threaded according to ASME B1.20.1.
  - d. Adapters and Caps with Chain: Brass or bronze, with outlet threaded according to NFPA 1963 and matching local fire-department threads.
  - e. Escutcheon Plate: Brass or bronze; rectangular.
  - f. Hose Valves: UL 668, bronze, with outlet threaded according to NFPA 1963 and matching local fire-department threads.
  - g. Exposed Parts Finish: brass.
  - h. Escutcheon Plate Marking: Equivalent to "FIRE PUMP TEST."
6. Manifold:
  - a. Test Connections: Comply with UL 405 except provide outlets without clappers instead of inlets.
  - b. Body: Exposed type, brass, with number of outlets required by NFPA 20.
  - c. Escutcheon Plate: Brass or bronze; round.
  - d. Hose Valves: UL 668, bronze, with outlet threaded according to NFPA 1963 and matching local fire-department threads. Include caps and chains.
  - e. Exposed Parts Finish: brass.
  - f. Escutcheon Plate Marking: Equivalent to "FIRE PUMP TEST."

## 2.4 GROUT

- A. Standard: ASTM C 1107, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Non-shrink and recommended for interior and exterior applications.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

## 2.5 SOURCE QUALITY CONTROL

- A. Testing: Test and inspect fire pumps according to UL 448 requirements for "Operation Test" and "Manufacturing and Production Tests."
  - 1. Verification of Performance: Rate fire pumps according to UL 448.
- B. Fire pumps will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

# PART 3 - EXECUTION

## 3.1 EXAMINATION

- A. Examine equipment bases and anchorage provisions, with Installer present, for compliance with requirements and for conditions affecting performance of fire pumps.
- B. Examine roughing-in for fire-suppression piping systems to verify actual locations of piping connections before fire-pump installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

## 3.2 INSTALLATION

- A. Fire-Pump Installation Standard: Comply with NFPA 20 for installation of fire pumps, relief valves, and related components.
- B. Equipment Mounting:
  - 1. Install fire pumps 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 and seismic control devices specified in Comply with requirements for vibration isolation devices specified in Section 210548.13 "Vibration Controls for Fire-Suppression Piping and Equipment."
- C. Install fire-pump suction and discharge piping equal to or larger than sizes required by NFPA 20.

- D. Support piping and pumps separately so weight of piping does not rest on pumps.
- E. Install valves that are same size as connecting piping. Comply with requirements for fire-protection valves specified in Section 211313 "Wet-Pipe Sprinkler Systems."
- F. Install pressure gages on fire-pump suction and discharge flange pressure-gage tappings. Comply with requirements for pressure gages specified in Section 211313 "Wet-Pipe Sprinkler Systems."
- G. Install piping hangers and supports, anchors, valves, gages, and equipment supports according to NFPA 20.
- H. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not factory mounted. Furnish copies of manufacturers' wiring diagram submittals to electrical Installer.
- I. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

### 3.3 ALIGNMENT

- A. Align split-case pump and driver shafts after complete unit has been leveled on concrete base, grout has set, and anchor bolts have been tightened.
- B. After alignment is correct, tighten anchor bolts evenly. Fill baseplate completely with grout, with metal blocks and shims or wedges in place. Tighten anchor bolts after grout has hardened. Check alignment and make required corrections.
- C. Align piping connections.
- D. Align pump and driver shafts for angular and parallel alignment according to HI 1.4 and to tolerances specified by manufacturer.

### 3.4 CONNECTIONS

- A. Comply with requirements for piping and valves specified in Section 211313 "Wet-Pipe Sprinkler Systems." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to pumps and equipment to allow service and maintenance.
- C. Connect relief-valve discharge to drainage piping or point of discharge.
- D. Connect fire pumps to their controllers.

### 3.5 IDENTIFICATION

- A. Identify system components. Comply with requirements for fire-pump marking according to NFPA 20.

### **3.6 FIELD QUALITY CONTROL**

- A.** Test each fire pump with its controller as a unit. Comply with requirements for electric-motor-driver fire-pump controllers specified in Section 213900 "Controllers for Fire-Pump Drivers."
- B.** Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- C.** 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.
- D.** Tests and Inspections:
  - 1.** After installing components, assemblies, and equipment including controller, test for compliance with requirements.
  - 2.** Test according to NFPA 20 for acceptance and performance testing.
  - 3.** Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
  - 4.** Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
  - 5.** Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- E.** Components, assemblies, and equipment will be considered defective if they do not pass tests and inspections.
- F.** Prepare test and inspection reports.
- G.** Furnish fire hoses in number, size, and length required to reach storm drain or other acceptable location to dispose of fire-pump test water. Hoses are for tests only and do not convey to Owner.

### **3.7 STARTUP SERVICE**

- A.** Engage a factory-authorized service representative to perform startup service.
  - 1.** Complete installation and startup check according to manufacturer's written instructions.

### **3.8 DEMONSTRATION**

- A.** Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fire pumps.

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## **SECTION 213900 - CONTROLLERS FOR FIRE PUMP DRIVERS**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

**A. Section Includes:**

1. Full-service, full-voltage controllers rated 600 V and less.
2. Controllers for pressure-maintenance pumps.
3. Remote alarm panels.
4. Low-suction-shutdown panels.

#### **1.2 DEFINITIONS**

- A. ATS:** Automatic transfer switch (es).
- B. ECM:** Electronic control module.
- C. MCCB:** Molded-case circuit breaker.
- D. N.O.:** Normally open.

#### **1.3 ACTION SUBMITTALS**

- A. Product Data:** For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings:** For each type of product indicated. Include dimensioned plans, elevations, sections, details, and attachments to other work, including required clearances and service spaces around controller enclosures.
1. Show tabulations of the following:
    - a. Each installed unit's type and details.
    - b. Enclosure types and details for types other than NEMA 250, Type 2.
    - c. Factory-installed devices.
    - d. Nameplate legends.
    - e. Short-circuit current (withstand) rating of integrated unit.

- f. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices.
  - g. Specified modifications.
2. Detail equipment assemblies and indicate dimensions, weights, loads, method of field assembly, components, and location and size of each field connection.
  3. Schematic and Connection Diagrams: For power, signal, alarm, and control wiring and for pressure-sensing tubing.

#### **1.4 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For qualified testing agency.
- B. Product Certificates: For each type of product indicated, from manufacturer.
- C. Manufacturer's factory test reports of fully assembled and tested equipment.
- D. Source quality-control reports.
- E. Field quality-control reports.

#### **1.5 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For each type of product indicated to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017800 "Operation and Maintenance Data," include the following:
  1. Manufacturer's written instructions for setting field-adjustable timers, controls, and status and alarm points.
  2. Manufacturer's written instructions for testing, adjusting, and reprogramming microprocessor-based logic controls.

#### **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. Indicating Lights: Two of each type and color of lens installed; two of each type and size of lamp installed.
  2. Auxiliary Contacts: One for each size and type of magnetic contactor installed.
  3. Power Contacts: Three for each size and type of magnetic contactor installed.
  4. Contactor Coils: One for each size and type of magnetic controller installed.

5. Relay Boards: One for each size and type of relay board installed.
6. Operator Interface: One microprocessor board(s), complete with display and membrane keypad.

## 1.7 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member company of an NRTL.
- B. Source Limitations: Obtain fire-pump controllers and all associated equipment from single source or producer.
- 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 standards of authorities having jurisdiction pertaining to materials and installation.
- E. Comply with NFPA 20 and NFPA 70.
- F. 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."

## 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store 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, protect controllers from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside controllers; connect factory-installed space heaters to temporary electrical service.

## 1.9 PROJECT CONDITIONS

- A. Environmental Limitations:
  1. Ambient Temperature Rating: Not less than 40 deg F and not exceeding 122 deg F unless otherwise indicated.
  2. Altitude Rating: Not exceeding 6600 feet unless otherwise indicated.
- B. Interruption of Existing Electric Service: Notify Architect no fewer than seven days in advance of proposed interruption of electric service, and comply with NFPA 70E.

## 1.10 COORDINATION

- A. Coordinate layout and installation of controllers with other construction including conduit, piping, fire-pump equipment, and adjacent surfaces. Maintain required clearances for workspace and equipment access doors and panels. Ensure that controllers are within sight of fire-pump drivers.
- B. Coordinate sizes and locations of concrete bases with actual equipment provided.

## PART 2 - PRODUCTS

### 2.1 FULL-SERVICE CONTROLLERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  1. ASCO Power Technologies, LP; Firetrol Products.
  2. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
  3. Hubbell Incorporated; Hubbell Industrial Controls.
  4. Joslyn Clark Corporation.
  5. Master Control Systems, Inc.
  6. Metron, Inc.
- B. General Requirements for Full-Service Controllers:
  1. Comply with NFPA 20 and UL 218.
  2. Listed by an NRTL for electric-motor driver for fire-pump service.
  3. Combined automatic and non-automatic operation.
  4. Factory assembled, wired, and tested; continuous-duty rated.
  5. Service Equipment Label: NRTL labeled for use as service equipment.
- C. Method of Starting:
  1. Pressure-switch actuated.
    - a. Water-pressure-actuated switch and pressure transducer with independent high- and low-calibrated adjustments responsive to water pressure in fire-suppression piping.

- b. System pressure recorder, electric ac driven, with spring backup.
  - c. Programmable minimum-run-time relay to prevent short cycling.
  - d. Programmable timer for weekly tests.
2. Solid-State Controller: Reduced-voltage type.
3. Emergency Start: Mechanically operated start handle that closes and retains the motor RUN contactor independent of all electric or pressure actuators.
- D. Method of Stopping: Automatic and non-automatic shutdown after automatic starting.
- E. Capacity: Rated for fire-pump-driver horsepower and short-circuit-current (withstand) 100,000 RMS rating equal to or greater than short-circuit current available at controller location.
- F. Method of Isolation and Overcurrent Protection: Interlocked isolating switch and nonthermal MCCB; with a common, externally mounted operating handle, and providing locked-rotor protection.
- G. Door-Mounted Operator Interface and Controls:
- 1. Monitor, display, and control the devices, alarms, functions, and operations listed in NFPA 20 as required for drivers and controller types used.
  - 2. Method of Control and Indication:
    - a. Microprocessor-based logic controller, with multiline digital readout.
    - b. Membrane keypad.
    - c. LED alarm and status indicating lights.
  - 3. Local and Remote Alarm and Status Indications:
    - a. Controller power on.
    - b. Motor running condition.
    - c. Loss-of-line power.
    - d. Line-power phase reversal.
    - e. Line-power single-phase condition.
  - 4. Audible alarm, with silence push button.
  - 5. Non-automatic START and STOP push buttons or switches.

**H. Optional Features:**

- 1. Extra Output Contacts:**
  - a. One N.O. contact(s) for motor running condition.
  - b. One set(s) of contacts for loss-of-line power.
- 2. Local alarm bell.**
- 3. Door-mounted thermal or impact printer for alarm and status logs.**
- 4. Operator Interface Communications Ports: USB, Ethernet, and RS485.**

**I. ATS:**

- 1. Complies with NFPA 20, UL 218, and UL 1008.**
- 2. Integral with controller as a listed combination fire-pump controller and power transfer switch.**
- 3. Automatically transfers fire-pump controller from normal power supply to alternate power supply in event of power failure.**
- 4. Allows manual transfer from one source to the other.**
- 5. Alternate-Source Isolating and Disconnecting Means: Integral molded-case switch, with an externally mounted operating handle.**
- 6. Alternate-Source Isolating and Disconnecting Means: Mechanically interlocked isolation switch and circuit breaker rated at a minimum of 115 percent of rated motor full-load current, with an externally mounted operating handle; circuit breaker shall be provided with nonthermal sensing, instantaneous-only short-circuit overcurrent protection to comply with available fault currents.**
- 7. Local and Remote Alarm and Status Indications:**
  - a. Normal source available.
  - b. Alternate source available.
  - c. In normal position.
  - d. In alternate position.
  - e. Isolating means open.
- 8. Audible alarm, with silence push button.**

9. Non-automatic (manual, nonelectric) means of transfer.
10. Engine test push button.
11. Start generator output contacts.
12. Timer for weekly generator tests.

## **2.2 CONTROLLERS FOR PRESSURE-MAINTENANCE PUMPS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  1. ASCO Power Technologies, LP; Firetrol Products.
  2. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
  3. Hubbell Incorporated; Hubbell Industrial Controls.
  4. Joslyn Clark Corporation.
  5. Master Control Systems, Inc.
  6. Metron, Inc.
- B. General Requirements for Pressure-Maintenance-Pump Controllers:
  1. Type: UL 508 factory assembled, -wired, and tested, across-the-line; for combined automatic and manual operation.
  2. Enclosure: UL 508 and NEMA 250, Type 2 for wall-mounting.
  3. Factory assembled, wired, and tested.
  4. Finish: Manufacturer's standard color paint.
- C. Rate controller for scheduled horsepower and include the following:
  1. Fusible disconnect switch.
  2. Pressure switch.
  3. Hand-off-auto selector switch.
  4. Pilot light.
  5. Running period timer.

## 2.3 REMOTE ALARM PANELS

- A. General Requirements for Remote Alarm Panels: Comply with NFPA 20 and UL 218; listed by an NRTL for fire-pump service.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. ASCO Power Technologies, LP; Firetrol Products.
  - 2. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
  - 3. Hubbell Incorporated; Hubbell Industrial Controls.
  - 4. Joslyn Clark Corporation.
  - 5. Master Control Systems, Inc.
  - 6. Metron, Inc.
- C. General Requirements for Remote Alarm Panels: Factory assembled, wired, and tested.
- D. Supervisory and Normal Control Voltage: 120-V ac single source.
- E. Audible and Visual Alarm and Status Indications:
  - 1. Driver running.
  - 2. Loss of phase.
  - 3. Phase reversal.
  - 4. Supervised power on.
  - 5. Common trouble on the controller.
  - 6. Controller connected to alternate power source.
- F. Audible and Visual Alarm and Status Indications: Manufacturer's standard indicating lights; push-to-test.
  - 1. Engine running.
  - 2. Controller main switch turned to the off or manual position.
  - 3. Supervised power on.

4. Common trouble on the controller.
  5. Common pump room trouble.
  6. Controller connected to alternate power source.
- G. Audible alarm, with silence push button.
- H. Pump REMOTE START push button.

## 2.4 LOW-SUCTION-SHUTDOWN PANELS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. ASCO Power Technologies, LP; Firetrol Products.
  2. Hubbell Incorporated; Hubbell Industrial Controls.
  3. Joslyn Clark Corporation.
  4. Master Control Systems, Inc.
  5. Metron, Inc.
- B. General Requirements for Low-Suction-Shutdown Panels:
1. Listed by an NRTL for fire-pump service.
  2. Factory assembled, wired, and tested.
  3. Prevents automatic start of fire pump, and shuts down automatically started fire pump, on low-suction pressure.
  4. Automatic reset.
- C. Operation: Integral pressure switch.
- D. Supervisory and Normal Control Voltage: 120-V ac dual source.
- E. Include audible and visual alarms and status indications, with silence push button, for the following conditions:
1. Control power available.
  2. Low-suction pressure.
  3. Normal-suction pressure.

## 2.5 ENCLOSURES

- A. Fire-Pump Controllers, ATS, Remote Alarm Panels, and Low-Suction-Shutdown Panels: NEMA 250, to comply with environmental conditions at installed locations and NFPA 20.
  - 1. Indoor, Dry and Clean Locations: Type 1 (IEC IP10).
  - 2. Indoor Locations Subject to Dripping Noncorrosive Liquids: Type 2 (IEC IP11).
  - 3. Outdoor Locations: Type 3R (IEC IP14).
  - 4. Other Wet or Damp, Indoor Locations: Type 4 (IEC IP56).
  - 5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: Type 12 (IEC IP12).
- B. Enclosure Color: Manufacturer's standard "fire-pump-controller red".
- C. Nameplates: Comply with NFPA 20; complete with capacity, characteristics, approvals, listings, and other pertinent data.
- D. Optional Features:
  - 1. Floor stands, 12 inches high, for floor-mounted controllers.
  - 2. Space heater, 120-V ac, with thermostat.
  - 3. Tropicalization.

## 2.6 SOURCE QUALITY CONTROL

- A. Testing: Test and inspect fire-pump controllers according to requirements in NFPA 20 and UL 218.
  - 1. Verification of Performance: Rate controllers according to operation of functions and features specified.
- B. Fire-pump controllers will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas and surfaces to receive equipment, with Installer present, for compliance with requirements and other conditions affecting performance.
- B. Examine equipment before installation. Reject equipment that is wet or damaged by moisture or mold.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 CONTROLLER INSTALLATION

- A. Install controllers within sight of their respective drivers.
- B. Connect controllers to their dedicated pressure-sensing lines.
- C. Wall-Mounting Controllers: Install controllers on walls with disconnect operating handles not higher than 79 inches above finished floor, and bottom of enclosure not less than 12 inches above finished floor unless otherwise indicated. Bolt units to wall or mount on lightweight structural-steel channels bolted to wall. For controllers not on walls, provide freestanding racks complying with Section 260529 "Hangers and Supports for Electrical Systems."
- D. Floor-Mounting Controllers: Install controllers on 4-inch nominal-thickness concrete bases, using floor stands high enough so that the bottom of enclosure cabinet is not less than 12 inches above finished floor. Comply with requirements for concrete bases specified in Section 030505 "Common Work Results for 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.
- E. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- F. Comply with NEMA ICS 15.

### **3.3 REMOTE ALARM AND LOW-SUCTION-SHUTDOWN PANEL INSTALLATION**

- A. Install panels on walls with tops not higher than 72 inches above finished floor unless otherwise indicated. Bolt units to wall or mount on lightweight structural-steel channels bolted to wall. For ATS not on walls, provide freestanding racks complying with Section 260529 "Hangers and Supports for Electrical Systems."

### **3.4 POWER WIRING INSTALLATION**

- A. Install power wiring between controllers and their services or sources, and between controllers and their drivers. Comply with requirements in NFPA 20, NFPA 70, and Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

### **3.5 CONTROL AND ALARM WIRING INSTALLATION**

- A. Install wiring between controllers and remote devices and facility's central monitoring system. Comply with requirements in NFPA 20 and NFPA 70.
- B. Install wiring between remote alarm and low-suction-shutdown panels and controllers. Comply with requirements in NFPA 20 and NFPA 70.
- C. Install wiring between controllers and the building's fire-alarm system. Comply with requirements specified in Section 283111 "Digital, Addressable Fire-Alarm System."
- D. Bundle, train, and support wiring in enclosures.
- E. Connect remote manual and automatic activation devices where applicable.

### **3.6 IDENTIFICATION**

- A. Comply with requirements in NFPA 20 for marking fire-pump controllers.
- B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification in NFPA 20 and as specified in Section 260553 "Identification for Electrical Systems."

### **3.7 FIELD QUALITY CONTROL**

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- C. 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.

**D. Acceptance Testing Preparation:**

1. Inspect and Test Each Component:
  - a. Inspect wiring, components, connections, and equipment installations. Test and adjust components and equipment.
  - b. Test insulation resistance for each element, component, connecting supply, feeder, and control circuits.
  - c. Test continuity of each circuit.
2. Verify and Test Each Electric-Driver Controller:
  - a. Verify that voltages at controller locations are within plus 10 or minus 1 percent of motor nameplate rated voltages, with motors off. If outside this range for any motor, notify Architect before starting the motor(s).
  - b. Test each motor for proper phase rotation.
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.

**E. Field Acceptance Tests:**

1. Do not begin field acceptance testing until suction piping has been flushed and hydrostatically tested and the certificate for flushing and testing has been submitted to Architect and authorities having jurisdiction.
2. Prior to starting, notify authorities having jurisdiction of the time and place of the acceptance testing.
3. Engage manufacturer's factory-authorized service representative to be present during the testing.
4. Perform field acceptance tests as outlined in NFPA 20.

**F. Controllers will be considered defective if they do not pass tests and inspections.**

**G. Prepare test and inspection reports.**

### **3.8 STARTUP SERVICE**

- A. Engage a factory-authorized service representative to perform startup service.
  - 1. Complete installation and startup check according to manufacturer's written instructions.

### **3.9 ADJUSTING**

- A. Adjust controllers and battery charger systems to function smoothly and as recommended by manufacturer.
- B. Set field-adjustable switches, auxiliary relays, time-delay relays, and timers.
- C. Program microprocessors for required operational sequences, status indications, alarms, event recording, and display features. Clear events memory after final acceptance testing and prior to Substantial Completion.
- D. Set field-adjustable pressure switches.

### **3.10 PROTECTION**

- A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions until enclosed controllers are ready to be energized and placed into service.
- B. Replace controllers whose interiors have been exposed to water or other liquids prior to Substantial Completion.

### **3.11 DEMONSTRATION**

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain controllers, remote alarm panels, low-suction-shutdown panels, and to use and reprogram microprocessor-based controls within this equipment.



## SECTION 220500 - COMMON WORK RESULTS FOR PLUMBING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Plumbing equipment coordination and installation.
  - 2. Common plumbing installation requirements.
- B. Coordinate arrangement, mounting, and support of plumbing equipment:
  - 1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
  - 2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
  - 3. To allow right of way for piping and conduit installed at required slope.
  - 4. So connecting piping will be clear of obstructions and of the working and access space of other equipment.
- C. Coordinate installation of required supporting devices and set sleeves in masonry walls, and other structural components as they are constructed.
- D. Coordinate sleeve selection and application with selection and application of firestopping.
- E. All associated work, planning and coordination, pre-testing, start-up, re-test, set-ups, reporting, and close-out activities required during the commissioning process and final acceptance. Coordinate with the requirements of Division 1, Specification section 019100 “Commissioning”.
- F. System Identification requirement will need to be coordinated for final approval from the Client’s facilities management team.

#### 1.3 COMMON REQUIREMENTS FOR PLUMBING INSTALLATION

- A. Comply with the International Plumbing Codes.

- B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
- C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. Right of Way: Give to piping systems installed at a required slope.

**PART 2 - PRODUCTS (NOT USED)**

**PART 3 - EXECUTION (NOT USED)**



## **SECTION 220513 - COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT**

### **PART 1 GENERAL**

#### **1.1 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.

#### **1.2 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**

#### **1.1 GENERAL MOTOR REQUIREMENTS**

- A. Comply with NEMA MG 1 unless otherwise indicated.
- B. Comply with IEEE 841 for severe-duty motors.

#### **1.2 MOTOR CHARACTERISTICS**

- A. Duty: Continuous duty at ambient temperature of 104 deg F 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.

#### **1.3 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.
  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: Regreaseable, 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. Starting codes in first subparagraph below are adequate for most variable-torque loads encountered in plumbing applications; 15 hp is a common breakpoint in rating among manufacturers when Code F and Code G apply. Retain both subparagraphs and options unless Project conditions or equipment characteristics dictate otherwise.
  - 2. Motors 15 HP and Larger: NEMA starting Code F or Code G.
  - 3. 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.

#### 1.4

#### 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. See "Multispeed and Variable-Speed Considerations" Article in the Evaluations for discussion of thermally protected motors. Thermal protection is not usually required for plumbing equipment and energy- or premium-efficient motors specified in this Section. Retain subparagraph below to require the added protection from overheating or if inverter-duty motors are required.
  - 5. 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.

## 2.2 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. See Evaluations for a comparison of single-phase motor types.
  2. Permanent-split capacitor.
  3. Split phase.
  4. Capacitor start, inductor run.
  5. 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 USED)



## SECTION 220517 - SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

### PART 1 - GENERAL

#### 1.1 SUMMARY

**A.** Section Includes:

1. Sleeves.
2. Sleeve-seal systems.
3. Grout.

#### 1.2 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.
- E.** Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

#### 2.2 SLEEVE-SEAL SYSTEMS

- A.** Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  1. 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.

## 2.3 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.

## 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 078400 "Firestopping."

### **3.2 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.

### **3.3 SLEEVE AND SLEEVE-SEAL SCHEDULE**

- A.** Use sleeves and sleeve seals for the following piping-penetration applications:

- 1.** Exterior Concrete Walls above Grade:
  - a. Piping Smaller Than NPS 6: Cast-iron wall sleeves Galvanized-steel wall sleeves Galvanized-steel-pipe sleeves.
  - b. Piping NPS 6 and Larger: Cast-iron wall sleeves Galvanized-steel wall sleeves Galvanized-steel-pipe sleeves.
- 2.** Exterior Concrete Walls below Grade:
  - a. Piping Smaller Than NPS 6: Cast-iron wall sleeves with sleeve-seal system Galvanized-steel wall sleeves with sleeve-seal system Galvanized-steel-pipe sleeves with sleeve-seal system
    - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
  - b. Piping NPS 6 and Larger: Cast-iron wall sleeves with sleeve-seal system Galvanized-steel wall sleeves with sleeve-seal system Galvanized-steel-pipe sleeves with sleeve-seal system.
    - 1) 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:
  - a. Piping Smaller Than NPS 6: Cast-iron wall sleeves with sleeve-seal system Galvanized-steel wall sleeves with sleeve-seal system Galvanized-steel-pipe sleeves with sleeve-seal system.

- 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
- b. Piping NPS 6 and Larger: Cast-iron wall sleeves with sleeve-seal system Galvanized-steel wall sleeves with sleeve-seal system Galvanized-steel-pipe sleeves with sleeve-seal system.
  - 1) 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:**

- a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves Sleeve-seal fittings Molded-PE or -PP sleeves.
- b. Piping NPS 6 and Larger: Galvanized-steel-pipe sleeves.

**5. Interior Partitions:**

- a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves Sleeve-seal fittings
- b. Piping NPS 6 and Larger: Galvanized-steel-pipe sleeves

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## SECTION 220518 - ESCUTCHEONS FOR PLUMBING PIPING

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Escutcheons.
2. Floor plates.

#### 1.2 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 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.

#### 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.

### 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 Piping:

- a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
- b. Chrome-Plated Piping: One-piece, cast-brass type with polished, chrome-plated finish.
- c. Insulated Piping: One-piece, stamped-steel type.
- d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
- e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.

- f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
  - g. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type.
  - h. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
  - i. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type.
  - j. Bare Piping in Equipment Rooms: One-piece, cast-brass type with rough-brass finish.
  - k. Bare Piping in Equipment Rooms: One-piece, stamped-steel type.
- 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. One-piece, floor-plate type.
  - 2. Split-casting, floor-plate type.

### **3.2 FIELD QUALITY CONTROL**

- A. Replace broken and damaged escutcheons and floor plates using new materials.



## **SECTION 220519 - METERS AND GAUGES FOR PLUMBING PIPING**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. Section Includes:**
  - 1. Liquid-in-glass thermometers.
  - 2. Thermowells.
  - 3. Dial-type pressure gauges.
  - 4. Gauge attachments.
  - 5. Test plugs.
  - 6. Test-plug kits.
- B. Related Sections:**
  - 1. Section 211313 "Wet-Pipe Sprinkler Systems" and Section 211316 "Dry-Pipe Sprinkler Systems" for fire protection pressure gauges.

#### **1.2 ACTION SUBMITTALS**

- A. Product Data:** For each type of product indicated.

#### **1.3 INFORMATIONAL SUBMITTALS**

- A. Product Certificates:** For each type of meter and gauge, from manufacturer.

#### **1.4 CLOSEOUT SUBMITTALS**

- A. 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, Compact-Style, Liquid-in-Glass Thermometers:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Trerice, H. O. Co.
2. Standard: ASME B40.200.
3. Case: Cast aluminum; 6-inch nominal size.
4. Case Form: Back 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 or plastic.
8. Stem: Aluminum or brass and of length to suit installation.
  - a. Design for Thermowell Installation: Bare stem.
9. Connector: 3/4 inch, 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: CNR or CUNI.
  4. Type: Stepped shank unless straight or tapered shank is indicated.
  5. External Threads: NPS 1/2, NPS 3/4, or NPS 1, ASME B1.20.1 pipe threads.
  6. Internal Threads: 1/2, 3/4, and 1 inch, with ASME B1.1 screw threads.
  7. Bore: Diameter required to match thermometer bulb or stem.
  8. Insertion Length: Length required to match thermometer bulb or stem.
  9. Lagging Extension: Include on thermowells for insulated piping and tubing.
  10. 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 GAUGES

- A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gauges:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. AMETEK, Inc.; U.S. Gauge.
    - b. Ashcroft Inc.
    - c. Ernst Flow Industries.
    - d. Flo Fab Inc.
    - e. Trerice, H. O. Co.

- f. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
2. Standard: ASME B40.100.
3. Case: Sealed 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: Plastic.
10. Ring: Metal.
11. Accuracy: Grade C, plus or minus 3 percent of middle half of scale range.

## 2.4 GAUGE ATTACHMENTS

- A. Snubbers: ASME B40.100, brass; with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and piston-type surge-dampening device. Include extension for use on insulated piping.
- B. Valves: Brass ball, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads.

## 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 gauges in piping tees with pressure gauge located on pipe at the most readable position.
- G. Install valve and snubber in piping for each pressure gauge for fluids.
- H. Install thermometers in the following locations:

1. Inlet and outlet of each water heater.
- I. Install pressure gauges in the following locations:
  1. Building water service entrance into building.

### **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. Compact-style, liquid-in-glass type.

### **3.5 THERMOMETER SCALE-RANGE SCHEDULE**

- A. Scale Range for Domestic Hot-Water Piping: 30 to 240 deg F.

### **3.6 PRESSURE-GAUGE SCHEDULE**

- A. Pressure gauges at discharge of each water service into building shall be the following:
  1. Sealed, direct-mounted, metal case.

### **3.7 PRESSURE-GAUGE SCALE-RANGE SCHEDULE**

- A. Scale Range for Water Service Piping: 0 to 160 psi.

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## SECTION 220523 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Bronze ball valves.
2. Bronze swing check valves.
3. Bronze gate valves.

B. Related Sections:

Section 220553 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

2. Section 221116 "Domestic Water Piping" for valves applicable only to this piping.
3. Section 221319 "Sanitary Waste Piping Specialties" for valves applicable only to this piping.
4. Section 221423 "Storm Drainage Piping Specialties" for valves applicable only to this piping.
5. Section 221513 "General-Service Compressed-Air Piping" for valves applicable only to this piping.

#### 1.2 DEFINITIONS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene copolymer rubber.
- C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile butadiene rubber.
- D. NRS: Nonrising stem.
- E. OS&Y: Outside screw and yoke.
- F. RS: Rising stem.
- G. SWP: Steam working pressure.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of valve indicated.

#### 1.4 QUALITY ASSURANCE

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:
  1. ASME B31.9 for building services piping valves.
- C. NSF Compliance: NSF 61 for valve materials for potable-water service.

#### 1.5 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. Handwheel: For valves other than quarter-turn types.
  2. Handlever: For quarter-turn valves NPS 6 and smaller.
- 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.
  3. Butterfly Valves: With extended neck.
- F. Valve-End Connections:
  1. Flanged: With flanges according to ASME B16.1 for iron valves.
  2. Grooved: With grooves according to AWWA C606.
  3. Solder Joint: With sockets according to ASME B16.18.
  4. Threaded: With threads according to ASME B1.20.1.
- G. Valve Bypass and Drain Connections: MSS SP-45.

### 2.2 BRONZE BALL VALVES

- A. Two-Piece, Regular-Port, Bronze Ball Valves with Bronze Trim:
- General-Duty Valves for Plumbing Piping  
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1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. American Valve, Inc.
  - b. Conbraco Industries, Inc.; Apollo Valves.
  - c. Crane Co.; Crane Valve Group; Jenkins Valves.
  - d. Crane Co.; Crane Valve Group; Stockham Division.
  - e. DynaQuip Controls.
  - f. Hammond Valve.
  - g. Lance Valves; a division of Advanced Thermal Systems, Inc.
  - h. Milwaukee Valve Company.
  - i. NIBCO INC.
2. Description:
  - a. Standard: MSS SP-110.
  - b. SWP Rating: 150 psig.
  - c. CWP Rating: 600 psig.
  - d. Body Design: Two piece.
  - e. Body Material: Bronze.
  - f. Ends: Threaded.
  - g. Seats: PTFE or TFE.
  - h. Stem: Bronze.
  - i. Ball: Chrome-plated brass.
  - j. Port: Regular.

### 2.3 BRONZE SWING CHECK VALVES

#### A. Class 125, Bronze Swing Check Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. American Valve, Inc.
  - b. Crane Co.; Crane Valve Group; Crane Valves.
  - c. Crane Co.; Crane Valve Group; Jenkins Valves.
  - d. Crane Co.; Crane Valve Group; Stockham Division.
  - e. Hammond Valve.
  - f. Milwaukee Valve Company.
  - g. NIBCO INC.
  - h. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
  - a. Standard: MSS SP-80, Type 3.
  - b. CWP Rating: 200 psig.

- c. Body Design: Horizontal flow.
- d. Body Material: ASTM B 62, bronze.
- e. Ends: Threaded.
- f. Disc: Bronze.

## 2.4 BRONZE GATE VALVES

### A. Class 125, NRS Bronze Gate Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- a. Crane Co.; Crane Valve Group; Crane Valves.
- b. Crane Co.; Crane Valve Group; Jenkins Valves.
- c. Crane Co.; Crane Valve Group; Stockham Division.
- d. Hammond Valve.
- e. Milwaukee Valve Company.
- f. NIBCO INC.
- g. Powell Valves.
- h. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

- a. Standard: MSS SP-80, Type 1.
- b. CWP Rating: 200 psig.
- c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
- d. Ends: Threaded or solder joint.
- e. Stem: Bronze.
- f. Disc: Solid wedge; bronze.
- g. Packing: Asbestos free.
- h. Handwheel: Malleable iron, bronze, or aluminum.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. Section Includes:

- 1. Escutcheons.
  - 2. Floor plates.
- 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 check valves for proper direction of flow and as follows:
  1. Swing Check Valves: In horizontal position with hinge pin level.

### **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, butterfly, or gate valves.
  2. Butterfly Valve Dead-End Service: Single-flange (lug) type.
- 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 LOW-PRESSURE, COMPRESSED-AIR VALVE SCHEDULE (150 PSIG OR LESS)**

- A. Pipe NPS 2 and Smaller:
  1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
  2. Ball Valves: Two piece, regular port, bronze with bronze trim.
  3. Bronze Swing Check Valves: Class 125, bronze disc.
  4. Bronze Gate Valves: Class 125, NRS.

### **3.6 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:** Two piece, regular port, bronze with bronze trim.
- 3. Bronze Swing Check Valves:** Class 125, bronze disc.
- 4. Bronze Gate Valves:** Class 125, NRS.



## SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

### PART 1 - GENERAL

#### 1.1 SUMMARY

**A.** Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Thermal-hanger shield inserts.
4. Fastener systems.
5. Pipe positioning systems.

**B.** Related Sections:

1. Section 055000 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.

#### 1.2 DEFINITIONS

**A.** MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

#### 1.3 PERFORMANCE REQUIREMENTS

**A.** Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional Architect, 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.

#### 1.4 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.

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2. Metal framing systems.
  3. Pipe stands.
  4. Equipment supports.
- C.** Paragraph below is defined in Section 013300 "Submittal Procedures" as a "Delegated-Design Submittal." Retain if Work of this Section is required to withstand specific design loads and design responsibilities have been delegated to Contractor or if structural data are required as another way to verify compliance with performance requirements. Architect qualifications are specified in Section 014000 "Quality Requirements."
- D.** 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 Architect responsible for their preparation.
1. Detail fabrication and assembly of trapeze hangers.
  2. Design Calculations: Calculate requirements for designing trapeze hangers.

## **1.5 INFORMATIONAL SUBMITTALS**

- A.** Welding certificates.

## **1.6 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:

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: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 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. Paint Coating: Epoxy.
9. Plastic Coating: Epoxy.

## **2.4 THERMAL-HANGER SHIELD INSERTS**

- A.** Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  1. 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.
- 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, zinc-coated 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 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.

## 2.7 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.
- 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 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 Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.
- 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.
- 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.
5. 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.
- 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 Section 099113 "Exterior Painting."
- 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 copper-plated pipe hangers and attachments for copper piping and tubing.
- G.** Use padded hangers for piping that is subject to scratching.
- H.** Use thermal-hanger shield inserts for insulated piping and tubing.
- I.** 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.
  - 2. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
  - 3. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.

4. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
  5. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
  6. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
  7. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
  8. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
  9. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
  10. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
  11. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
- J. 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.
- K. 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.
- L. 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-joist 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. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
  14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
  15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- M.** 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.
- N. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- O. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
- P. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.
- Q. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.



## SECTION 220533 - HEAT TRACING FOR PLUMBING PIPING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes plumbing piping heat tracing for freeze prevention with the following electric heating cables:
  - 1. Self-regulating, parallel resistance.
- B. Related Requirements:
  - 1. Section 238234 "Heating Terminals - Electric."

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include rated capacities, operating characteristics, and furnished specialties and accessories.
  - 2. Schedule heating capacity, length of cable, spacing, and electrical power requirement for each electric heating cable required.
- B. Shop Drawings: For electric heating cable.
  - 1. Include plans, elevations, sections, and attachment details.
  - 2. Include diagrams for power, signal, and control wiring.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Retain "Field quality-control reports" Paragraph below if Contractor is responsible for field quality-control testing and inspecting.
- B. Field quality-control reports.
- C. Sample Warranty: For special warranty.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For electric heating cables to include in operation and maintenance manuals.

#### 1.5 WARRANTY

- A. When warranties are required, verify with Owner's counsel that warranties stated in this article are not less than remedies available to Owner under prevailing local laws.

1. Warranty Period: Five years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 SELF-REGULATING, PARALLEL-RESISTANCE HEATING CABLES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Thermon Americas Inc. (Basis-of-Design)
  2. Raychem; a brand of Tyco Thermal Controls LLC.
  3. Nelson Heat Trace
- B. Heating Element: Pair of parallel No. 16 AWG, bus wires embedded in crosslinked conductive polymer core, which varies heat output in response to temperature along its length. Terminate with waterproof, factory-assembled, non-heating leads with connectors at one end, and seal the opposite end watertight. Cable shall be capable of crossing over itself once without overheating.
- C. Electrical Insulating Jacket: Flame-retardant polyolefin.
- D. Outer jacket in "Cable Cover" Paragraph below is optional feature and is required for waterproof applications; verify availability with manufacturer.
- E. Cable Cover: Tinned-copper braid and polyolefin outer jacket with ultraviolet inhibitor.
- F. Maximum Operating Temperature (Power On): 150 deg F.
- G. Verify temperature of circulated media in freeze-protected piping in "Maximum Exposure Temperature (Power Off)" Paragraph below.
- H. Maximum Exposure Temperature (Power Off): 185 deg F.
- I. 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.
- J. Capacities and Characteristics:
  1. Maximum Heat Output: 3 W/ft, 5Wft, 8Wft as required per manufacturers design guide.
  2. Piping Diameter: Size as indicated on drawings.
  3. Number of Parallel Cables: As required per manufacturers design guide.
  4. Electrical Characteristics for Single-Circuit Connection:
    - a. Volts: 120, 208-277.
    - b. Phase: 1.

- c. Hertz: 60.
- d. Verify available voltages and heat-output ratings with manufacturer. Use 208-277V when possible.

## 2.2 CONTROLS

A. Local Thermostat with Ground Fault Protection and Alarm Relay model GPT-130, or equal:

- 1. Remote bulb unit preset to activate heat trace at 40 deg F.
- 2. Two-pole contactor switches up to 30 AMP heater loads.
- 3. Integral 30ma GFEP.
- 4. Enclosure shall be corrosion-resistant polycarbonate and NEMA 4X rated.
- 5. The system shall sense ambient temperature in the general area of the traced pipe and turn heat tracing on when outside temperature is below 40 deg F and turn the heat tracing off when outside temperature is above 42 deg F.
- 6. Remote interface provided via alarm relay. The system shall alarm for no power, ground fault condition, GFEP function test failure, and damaged thermistor.

## 2.3 ACCESSORIES

- A. Cable Installation Accessories: Fiberglass tape, heat-conductive putty, cable ties, silicone end seals and splice kits, and installation clips all furnished by manufacturer, or as recommended in writing by manufacturer.
- B. Warning Labels: Refer to Section 220553 "Identification for Plumbing Piping and Equipment."
- C. Warning Tape: Continuously printed "Electrical Tracing"; vinyl, at least 3 mils thick, and with pressure-sensitive, permanent, waterproof, self-adhesive back.
  - 1. Width for Markers on Pipes with OD, Including Insulation, Less Than 6 Inches: 3/4 inch minimum.
  - 2. Width for Markers on Pipes with OD, Including Insulation, 6 Inches or Larger: 1-1/2 inches minimum.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine surfaces and substrates to receive electric heating cables for compliance with requirements for installation tolerances and other conditions affecting performance.
  - 1. Ensure surfaces and pipes in contact with electric heating cables are free of burrs and sharp protrusions.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 INSTALLATION**

- A. The Division 26 contractor shall be responsible for power wiring and terminations between the electrical power system, the controls, and the heat trace power connections kits. The Division 22 contractor shall be responsible for control wiring and conduit if required. The Division 22 contractor shall provide system layout drawing including cable, control location, sensors, and power connection points. Divisions will be required to coordinate with each other to meet specified installation requirements.
- B. Indicate location of controls on Drawings.
- C. Install electric heating cable across expansion, construction, and control joints according to manufacturer's written instructions; use cable-protection conduit and slack cable to allow movement without damage to cable.
- D. Install Controls per manufacturer's written instruction.
- E. Electric Heating-Cable Installation for Freeze Protection for Piping:
  - 1. Install electric heating cables after piping has been tested and before insulation is installed.
  - 2. Install electric heating cables according to IEEE 515.1.
  - 3. Install insulation over piping with electric cables according to Section 220719 "Plumbing Piping Insulation."
  - 4. Install warning tape on piping insulation where piping is equipped with electric heating cables.
- F. Set field-adjustable switches and circuit-breaker trip ranges.

### **3.3 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."

### **3.4 FIELD QUALITY CONTROL**

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

- C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
- D. Perform tests after cable installation but before application of coverings such as insulation, wall or ceiling construction, or concrete.
  - 1. Perform tests after cable installation but before application of coverings such as insulation, wall or ceiling construction, or concrete.
  - 2. Test cables for electrical continuity and insulation integrity before energizing.
  - 3. Test cables to verify rating and power input. Energize and measure voltage and current simultaneously.
- E. Repeat tests for continuity, insulation resistance, and input power after applying thermal insulation on pipe-mounted cables.
- F. Cables will be considered defective if they do not pass tests and inspections.
- G. Prepare test and inspection reports.

### **3.5 PROTECTION**

- A. Protect installed heating cables, including nonheating leads, from damage during construction.
- B. Remove and replace damaged heat-tracing cables.



## **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. Open-spring isolators.
5. Housed-spring isolators.
6. Restrained-spring isolators.
7. Housed-restrained-spring isolators.
8. Pipe-riser resilient supports.
9. Resilient pipe guides.
10. Elastomeric hangers.
11. 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.

#### **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. Qualification Data: For testing agency.
- C. Welding certificates.
- D. Air-Mounting System Performance Certification: Include natural frequency, load, and damping test data performed by an independent agency.

#### **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 ELASTOMERIC ISOLATION PADS**

- A. Elastomeric Isolation Pads:
  1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Ace Mountings Co., Inc.
    - b. Kinetics Noise Control, Inc.
    - c. Mason Industries, Inc.
  2. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.
  3. Size: Factory or field cut to match requirements of supported equipment.

4. Pad Material: Oil and water resistant with elastomeric properties.
5. Surface Pattern: Waffle pattern.
6. Infused nonwoven cotton or synthetic fibers.
7. Load-bearing metal plates adhered to pads.
8. Sandwich-Core Material: elastomeric.
  - a. Surface Pattern: Waffle pattern.
  - b. Infused nonwoven cotton or synthetic fibers.

## **2.2 ELASTOMERIC ISOLATION MOUNTS**

### **A. Double-Deflection, Elastomeric Isolation Mounts:**

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Ace Mountings Co., Inc.
  - b. Kinetics Noise Control, Inc.
  - c. Mason Industries, Inc.
2. 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.
3. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

## **2.3 RESTRAINED ELASTOMERIC ISOLATION MOUNTS**

### **A. Restrained Elastomeric Isolation Mounts:**

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Ace Mountings Co., Inc.
  - b. Kinetics Noise Control, Inc.

- c. Mason Industries, Inc.
- 2. 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.

## 2.4 OPEN-SPRING ISOLATORS

### A. Freestanding, Laterally Stable, Open-Spring Isolators:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Ace Mountings Co., Inc.
  - b. Kinetics Noise Control, Inc.
  - c. Mason Industries, Inc.
- 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. 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.
- 7. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

## 2.5 HOUSED-SPRING ISOLATORS

- ### A. Freestanding, Laterally Stable, Open-Spring Isolators in Two-Part Telescoping Housing:
- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Ace Mountings Co., Inc.

- b. Kinetics Noise Control, Inc.
- c. Mason Industries, Inc.
- 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. 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.

## **2.6 RESTRAINED-SPRING ISOLATORS**

- A. Freestanding, Laterally Stable, Open-Spring Isolators with Vertical-Limit Stop Restraint:
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Ace Mountings Co., Inc.
    - b. Kinetics Noise Control, Inc.
    - c. Mason Industries, Inc.
  - 2. Housing: Steel housing with vertical-limit stops to prevent spring extension due to weight being removed.
    - 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 elastomeric pad.
    - c. Internal leveling bolt that acts as blocking during installation.
  - 3. Restraint: Limit stop as required for equipment and authorities having jurisdiction.
  - 4. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
  - 5. Minimum Additional Travel: 50 percent of the required deflection at rated load.

6. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
7. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

## 2.7 HOUSED-RESTRAINED-SPRING ISOLATORS

- A. Freestanding, Laterally Stable, Open-Spring Isolators with Vertical-Limit Stop Restraint:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Ace Mountings Co., Inc.
    - b. Kinetics Noise Control, Inc.
    - c. Mason Industries, Inc.
  2. Two-Part Telescoping Housing: A steel top and bottom frame separated by an elastomeric material and enclosing the spring isolators. Housings are equipped with adjustable snubbers to limit vertical movement.
    - 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. Threaded top housing with adjustment bolt and cap screw to fasten and level equipment.
  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.

## 2.8 PIPE-RISER RESILIENT SUPPORT

- A. Description: All-directional, acoustical pipe anchor consisting of two steel tubes separated by a minimum 1/2-inch- thick neoprene.
1. Vertical-Limit Stops: Steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions.
  2. Maximum Load Per Support: 500 psig isolation material providing equal isolation in all directions.

## **2.9 RESILIENT PIPE GUIDES**

- A. Description: Telescopic arrangement of two steel tubes or post and sleeve arrangement separated by a minimum 1/2-inch- thick neoprene.
1. Factory-Set Height Guide with Shear Pin: Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

## **2.10 ELASTOMERIC HANGERS**

- A. Elastomeric Mount in a Steel Frame with Upper and Lower Steel Hanger Rods:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Ace Mountings Co., Inc.
    - b. Kinetics Noise Control, Inc.
    - c. Mason Industries, Inc.
  2. 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.
  3. Dampening Element: Molded, oil-resistant rubber, neoprene, or other elastomeric material with a projecting bushing for the underside opening preventing steel to steel contact.

## **2.11 SPRING HANGERS**

- A. Combination Coil-Spring and Elastomeric-Insert Hanger with Spring and Insert in Compression:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Ace Mountings Co., Inc.
    - b. Kinetics Noise Control, Inc.
    - c. Mason Industries, Inc.
  2. 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.

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.
7. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
8. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
9. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

### 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 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.
- B. Installation of vibration isolators must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.



## **SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Equipment labels.
  - 2. Pipe labels.
  - 3. Stencils.
  - 4. Valve tags.

#### **1.2 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.

#### **1.3 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.
- D. System Identification requirement will need to be coordinated for final approval from the Client's facilities management team.

### **PART 2 - PRODUCTS**

#### **2.1 EQUIPMENT LABELS**

- A. Plastic Labels for Equipment:
  - 1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.

2. Letter Color: White.
  3. Background Color: Black.
  4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
  5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
  6. 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-fourths the size of principal lettering.
  7. 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), plus the Specification Section number and title where equipment is specified.

## 2.2 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, 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 inches high.

## 2.3 STENCILS

- A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; and minimum letter height of 3/4 inch for access panel and door labels, equipment labels, and similar operational instructions.
  1. Stencil Material: Fiberboard or metal.
  2. Stencil Paint: Exterior, gloss, acrylic enamel black unless otherwise indicated. Paint may be in pressurized spray-can form.

3. Identification Paint: Exterior, acrylic enamel in colors according to ASME A13.1 unless otherwise indicated.

## 2.4 VALVE TAGS

- A. Valve Tags: All valves are to have a 2 inch diameter brass tag with 1 inch high number filled in with black enamel. The tag is to be secured to the valve with a brass hook and a brass window sash chain. Color coded PVC bands shall be applied to all pipe. The bands are to identify the pipe contents and the direction of flow, and colors conforming to ASAA 13.1.
- 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.

## 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 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

### 3.3 PIPE LABEL INSTALLATION

- A. Piping Color-Coding: Painting of piping is specified in Section 099123 "Interior Painting."
- B. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels 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. 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. Pipe Label Color Schedule:**

1. Low-Pressure, Compressed-Air Piping:
  - a. Background Color: White.
  - b. Letter Color: Black.
2. Domestic Water Piping:
  - a. Background Color: Blue.
  - b. Letter Color: White.
3. Sanitary Waste and Storm Drainage Piping:
  - a. Background Color: Black.
  - b. Letter Color: White.

**3.4 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: 2 inches, round.
    - b. Hot Water: 2 inches, round.

**2.** Valve-Tag Color:

- a. Color to conform as per ASAA 13.1 requirement.

**3.** Letter Color:

- a. Cold Water: Black Enamel.
- b. Hot Water: Black Enamel.



## SECTION 220719 - PLUMBING PIPING INSULATION

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes insulating the following plumbing piping services:
1. Domestic cold-water piping.
  2. Domestic hot-water piping.
  3. Roof drains and rainwater leaders.
  4. Supplies and drains for handicap-accessible lavatories and sinks.

#### 1.2 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. LEED Submittals:
1. Product Data for Credit IEQ 4.1: For adhesives and sealants, documentation including printed statement of VOC content and chemical components.
- 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 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.

#### 1.3 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.

#### **1.4 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.

#### **1.5 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 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.

## 1.7 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 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. 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. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Pittsburgh Corning Corporation; Foamglas.
  - 2. Block Insulation: ASTM C 552, Type I.
  - 3. Special-Shaped Insulation: ASTM C 552, Type III.
  - 4. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.
  - 5. Preformed Pipe Insulation with Factory-Applied ASJ-SSL: Comply with ASTM C 552, Type II, Class 2.
  - 6. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.

**G. Mineral-Fiber, Preformed Pipe Insulation:**

- 1.** Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Fibrex Insulations Inc.; Coreplus 1200.
  - b. Johns Manville; Micro-Lok.
  - c. Knauf Insulation; 1000-Degree Pipe Insulation.
  - d. Manson Insulation Inc.; Alley-K.
  - e. 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-SSL. 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: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Ramco Insulation, 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.** 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.
- 1.** Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 81-84.
  - 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. Flexible Elastomeric Adhesive:** Comply with MIL-A-24179A, Type II, Class I.

- 1.** Products: Subject to compliance with requirements, provide one of the following:
  - a. Aeroflex USA, Inc.; Aeroseal.
  - b. Armacell LLC; Armaflex 520 Adhesive.
  - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-75.
  - d. K-Flex USA; R-373 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."

**D. Mineral-Fiber Adhesive:** Comply with MIL-A-3316C, Class 2, Grade A.

- 1.** Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.
  - b. Eagle Bridges - Marathon Industries; 225.
  - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.
  - d. 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."

**2.4 SEALANTS**

**A. Joint Sealants:**

- 1.** Joint Sealants for Cellular-Glass Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

- a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
- b. Eagle Bridges - Marathon Industries; 405.
- c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-45.
- d. Mon-Eco Industries, Inc.; 44-05.
- e. Pittsburgh Corning Corporation; Pittseal 444.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Permanently flexible, elastomeric sealant.
4. Service Temperature Range: Minus 100 to plus 300 deg F.
5. Color: White or gray.
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."

**B. ASJ Flashing Sealants:**

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 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."

## 2.5 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-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.

## 2.6 TAPES

- A.** ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
- 1.** Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. ABI, Ideal Tape Division; 428 AWF ASJ.
    - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
    - c. Compac Corporation; 104 and 105.
    - 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.

## 2.7 FIELD-APPLIED JACKETS

- A.** Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B.** Metal Jacket:
- 1.** Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Metal Jacketing Systems.
    - b. ITW Insulation Systems; Aluminum and Stainless Steel Jacketing.

- 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 Outdoor Applications: 2.5-mil-thick polysurlyn.
  - 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.
    - 6) Beveled collars.
    - 7) Valve covers.
    - 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.
- 3. Stainless-Steel Jacket: ASTM A 167 or ASTM A 240/A 240M.
  - a. Sheet and roll stock ready for shop or field sizing.
  - b. Material, finish, and thickness are indicated in field-applied jacket schedules.
  - c. Moisture Barrier for Outdoor Applications: 2.5-mil-thick polysurlyn.
  - 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.

- 6) Beveled collars.
- 7) Valve covers.
- 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

## 2.8 PROTECTIVE SHIELDING GUARDS

### A. Protective Shielding Pipe Covers:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Engineered Brass Company.
  - b. Insul-Tect Products Co.; a subsidiary of MVG Molded Products.
  - c. McGuire Manufacturing.
  - d. Plumberex.
  - e. Truebro; a brand of IPS Corporation.
  - f. Zurn Industries, LLC; Tubular Brass Plumbing Products Operation.
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.

### B. Protective Shielding Piping Enclosures:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Truebro; a brand of IPS Corporation.
  - b. Zurn Industries, LLC; Tubular Brass Plumbing Products Operation.
2. 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 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. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils thick and an epoxy finish 5 mils thick if operating in a temperature range between 140 and 300 deg F. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
  - 2. 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.
- 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.
- 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.
  - 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.
- 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 078400 "Firestopping."

### **3.5 GENERAL PIPE INSULATION INSTALLATION**

- A. 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.
- B. 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.
- C. 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.
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 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.

**3.8 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.

### **3.9 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. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

### **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, and three locations of threaded 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 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.

### **3.12 INDOOR PIPING INSULATION SCHEDULE**

**A. Domestic Cold Water:**

- 1.** NPS 1 and Smaller: Insulation shall be one of the following:
  - a. Cellular Glass: 1-inch thick.
  - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
- 2.** NPS 1-1/4 and Larger: Insulation shall be one of the following:
  - a. Cellular Glass: 1-inch thick.
  - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

**B. Domestic Hot Water:**

- 1.** NPS 1-1/4 and Smaller: Insulation shall be one of the following:
  - a. Cellular Glass: 1-inch thick.
  - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1-inch thick.
- 2.** NPS 1-1/2 and Larger: Insulation shall be one of the following:
  - a. Cellular Glass: 1-1/2 inches thick.
  - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inches thick.

**C. Stormwater and Overflow:**

- 1.** All Pipe Sizes: Insulation shall be one of the following:
  - a. Cellular Glass: 1-inch thick.
  - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

**D. Roof Drain and Overflow Drain Bodies:**

- 1.** All Pipe Sizes: Insulation shall be one of the following:
  - a. Cellular Glass: 1-inch thick.
  - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

**E. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities:**

- 1.** All Pipe Sizes: Insulation shall be one of the following:

- a. Protective Shielding Pipe Covers.
  - b. Protective Shielding Piping Enclosures
- F.** 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 one of the following:
- a. Cellular Glass: 1-1/2 inches thick.
  - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.



## SECTION 221116 - DOMESTIC WATER PIPING

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Under-building-slab and aboveground domestic water pipes, tubes, and fittings inside buildings.

#### 1.2 ACTION SUBMITTALS

A. Product Data: For transition fittings and dielectric fittings.

B. LEED Submittals:

1. Product Data for Credit IEQ 4.1: For solvent cements and adhesive primers, documentation including printed statement of VOC content.

#### 1.3 INFORMATIONAL SUBMITTALS

A. System purging and disinfecting activities report.

B. Field quality-control reports.

### 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. Plastic piping components shall be marked with "NSF-pw."

#### 2.2 COPPER TUBE AND FITTINGS (FOR WATER MAINS AND RISERS)

A. Hard Copper Tube: ASTM B 88, Type L 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. 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.
- E. Copper-Tube, Extruded-Tee Connections:
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. T-Drill Industries Inc.
  2. Description: Tee formed in copper tube according to ASTM F 2014.

## **2.3 DUCTILE-IRON PIPE AND FITTINGS (INCOMING WATER SUPPLY)**

- A. Mechanical-Joint, Ductile-Iron Pipe:
1. AWWA C151/A21.51, with mechanical-joint bell and plain spigot or flanged ends.
  2. A21.11, ductile-or gray-iron glands, rubber gaskets and steel bolts.

## **2.4 CPVC PIPING (INDIVIDUAL BRANCH PIPING WITHIN APARTMENTS ONLY)**

- A. CPVC Pipe: ASTM F 441/F 441M, Schedule 40.
1. CPCV Socket Fittings: ASTM F 438 for Schedule 40.
- B. CPVC Piping System: ASTM D 2846/D 2846M, SDR 11, pipe and socket fittings.

## **2.5 PIPING JOINING MATERIALS**

- A. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- B. Solder Filler Metals: ASTM B 32, lead-free alloys.
- C. Flux: ASTM B 813, water flushable.
- D. Solvent Cements for Joining CPVC Piping and Tubing: ASTM F 493:
1. CPVC solvent cement shall have a VOC content of 490 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  2. 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).

## **2.6 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: Subject to compliance with requirements, provide products by one of the following:
    - a. Cascade Waterworks Manufacturing.
    - b. Dresser, Inc.; Piping Specialties Products.
    - c. Ford Meter Box Company, Inc. (The).
    - d. JCM Industries.
    - e. Viking Johnson.
- D.** Plastic-to-Metal Transition Fittings:
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. Charlotte Pipe and Foundry Company.
    - b. Spears Manufacturing Company.
  2. Description:
    - a. One end with threaded brass insert and one solvent-cement-socket or threaded end.
- E.** Plastic-to-Metal Transition Unions:
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - b. Colonial Engineering, Inc.
    - c. NIBCO Inc.
    - d. Spears Manufacturing Company.
  2. Description:

- e. CPVC four-part union.
- f. Solvent-cement-joint or threaded plastic end.

## 2.7 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 the following:
    - a. Capitol Manufacturing Company; member of the Phoenix Forge Group.
    - b. Watts; a division of Watts Water Technologies, Inc.
    - c. Wilkins; a Zurn company.
  - 2. Standard: ASSE 1079.
  - 3. Pressure Rating: 125 psig minimum at 180 deg F.
  - 4. End Connections: Solder-joint copper alloy and threaded ferrous.
- C. Dielectric Nipples:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Elster Perfection Corporation.
    - b. Grinnell Mechanical Products; Tyco Fire Products LP.
    - c. Matco-Norca.
    - d. Precision Plumbing Products, Inc.
    - e. 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.

## 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.
- 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 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."
- E. Install shutoff valve immediately upstream of each dielectric fitting.
- F. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements for pressure-reducing valves in Section 221119 "Domestic Water Piping Specialties."
- G. Install domestic water piping level with 0.25 percent slope downward toward drain and plumb.
- H. Rough-in domestic water piping for water-meter installation according to utility company's requirements.
- I. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- J. 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.

- K. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- L. Install piping to permit valve servicing.
- M. 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.
- N. Install piping free of sags and bends.
- O. Install fittings for changes in direction and branch connections.
- P. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- Q. Install pressure gages on suction and discharge piping for each plumbing pump and packaged booster pump. Comply with requirements for pressure gages in Division 22 Section "Meters and Gages for Plumbing Piping."
- R. Install thermometers on inlet and outlet piping from each water heater. Comply with requirements for thermometers in Section 220519 "Meters and Gages for Plumbing Piping."
- S. Install water tight 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."
- T. 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."
- U. 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."
- V. 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. Soldered Joints for Copper Tubing: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."
- E. 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.
- F. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.
- G. Joint Construction for Solvent-Cemented Plastic Piping: 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. Apply primer.
  2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
- G. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

### **3.4 TRANSITION FITTING INSTALLATION**

- A. Install transition couplings at joints of dissimilar piping.
- B. Transition Fittings in Aboveground Domestic Water Piping:
  1. Fittings for NPS 2 and Smaller: Plastic-to-metal transition unions.
  2. Fittings for NPS 3 and Larger: Sleeve-type coupling.

### **3.5 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 couplings.
- 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.

### 3.6 HANGER AND SUPPORT INSTALLATION

- A. 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.
- B. Support vertical piping and tubing at base and at each floor.
- C. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.
- D. 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.
- E. Install supports for vertical copper tubing every 10 feet.
- F. Install vinyl-coated hangers for CPVC piping with the following maximum horizontal spacing and minimum rod diameters:
  - 1. NPS 1 and Smaller: 36 inches with 3/8-inch rod.
- G. Install supports for vertical CPVC piping every 60 inches for NPS 1 and smaller, and every 72 inches for NPS 1-1/4 and larger.

- F. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

### 3.7 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.
  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.

### 3.8 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.

### 3.9 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 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.

**3.10 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.

### **3.11 CLEANING**

- A. Clean and disinfect 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 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.

- 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 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.

### **3.12 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. Aboveground domestic water piping:

1. Refer to Part 2 Product data for piping materials and fittings.

### **3.13 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.



## SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES

### PART 1 - GENERAL

#### 1.1 SUMMARY

**A.** Section Includes:

1. Vacuum breakers.
2. Backflow preventers.
3. Water pressure-reducing valves.
4. Balancing valves.
5. Temperature-actuated, water mixing valves.
6. Hose bibbs.
7. Wall hydrants.
8. Drain valves.
9. Water-hammer arresters.
10. Air vents.
11. Trap-seal primer valves.
12. Trap-seal primer systems.
13. 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 223100 "Domestic Water Softeners" for water filters in domestic water piping.
3. Section 224716 "Pressure Water Coolers" for water filters for water coolers.

#### 1.2 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.

### **1.3 INFORMATIONAL SUBMITTALS**

- A.** Field quality-control reports.

### **1.4 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.

### **2.2 PERFORMANCE REQUIREMENTS**

- A.** Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig unless otherwise indicated.

### **2.3 VACUUM BREAKERS**

- A.** Pipe-Applied, Atmospheric-Type Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - a. Ames Fire & Waterworks; a division of Watts Water Technologies, Inc.
  - b. Cash Acme; a division of Reliance Worldwide Corporation.
  - c. Conbraco Industries, Inc.
  - d. FEBCO; a division of Watts Water Technologies, Inc.
  - e. Rain Bird Corporation.
  - f. Toro Company (The); Irrigation Div.
  - g. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
  - h. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
2. Standard: ASSE 1001.
3. Size: NPS 1/4 to NPS 3, as required to match connected piping.
4. Body: Bronze.

5. Inlet and Outlet Connections: Threaded.

6. Finish: Rough bronze.

**B. Hose-Connection Vacuum Breakers:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Arrowhead Brass Products.

b. Cash Acme; a division of Reliance Worldwide Corporation.

c. Conbraco Industries, Inc.

d. Legend Valve.

e. MIFAB, Inc.

f. Prier Products, Inc.

g. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.

h. Woodford Manufacturing Company; a division of WCM Industries, Inc.

i. Zurn Industries, LLC; Plumbing Products Group; Light Commercial Products.

j. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.

2. Standard: ASSE 1011.

3. Body: Bronze, nonremovable, with manual drain.

4. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.

5. Finish: Rough bronze.

**2.4 BACKFLOW PREVENTERS**

**A. Reduced-Pressure-Principle Backflow Preventers:**

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Ames Fire & Waterworks; a division of Watts Water Technologies, Inc.

General-Duty Valves for Plumbing Piping

- b. Conbraco Industries, Inc.
- c. FEBCO; a division of Watts Water Technologies, Inc.
- d. Flomatic Corporation.
- e. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
- f. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.

2. Standard: ASSE 1013.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 12 psig maximum, through middle third of flow range.
5. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
6. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
7. Configuration: Designed for horizontal, straight-through flow.
8. Accessories:

- a. Valves NPS 2 and Smaller: Ball type with threaded ends on inlet and outlet.
- b. Valves NPS 2-1/2 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.

**B. Dual-Check-Valve Backflow Preventers:**

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - a. Cash Acme; a division of Reliance Worldwide Corporation.
  - b. Conbraco Industries, Inc.
  - c. FEBCO; a division of Watts Water Technologies, Inc.
  - d. Flomatic Corporation.

- e. Ford Meter Box Company, Inc. (The).
  - f. Honeywell International Inc.
  - g. Legend Valve.
  - h. McDonald, A. Y. Mfg. Co.
  - i. Mueller Co. Ltd.; a subsidiary of Mueller Water Products Inc.
  - j. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
  - k. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
- 2.** Standard: ASSE 1024.
- 3.** Operation: Continuous-pressure applications.
- 4.** Size: NPS 1/2.
- 5.** Body: Bronze with union inlet.
- C.** Double-Check, Detector-Assembly Backflow Preventers:
- 1.** Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. Ames Fire & Waterworks; a division of Watts Water Technologies, Inc.
    - b. Conbraco Industries, Inc.
    - c. FEBCO; a division of Watts Water Technologies, Inc.
    - d. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
    - e. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
- 2.** Standard: ASSE 1048 and is FM Global approved or UL listed.
- 3.** Operation: Continuous-pressure applications.
- 4.** Pressure Loss: 5 psig maximum, through middle third of flow range.
- 5.** Body: Cast iron with interior lining that complies with AWWA C550 or that is FDA approved.

6. End Connections: Flanged.
  7. Configuration: Designed for horizontal, straight-through flow.
  8. Accessories:
    - a. Valves: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.
    - b. Bypass: With displacement-type water meter, shutoff valves, and reduced-pressure backflow preventer.
- D. Backflow-Preventer Test Kits:**
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. Conbraco Industries, Inc.
    - b. FEBCO; a division of Watts Water Technologies, Inc.
    - c. Flomatic Corporation.
    - d. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
    - e. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
  2. Description: Factory calibrated, with gages, fittings, hoses, and carrying case with test-procedure instructions.

## **2.5 WATER PRESSURE-REDUCING VALVES**

**A. Water-Control Valves PRV-1:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. CLA-VAL.
  - a. Flomatic Corporation.
  - b. OCV Control Valves.

- c. Watts; a division of Watts Water Technologies, Inc.; Control Valves (Watts ACV).
  - d. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
2. Description: Pilot-operated, diaphragm-type, single-seated, main water-control valve.
3. Pressure Rating: Initial working pressure of 150 psig minimum with AWWA C550 or FDA-approved, interior epoxy coating. Include small pilot-control valve, restrictor device, specialty fittings, and sensor piping.
4. Main Valve Body: Cast- or ductile-iron body with AWWA C550 or FDA-approved, interior epoxy coating; or stainless-steel body.
- a. Size: NPS 4.
  - b. Pattern: Globe-valve design.
  - c. Trim: Stainless steel.
5. Design Flow: 40 gpm
6. Design Inlet Pressure: 140 psig.
7. Design Outlet Pressure Setting: 75 psig.
8. End Connections: flanged.

## **2.6 TEMPERATURE-ACTUATED, WATER MIXING VALVES**

### **A. Primary, Thermostatic, Water Mixing Valves TMV-1:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- a. Armstrong International, Inc.
  - b. Lawler Manufacturing Company, Inc.
  - c. Leonard Valve Company.
  - d. Powers; a division of Watts Water Technologies, Inc.

- e. Symmons Industries, Inc.
  
  2. Standard: ASSE 1017.
  3. Pressure Rating: 125 psig minimum unless otherwise indicated.
  4. Type: Cabinet-type, thermostatically controlled, water mixing valve.
  5. Material: Bronze body with corrosion-resistant interior components.
  6. Connections: Threaded union inlets and outlet.
  7. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
  8. Tempered-Water Setting: 110 degrees F.
  9. Tempered-Water Design Flow Rate: 5 gpm.
  10. Selected Valve Flow Rate at 45-psig Pressure Drop: 15 gpm.
  11. Pressure Drop at Design Flow Rate: 10 psig.
  12. Valve Finish: Rough bronze.
  13. Piping Finish: Copper.
  14. Cabinet: Factory fabricated, stainless steel, for surface mounting and with hinged, stainless-steel door.
- B. Individual-Fixture, Water Tempering Valves:**
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. Cash Acme; a division of Reliance Worldwide Corporation.
    - b. Conbraco Industries, Inc.
    - c. Honeywell International Inc.
    - d. Lawler Manufacturing Company, Inc.
    - e. Leonard Valve Company.
    - f. Powers; a division of Watts Water Technologies, Inc.
    - g. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.

- h. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
- 2. Standard: ASSE 1016, thermostatically controlled, water tempering valve.
- 3. Pressure Rating: 125 psig minimum unless otherwise indicated.
- 4. Body: Bronze body with corrosion-resistant interior components.
- 5. Temperature Control: Adjustable.
- 6. Inlets and Outlet: Threaded.
- 7. Finish: Rough or chrome-plated bronze.
- 8. Tempered-Water Setting: 110 deg F.
- 9. Retain "Tempered-Water Design Flow Rate" Subparagraph below only if required.
- 10. Tempered-Water Design Flow Rate: 0.5 GPM.

## 2.7 OUTLET BOXES

### A. Icemaker Outlet Boxes:

- 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - a. Acorn Engineering Company.
  - b. IPS Corporation.
  - c. LSP Products Group, Inc.
  - d. Oatey.
  - e. Plastic Oddities.
- 2. Mounting: Recessed.
- 3. Material and Finish: Enameled-steel, epoxy-painted-steel, or plastic box and faceplate.
- 4. Faucet: Valved fitting complying with ASME A112.18.1. Include NPS 1/2 or smaller copper tube outlet.

5. Supply Shutoff Fitting: NPS 1/2 gate, globe, or ball valve and NPS 1/2 copper, water tubing.

## 2.8 HOSE BIBBS

### A. Hose Bibbs:

1. Standard: ASME A112.18.1 for sediment faucets.
2. Body Material: Bronze.
3. Seat: Bronze, replaceable.
4. Supply Connections: NPS 3/4 threaded or solder-joint inlet.
5. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
6. Pressure Rating: 125 psig.
7. Vacuum Breaker: Integral or field-installation, nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
8. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.
9. Finish for Service Areas: Rough bronze.
10. Finish for Finished Rooms: Chrome or nickel plated.
11. Operation for Equipment Rooms: Wheel handle or operating key.
12. Operation for Service Areas: Wheel handle.
13. Operation for Finished Rooms: Wheel handle.
14. Include integral wall flange with each chrome- or nickel-plated hose babb.

## 2.9 WALL HYDRANTS

### A. Nonfreeze Wall Hydrants:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - a. Josam Company.
  - b. MIFAB, Inc.
  - c. Prier Products, Inc.
  - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.

- e. Tyler Pipe; Wade Div.
  - f. Watts Drainage Products.
  - g. Woodford Manufacturing Company; a division of WCM Industries, Inc.
  - h. Zurn Industries, LLC; Plumbing Products Group; Light Commercial Products.
  - i. Zurn Industries, LLC; Plumbing Products Group; Specification Drainage Products.
2. Standard: ASME A112.21.3M for concealed-outlet, self-draining wall hydrants.
  3. Pressure Rating: 125 psig.
  4. Operation: Loose key.
  5. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
  6. Inlet: NPS 3/4.
  7. Outlet: Concealed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
  8. Box: Deep, flush mounted with cover.
  9. Box and Cover Finish: Polished nickel bronze.
  10. Outlet: Exposed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
  11. Nozzle and Wall-Plate Finish: Polished nickel bronze.
  12. Operating Keys(s): Two with each wall hydrant.

## 2.10 DRAIN VALVES

### A. Ball-Valve-Type, Hose-End Drain Valves:

1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
2. Pressure Rating: 400-psig minimum CWP.
3. Size: NPS 3/4.
4. Body: Copper alloy.
5. Ball: Chrome-plated brass.
6. Seats and Seals: Replaceable.

7. Handle: Vinyl-covered steel.
8. Inlet: Threaded or solder joint.
9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

**B.** Gate-Valve-Type, Hose-End Drain Valves:

1. Standard: MSS SP-80 for gate valves.
2. Pressure Rating: Class 125.
3. Size: NPS 3/4.
4. Body: ASTM B 62 bronze.
5. Inlet: NPS 3/4 threaded or solder joint.
6. Outlet: Garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

**C.** Stop-and-Waste Drain Valves:

1. Standard: MSS SP-110 for ball valves or MSS SP-80 for gate valves.
2. Pressure Rating: 200-psig minimum CWP or Class 125.
3. Size: NPS 3/4.
4. Body: Copper alloy or ASTM B 62 bronze.
5. Drain: NPS 1/8 side outlet with cap.

## **2.11 WATER-HAMMER ARRESTERS**

**A.** Water-Hammer Arresters :

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - a. AMTROL, Inc.
  - b. Josam Company.
  - c. MIFAB, Inc.
  - d. Precision Plumbing Products, Inc.
  - e. Sioux Chief Manufacturing Company, Inc.
  - f. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.  
General-Duty Valves for Plumbing Piping

- g. Tyler Pipe; Wade Div.
  - h. Watts Drainage Products.
  - i. Zurn Industries, LLC; Plumbing Products Group; Specification Drainage Products.
2. Standard: ASSE 1010 or PDI-WH 201.
  3. Type: Copper tube with piston.
  4. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.

## 2.12 AIR VENTS

- A. Bolted-Construction Automatic Air Vents:
  1. Body: Bronze.
  2. Pressure Rating and Temperature: 125-psig minimum pressure rating at 140 deg F.
  3. Float: Replaceable, corrosion-resistant metal.
  4. Mechanism and Seat: Stainless steel.
  5. Size: NPS 3/8 minimum inlet.
  6. Inlet and Vent Outlet End Connections: Threaded.
- B. Welded-Construction Automatic Air Vents:
  1. Body: Stainless steel.
  2. Pressure Rating: 150-psig minimum pressure rating.
  3. Float: Replaceable, corrosion-resistant metal.
  4. Mechanism and Seat: Stainless steel.
  5. Size: NPS 3/8 minimum inlet.
  6. Inlet and Vent Outlet End Connections: Threaded.

## 2.13 TRAP-SEAL PRIMER DEVICE

- A. Supply-Type, Trap-Seal Primer Device:
  1. Retain "Manufacturers" Subparagraph and list of manufacturers below to require products from manufacturers listed or a comparable product from other manufacturers.

2. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - a. MIFAB, Inc.
  - b. Precision Plumbing Products, Inc.
  - c. Sioux Chief Manufacturing Company, Inc.
  - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
  - e. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
3. Standard: ASSE 1018.
4. Pressure Rating: 125 psig minimum.
5. Body: Bronze.
6. Inlet and Outlet Connections: NPS 1/2 threaded, union, or solder joint.
7. Gravity Drain Outlet Connection: NPS 1/2 threaded or solder joint.
8. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

## 2.14 TRAP-SEAL PRIMER SYSTEMS

- A. Trap-Seal Primer Systems:
1. Retain "Manufacturers" Subparagraph and list of manufacturers below to require products from manufacturers listed or a comparable product from other manufacturers.
  2. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. Precision **Plumbing Products, Inc.**
  3. Standard: ASSE 1044.
  4. Piping: NPS 3/4, ASTM B 88, Type L; copper, water tubing.
  5. Cabinet: Recessed-mounted steel box with stainless-steel cover.
  6. Electric Controls: 24-hour timer, solenoid valve, and manual switch for 120-V ac power.
    - 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.

7. Vacuum Breaker: ASSE 1001.
8. Number Outlets: As required.
9. Size Outlets: NPS 1/2.

## 2.15 FLEXIBLE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Retain "Basis-of-Design Product" Paragraph and list of manufacturers below to identify a specific product or a comparable product from manufacturers listed. Retain option and delete insert note if manufacturer's name and model number are indicated on Drawings.
2. Flex-Hose Co., Inc.
3. Flexicraft Industries.
4. Flex Pression, Ltd.
5. Flex-Weld Incorporated.
6. Hyspan Precision Products, Inc.
7. Mercer Gasket & Shim, Inc.
8. Metraflex, Inc.
9. Proco Products, Inc.
10. TOZEN Corporation.
11. Unaflex.Universal Metal Hose; a Hyspan company.

B. Bronze-Hose Flexible Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.

1. Working-Pressure Rating: Minimum 200 psig.
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 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 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 temperature-actuated, water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.
  - 1. Install cabinet-type units recessed in or surface mounted on wall as specified.
- C. Install outlet boxes recessed in wall or surface mounted on wall. Install 2-by-4-inch fire-retardant-treated-wood blocking, wall reinforcement between studs. Comply with requirements for fire-retardant-treated-wood blocking in Section 061000 "Rough Carpentry."
- D. Install water-hammer arresters in water piping according to PDI-WH 201.
- E. Install air vents at high points of water piping.
- F. 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.
- G. Install drainage-type, trap-seal primer valves as lavatory trap with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting.
- H. Install trap-seal primer systems with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust system 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.** Coordinate list below with products retained in Part 2.
  - 2.** Reduced-pressure-principle backflow preventers.
  - 3.** Dual-check-valve backflow preventers.
  - 4.** Double-check, detector-assembly backflow preventers.
  - 5.** Primary, thermostatic, water mixing valves.
  - 6.** Outlet boxes.
  - 7.** Supply-type, trap-seal primer valves.
  - 8.** Trap-seal primer systems.
- 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 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.

### **3.5 ADJUSTING**

- A.** Set field-adjustable pressure set points of water pressure-reducing valves.
- B.** Set field-adjustable flow set points of balancing valves.
- C.** Set field-adjustable temperature set points of temperature-actuated, water mixing valves.



General-Duty Valves for Plumbing Piping  
22 05 18 - 18

## SECTION 221123 - DOMESTIC WATER PUMPS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Horizontally mounted, in-line, close-coupled centrifugal pumps.

#### 1.2 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.

#### 1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include materials of construction, rated capacities, certified performance curves with operating points plotted on curves, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. LEED Submittals:

1. Product Data for Prerequisite EA 2: Documentation indicating that units comply with applicable requirements in ASHRAE/IESNA 90.1, without amendments, Section 7 - "Service Water Heating."

#### 1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For domestic water pumps to include in 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. UL Compliance: Comply with UL 778 for motor-operated water pumps.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

A. Retain shipping flange protective covers and protective coatings during storage.

B. Protect bearings and couplings against damage.

C. Comply with pump manufacturer's written rigging instructions for handling.

## 1.7 COORDINATION

- A. Coordinate sizes and locations with proper access to actual equipment provided.

## PART 2 - PRODUCTS

### 2.1 HORIZONTALLY MOUNTED, IN-LINE, CLOSE-COUPLED CENTRIFUGAL PUMPS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  1. Armstrong Pumps Inc.
  2. Bell & Gossett Domestic Pump; ITT Corporation.
  3. Grundfos Pumps Corp.
  4. TACO Incorporated.
  5. WILO USA LLC - WILO Canada Inc.
- B. Description: Factory-assembled and tested, in-line, close-coupled, canned-motor, seal-less, overhung-impeller centrifugal pumps.
- C. Pump Construction:
  1. Pump and Motor Assembly: Hermetically sealed, replaceable-cartridge type with motor and impeller on common shaft and designed for installation with pump and motor shaft horizontal.
  2. Casing: Bronze, with threaded or companion-flange connections.
  3. Impeller: mixed flow.
  4. Motor: Single speed, unless otherwise indicated.
- D. Capacities and Characteristics:
  1. Capacity: See drawing schedule.
  2. Total Dynamic Head: See drawing schedule.
  3. Minimum Working Pressure: 125 psig.
  4. Maximum Continuous Operating Temperature: 220 deg F
  5. Inlet and Outlet Size: See drawings.
  6. Pump Speed: See drawing schedule

7. Pump Control: Thermostat
8. Motor Horsepower: See drawing schedule
9. Electrical Characteristics:
  - a. Volts: See drawing schedule.
  - b. Phases: See drawing schedule
  - c. Hertz: See drawing schedule
  - d. Full-Load Amperes: See drawing schedule

## 2.2 MOTORS

- A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 220513 "Common Motor Requirements for Plumbing 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.

## 2.3 CONTROLS

- A. Thermostats: Electric; adjustable for control of hot-water circulation, HWRCP-1 pump.
  1. Type: Water-immersion temperature sensor, for installation in piping.
  2. Range: 65 to 200 deg F range (adjustable).
  3. Enclosure: NEMA 250, Type 4X.
  4. Operation of Pump: On or off.
  5. Transformer: Provide if required.
  6. Power Requirement: 120 V, ac.
  7. Settings: Start pump at 110 deg F and stop pump at 120 deg F (adjustable).

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine roughing-in of domestic-water-piping system to verify actual locations of connections before pump installation.

### 3.2 PUMP INSTALLATION

- A. Comply with HI 1.4.
- B. Install horizontally mounted, in-line, close-coupled centrifugal pumps with shaft(s) horizontal.
- C. Install vertically mounted, close-coupled centrifugal pumps with shaft vertical.
- D. Install continuous-thread hanger rods and spring hangers of size required to support pump weight.
  - 1. Comply with requirements for vibration isolation devices specified in Section 220548 "Vibration Controls for Plumbing Piping and Equipment." Fabricate brackets or supports as required.
  - 2. Comply with requirements for hangers and supports specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
- E. Install thermostats in hot-water return piping.
- F. Install timers (By electrical contractor, plumbing contractor to coordinate) on wall in engineer's office.
- G. Install time-delay relays in piping between water heaters and hot-water storage tanks.

### 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. Install piping adjacent to pumps to allow service and maintenance.
- C. Connect domestic water piping to pumps. Install suction and discharge piping equal to or greater than size of pump nozzles.
  - 1. Install flexible connectors adjacent to pumps in suction and discharge piping of the following pumps:
    - a. Horizontally mounted, in-line, separately coupled centrifugal pumps.
    - b. Horizontally mounted, in-line, close-coupled centrifugal pumps.
    - c. Vertically mounted, in-line, close-coupled centrifugal pumps.
    - d. Comply with requirements for flexible connectors specified in Section 221116 "Domestic Water Piping."
  - 2. Install shutoff valve and strainer on suction side of each pump, and check, shutoff, and throttling valves on discharge side of each pump. Install valves same size as connected

piping. Comply with requirements for valves specified in Section 220523 "General-Duty Valves for Plumbing Piping" and comply with requirements for strainers specified in Section 221119 "Domestic Water Piping Specialties."

3. Install pressure gage and snubber at suction of each pump and pressure gage and snubber at discharge of each pump. Install at integral pressure-gage tappings where provided or install pressure-gage connectors in suction and discharge piping around pumps. Comply with requirements for pressure gages and snubbers specified in Section 220519 "Meters and Gages for Plumbing Piping."

- D. Connect pressure switches, and thermostats, to pumps that they control.
- E. Interlock pump (By electrical contractor. Plumbing contractor to coordinate) with water heater.

### **3.4 IDENTIFICATION**

- A. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment" for identification of pumps.

### **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. Set pressure switches, and thermostats, for automatic starting and stopping operation of pumps.
  5. Perform the following startup checks for each pump before starting:
    - 6.
    - 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.
  7. Prime pump by opening suction valves and closing drains and prepare pump for operation.
  8. Start motor.

9. Open discharge valve slowly.
10. Adjust temperature settings on thermostats.
11. Adjust timer settings.

### 3.6 ADJUSTING

- A. Adjust domestic water pumps to function smoothly and lubricate as recommended by manufacturer.
- B. Adjust initial temperature set points.
- C. Set field-adjustable switches and circuit-breaker trip ranges as indicated.



## **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, variable-speed booster pumps.

- B. Related Sections:

- 1. Section 221123 "Domestic Water Pumps" for domestic-water circulation pumps.

#### **1.3 DEFINITIONS**

- A. VFC: Variable-frequency controller(s).

#### **1.4 ACTION SUBMITTALS**

- A. Submittals shall be in accordance with requirements of general specifications. Submit 6 copies to the engineer for approval. All submittals must include the following:
  - B. Complete shop drawings and complete wiring diagrams. All drawings must be AUTOCADD Release 2000; complete with full mechanical Desk Top 3-D drawings in both hardcopy and disk format. Complete operating and maintenance instructions.
  - C. Furnish written certification of the manufacturers listing with Underwriters Laboratories as an approved manufacturer of control panels.
  - D. Furnish written certification that the manufacturer is listed by UL/C-UL as an approved manufacturer of factory assembled pumping systems.
  - E. A complete, easily readable functional description of the proposed equipment.
  - F. Upon completion of the installation, the results of the field and acceptance tests as specified under this section of the specification shall be submitted to the engineer.
  - G. Furnished written certification from the manufacturer's representative of the proper installation of the station.
  - H. Provide written certification that, a nationally recognized manufacturer of package pump systems, manufactures the pump system. A corporate officer must sign this certification.

- I. Operation and maintenance manuals: Submit complete operations and maintenance information for this specific equipment. The engineer shall review these manuals for completeness. They shall include complete parts list including manufacturers reference and ordering number, the local representative name, address and phone number, the model and serial number of the system.
- J. The manufacturers shall submit a certificate of product liability insurance for no less than one million dollars (\$1,000,000)

#### **1.5 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For booster pumps to include in emergency, operation, and maintenance manuals.

#### **1.6 QUALITY ASSURANCE**

- A. All equipment under this section shall be furnished by a single supplier and shall be products that the manufacturer regularly engages in. The supplier shall have sole responsibility for proper functioning of the system and equipment supplied.
- B. Equipment shall be a manufacturer's standard product presently in commercial production.
- C. The manufacturer shall have in place a quality assurance program to assure the quality of the material furnished.

#### **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, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  1. Tigerflow Systems (Basis of Design)
  2. Aurora
  3. Systecon
- B. Description: Furnish and install a Triplex, U.L./C-U.L. Listed Engineered Variable Speed packaged Water Booster System The system shall be rated for a system flow of 375 GPM at a system pressure of 62 PSIG including a suction pressure of 59 PSIG minimum, 132 PSIG

maximum and must be NSF-372 approved as a complete system for potable water and low lead certification. Individual components are not acceptable.

- C. Factory Prefabrication: Provide each system as a complete package system on a structural steel mounting frame, piped, tubed, mounted and wired. Unit shall be factory primed and painted with machine grade finish coat. All welding shall be performed by ASME Section 9 certified welders. System shall be (Vertical) construction. Branches, Suction and discharge headers shall be: (304 Stainless Steel). Grooved ends 6". System manufacturer shall isolate all ferrous from all non-ferrous materials.
- D. Pumps:
1. Type: Pump(s) shall be Cast Iron, Bronze Fitted, Mechanical Seal End Suction centrifugal type each close-coupled to a 3500 RPM, 460 Voltage, 3 Phase, 60 Hz, high efficiency motor.
    - a. Pump No. 1, 2 & 3 shall be Model VMS, 125 GPM at 143' TDH, 7-1/2 HP.
  2. Valves: Isolation Valves: 4" Individual pump suction and discharge valves shall be NSF 61 approved Lug Style Butterfly Valve(s) with Lever handle(s). Provide a 4" Wafer style non-slam check valve NSF 61 approved on the discharge of each pump.
  3. Over Temperature Protection: Each pump shall be equipped with an individual combination type non-electric temperature probe and purge assembly with PRV on Purge line.
  4. Controls: U.L. Listed, Nema 4, Solid State, Power and Control Panel
    - a. (\*) U.L./C.U.L. 508 Label
    - b. (\*) Micro Controller: WITH PLC and HMI Technology
    - c. 6" Blue Scale Touch Screen Operator Interface
    - d. Individual H-O-A Pump Operation
    - e. Individual Pump Run indicators
    - f. -Multi Level Security
    - g. -7 Password protected field changeable areas
    - h. Operator Adjustable settings:
      - i. -Tunable Variable Speed Pressure Sequencing with read out in PSI
      - j. -Pump Start / Stop Pressures
      - k. -Pump ON and OFF delay times

- l. -Suction and Discharge Pressure Read Out in PSI
- m. -Individual Pump Run Indication
- n. -Low Suction Alarm with TDR
- o. -Low System with TDR
- p. -High Suction Shutdown and TDR
- q. -High System Alarm with TDR
- r. -Adjustable Alternation method of Pumps
- s. Automatic on Lead Pump shutdown
- t. Daily/ weekly/ Monthly
- u. Manual alternation
- v. -Separate Alarm Silence and Reset Button
- w. -Event History Records of last 10 events
- x. Pump starts / stops
- y. Alarm conditions
- z. Alarm acknowledgements
- aa. Alarm reset
- bb. Date and Time of each event
- cc. (\*) Thru Door Disconnect(s) with Individual Motor Circuit Protection
- dd. (\*) Variable Speed Drives with PWM and thru door operator interface
- ee. (\*) FVNR Magnetic Starters with 3 leg overload protection
- ff. (\*) 24 Volt DC U.L./C-U.L., C.E. Approved Switching Power Supply Digital I/O maximum 256 I/O points
- gg. Alarm Horn and reset button
- hh. (1) Common Aux Alarm Contact
- ii. (2) Panel Mounted Stainless Steel Pressure Transducers [(1) Suction, (1) Discharge]

5. Lag Pump Sequencing: Each lag pump shall be sequenced by: (Pressure sequencing with programmable minimum run timers and time delay relays) Model 220B (Insertion type paddle wheel flow sensor complete with digital flow indication in GPM through operator interface). NOTE: Pressure switches in lieu of pressure transducers will not be allowed.
- E. Tank: The Hydro-Pneumatic tank shall be (Remote mounted as shown per drawings)
  1. Provide a Section VIII, ASME CODE, National Board stamped, Hydro-Pneumatic tank. Tank shall be provided complete with a NSF 61 approved replaceable bladder, bottom connection, air fill valve, drain valve, and gauge. Tank shall be: 185 GAL., 200 PSI).
- F. Capacities and Characteristics:
  1. Minimum Pressure Rating: 150 psig.
  2. Booster-Pump Electrical Characteristics:
    - a. Full-Load Amperes: Refer to contract documents.

## 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.

## 2.3 THIRD PARTY TESTING, NSF AND OSHA REQUIREMENT

- A. The package shall be UL Listed as a system for its intended use, a NSF 372 approved system per NSF 372 guidelines so meeting OSHA Federal Regulations 29 CFR 1910.303 and 399 as well as NFPA Pamphlet #70 (National Electric Code) Article 90-7, City of Los Angeles Approval Code, CMR248 Massachusetts State Plumbing Code Approval.
- B. Factory Test: The package shall be electrically and hydrostatically tested before shipment, in addition, each system shall be factory tested from 0-100% of flow and pressure. Provide certified x-y test report.

## 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 033053 "Miscellaneous 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 piping.

1. Install shutoff valves on piping connections to booster-pump suction and discharge piping. Install ball, butterfly, or gate valves same size as suction and discharge piping. 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."
2. Install union, flanged, or grooved-joint connections on suction and discharge piping at connection to domestic-water piping. Comply with requirements for unions and flanges specified in Section 221116 "Domestic Water Piping."
3. Install valves bypass, same size as and between piping, at connections to booster-pump suction and discharge piping. 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 piping. 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.** Perform tests and inspections.
  - 1.** Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- C.** Tests and Inspections:
  - 1.** 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.
- D.** Pumps and controls will be considered defective if they do not pass tests and inspections.
- E.** Prepare test and inspection reports.

### **3.6 STARTUP SERVICE**

- A.** The factory authorized local representative, Ames, Inc. shall provide (2) hours of startup and field training.

### **3.7 WARRANTY**

- A.** Each system shall be warranted for a period of (18) months from date of shipment or (12) months from date of startup, whichever occurs first.

### **3.8 QUALIFICATIONS**

- A.** All equipment under this section shall be furnished by a single supplier and shall be products that the manufacturer regularly engages in. The supplier shall have sole responsibility for proper functioning of the system and equipment supplied.
- B.** Equipment shall be a manufacturer's standard product presently in commercial production.
- C.** The manufacturer shall have in place a quality assurance program to assure the quality of the material furnished.

### **3.9 ADJUSTING**

- A. Adjust booster pumps to function smoothly and lubricate as recommended by manufacturer.
- B. Adjust pressure set points.
- 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.

### **3.10 DEMONSTRATION**

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain booster pumps.



## SECTION 221316 - SANITARY WASTE AND VENT PIPING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Pipe, tube, and fittings.
  - 2. Specialty pipe fittings.
  - 3. Encasement for underground metal piping.

#### 1.2 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.
  - 2. Waste, Forced-Main Piping: 100 PSI

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. LEED Submittals:
  - 1. Product Data for Credit IEQ 4.1: For solvent cements and adhesive primers, documentation including printed statement of VOC content.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

#### 1.5 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.

### 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 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS (FOR ABOVE FLOOR OR BELOW SLAB)**

- A. Pipe and Fittings: ASTM A 74, Service class.
- B. Gaskets: ASTM C 564, rubber.
- C. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

**2.3 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS (FOR ABOVE FLOOR OR BELOW SLAB)**

- A. Pipe and Fittings: ASTM A 888 or CISPI 301.
- B. CISPI, Hubless-Piping Couplings:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. ANACO-Husky.
    - b. Fernco Inc.
    - c. Matco-Norca, Inc.
    - d. MIFAB, Inc.
    - e. Mission Rubber Company; a division of MCP Industries, Inc.
    - f. Tyler Pipe.
  - 2. Standards: ASTM C 1277 and CISPI 310.
  - 3. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

**2.4 PVC PIPE AND FITTINGS (FOR INDIVIDUAL APARTMENT BRANCH PIPING AND BELOW SLAB)**

- A. Solid-Wall PVC Pipe: ASTM D 2665, Schedule 40, 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.
  - 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).

**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).

**2.5 PVC PIPE AND FITTINGS (Cannot be installed within Return Air Plenums and Future Retail Spaces)**

**2.6 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. Unshielded, Nonpressure Transition Couplings:
  - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - 1) Fernco Inc.
    - 2) Mission Rubber Company; a division of MCP Industries, Inc.
    - 3) Plastic Oddities; a division of Diverse Corporate Technologies, Inc.
  - b. Standard: ASTM C 1173.
  - c. Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
  - d. Sleeve Materials:
    - 1) For Cast-Iron Soil Pipes: ASTM C 564, rubber.
    - 2) For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
    - 3) For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

**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 Flanges:**

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- 1) Capitol Manufacturing Company.
- 2) Central Plastics Company.
- 3) Matco-Norca, Inc.
- 4) Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- 5) Wilkins; a Zurn company.

b. Description:

- 1) Standard: ASSE 1079.
- 2) Factory-fabricated, bolted, companion-flange assembly.
- 3) Pressure Rating: 125 psig minimum at 180 deg F.
- 4) End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

**3. Dielectric-Flange Insulating Kits:**

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- 1) Advance Products & Systems, Inc.
- 2) Calpico, Inc.
- 3) Central Plastics Company.
- 4) Pipeline Seal and Insulator, Inc.

b. 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.

**4. Dielectric Nipples:**

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- 1) Elster Perfection.
- 2) Grinnell Mechanical Products.
- 3) Matco-Norca, Inc.
- 4) Precision Plumbing Products, Inc.
- 5) Victaulic Company.

b. 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.

**2.7 ENCASEMENT FOR UNDERGROUND METAL PIPING**

- A. Standard: ASTM A 674 or AWWA C105/A 21.5.
- B. Material: Linear low-density polyethylene film of 0.008-inch or high-density, cross-laminated polyethylene film of 0.004-inch minimum thickness.
- C. Form: Sheet or tube.
- D. Color: Black or natural.

**PART 3 - EXECUTION**

**3.1 EARTH MOVING**

- A. Comply with requirements for excavating, trenching, and backfilling specified in Section 310000 "Earthwork."

**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.

- 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 at indicated slopes.
- F. Install piping free of sags and bends.
- G. Install fittings for changes in direction and branch connections.
- H. Install piping to allow application of insulation.
- I. 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.
- J. 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.
- K. 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: 1 percent downward in direction of flow.
  - 3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.
- L. 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.
- M. Install aboveground PVC piping according to ASTM D 2665.
- N. Install aboveground PVC piping according to ASTM D 2321.
- O. 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. Reduced-Size Venting: Comply with standards of authorities having jurisdiction.
- P. Install force mains at elevations indicated.
- 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 hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
- B. Join hub-and-spigot, cast-iron soil piping with calked joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead-and-oakum calked joints.

- C. 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.
- D. 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 Aboveground Forced Mains Piping: Fitting-type transition couplings.
  3. In Drainage Piping: Unshielded, nonpressure 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 nipples.
  3. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric nipples.
  4. Dielectric Fittings for NPS 5: Use dielectric flange kits.

### **3.5 VALVE INSTALLATION**

- A. Comply with valve installation requirements are specified in Section 220523 "General-Duty Valves for Plumbing Piping."
- B. Shutoff Valves:
  1. Install shutoff valve on each sewage pump discharge
  2. Install gate or full-port ball valve for piping NPS 2 and smaller.
  3. Install gate valve for piping NPS 2-1/2 and larger.
- C. Check Valves: Install swing check, between pump and shutoff valve, on each sewage pump discharge.

### **3.6 HANGER AND SUPPORT INSTALLATION**

- A. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- B. 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 carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
  - 2. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
  - 3. Vertical Piping: MSS Type 8 or Type 42, clamps.
  - 4. Install individual, straight, horizontal piping runs:
  - 5. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
  - 6. Longer Than 100 Feet MSS Type 43, adjustable roller hangers.
  - 7. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.
  - 8. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
  - 9. Base of Vertical Piping: MSS Type 52, spring hangers.
- C. Support horizontal piping and tubing within 12 inches of each fitting and coupling.
- D. Support vertical piping and tubing at base and at each floor.
- E. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.
- F. 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. Spacing for 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.
- G. Install supports for vertical cast-iron soil piping every 15 feet.

- H. 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.
- I. Install supports for vertical PVC piping every 48 inches.
- J. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

### 3.7 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. Connect forced-main piping to the following:
  - 1. Sanitary Sewer: To exterior force main.
  - 2. Sewage Pump: To sewage pump discharge.

- E. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.
- F. 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.

### **3.8 IDENTIFICATION**

- A. Identify exposed sanitary waste and vent piping. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

### **3.9 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.
- E. Test force-main piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
7. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
  8. 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 allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
  9. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
  10. Prepare reports for tests and required corrective action.

### **3.10 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.
- D. Exposed PVC Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.

### **3.11 PIPING SCHEDULE**

- A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.
- B. Aboveground soil, waste and vent drainage piping NPS 6 and smaller shall be any of the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
  2. Hubless, cast-iron soil pipe and fittings; CISPI, hubless-piping couplings; and coupled joints.
  3. Solid –wall, schedule 40, PVC pipe, PVC socket fittings, and solvent-cemented joints. (INDIVIDUAL APARTMENT BRANCH PIPING ONLY, NPS 3 AND SMALLER).
  4. Dissimilar Pipe-Material Couplings: Unshielded, non-pressure transition couplings.
  5. **PVC PIPE AND FITTINGS (Cannot be installed within Return Air Plenums and Future Retail Spaces).**
- C. Aboveground, soil, waste and vent drainage piping NPS 8 and larger shall be any of the following:
1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
  2. Hubless, cast-iron soil pipe and fittings; CISPI, hubless-piping couplings; and coupled joints.
  3. **PVC PIPE AND FITTINGS (Cannot be installed within Return Air Plenums and Future Retail Spaces).**
- D. Underground soil, waste and vent drainage piping NPS 6 and smaller shall be any of the following:
1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
  2. Solid –wall, schedule 40, PVC pipe, PVC socket fittings, and solvent-cemented joints.
- E. Underground, soil drainage piping NPS 8 and larger shall be any of the following:
1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
- F. Aboveground sanitary-sewage force mains NPS 1-1/2 and NPS 2 shall be the following:
1. Hard copper tube, Type L (Type B); copper pressure fittings; and soldered joints.
- G. Aboveground sanitary-sewage force mains NPS 4 and larger shall be the following:
1. Grooved-end, galvanized-steel pipe; grooved-joint, galvanized-steel-pipe appurtenances; and grooved joints.



## SECTION 221319 – SANITARY WASTE PIPING SPECIALTIES

### PART 1 - GENERAL

#### 1.1 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.
- B. Related Requirements:
  - 1. Section 221423 "Storm Drainage Piping Specialties" for storm drainage piping inside the building, drainage piping specialties, and drains.

#### 1.2 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. FRP: Fiberglass-reinforced plastic.
- C. HDPE: High-density polyethylene plastic.
- D. PE: Polyethylene plastic.
- E. PP: Polypropylene plastic.
- F. PVC: Polyvinyl chloride plastic.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Field quality-control test reports.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For drainage piping specialties to include in emergency, operation, and maintenance manuals.

## 1.5 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.

## 1.6 COORDINATION

- A. Coordinate size and location of roof penetrations.

# PART 2 - PRODUCTS

## 2.1 CLEANOUTS

- A. Exposed Metal Cleanouts:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Josam Company; Josam Div.
    - b. MIFAB, Inc.
    - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    - d. Tyler Pipe; Wade Div.
    - e. Watts Drainage Products Inc.
    - f. Zurn Plumbing Products Group; Specification Drainage Operation.
  - 2. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
  - 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: Countersunk or raised-head, cast-iron plug.
  - 6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
  - 7. Closure: Stainless-steel plug with seal.

**B. Metal Floor Cleanouts:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Josam Company; Josam Div.
  - b. Oatey.
  - c. Sioux Chief Manufacturing Company, Inc.
  - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
  - e. Tyler Pipe; Wade Div.
  - f. Watts Drainage Products Inc.
  - g. Zurn Plumbing Products Group; Light Commercial Operation.
  - h. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.36.2M for adjustable housing cast-iron soil pipe with cast-iron ferrule cleanout.
3. Size: Same as connected branch.
4. Type: Adjustable housing Cast-iron soil pipe with cast-iron ferrule.
5. Body or Ferrule: Cast iron.
6. Clamping Device: Not required.
7. Outlet Connection: Inside calk.
8. Closure: Brass plug with tapered threads.
9. Adjustable Housing Material: Cast iron with threads.
10. Frame and Cover Material and Finish: Rough bronze.
11. Frame and Cover Shape: .
12. Top Loading Classification: Medium Duty.
13. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.
14. Standard: ASME A112.3.1.
15. Size: Same as connected branch.
16. Housing: Stainless steel.

17. Closure: Stainless steel with seal.
18. Riser: Stainless-steel drainage pipe fitting to cleanout.

C. Cast-Iron Wall Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Josam Company; Josam Div.
  - b. MIFAB, Inc.
  - c. Smith, Jay R. Mfg. Co.; d of Smith Industries, Inc.
  - d. Tyler Pipe; Wade Div.
  - e. Watts Drainage Products Inc.
  - f. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.
4. Body: 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: Countersunk or raised-head, drilled-and-threaded brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with screw.

## 2.2 FLOOR DRAINS

A. Cast-Iron Floor Drains:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Commercial Enameling Co.
  - b. Josam Company; Josam Div.
  - c. MIFAB, Inc.
  - d. Prier Products, Inc.
  - e. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.

- f. Tyler Pipe; Wade Div.
  - g. Watts Drainage Products Inc.
  - h. Zurn Plumbing Products Group; Light Commercial Operation.
  - i. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.6.3.
  3. Pattern: Floor drain.
  4. Body Material: Gray iron.
  5. Outlet: Bottom.
  6. Coating in first subparagraph below is usually used only on sanitary floor drains.
  7. Top or Strainer Material: Bronze.
  8. Top of Body and Strainer Finish: Rough bronze.
  9. Top Shape: Round.
  10. Dimensions of Top or Strainer: 5 inches diameter
  11. Top Loading Classification: Medium Duty.
  12. Inlet Fitting: Gray iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.

### **2.3 ROOF FLASHING ASSEMBLIES**

- A. Roof Flashing Assemblies:
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Acorn Engineering Company; Elmdor/Stoneman Div.
    - b. Thaler Metal Industries Ltd.
- B. Description: Manufactured assembly made of 6.0-lb/sq. ft., 0.0938-inch- thick, lead flashing collar and skirt extending at least 10 inches from pipe, with galvanized-steel boot reinforcement and counterflashing fitting.
  1. Open-Top Vent Cap: Without cap.
  2. Low-Silhouette Vent Cap: With vandal-proof vent cap.

3. Extended Vent Cap: With field-installed, vandal-proof vent cap.

## 2.4 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

### A. Through-Penetration Firestop Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. ProSet Systems Inc.
2. Standard: UL 1479 assembly of sleeve and stack fitting with firestopping plug.
3. Size: Same as connected soil, waste, or vent stack.
4. 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.
5. Fitting in subparagraph below is for use with plastic stacks.
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.

## 2.5 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

### A. Open Drains:

1. Description: Shop or field fabricate from ASTM A 74, Service class, hub-and-spigot, cast-iron, soil-pipe fittings. Include P-trap, hub-and-spigot riser section; and where required, increaser fitting joined with ASTM C 564, rubber gaskets.
2. Size: Same as connected waste piping with increaser fitting of size indicated.

### B. Deep-Seal Traps:

1. Description: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.
2. Size: Same as connected waste piping.
  - a. NPS 2: 4-inch minimum water seal.
  - b. NPS 2-1/2 and Larger: 5-inch minimum water seal.

### C. Floor-Drain, Trap-Seal Primer Fittings:

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 side inlet.

**D. 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.

**E. 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.

**F. Vent Caps:**

1. Description: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and setscrews to secure to 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., 0.0625-inch thickness.

2. Vent Pipe Flashing: 3.0-lb/sq. ft., 0.0469-inch thickness.

3. Burning: 6-lb/sq. ft., 0.0938-inch 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..

2. Vent Pipe Flashing: 8 oz./sq. ft..

- C. 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.
- D. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil minimum thickness.
- 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.

## 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. Use NPS 4 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 for piping NPS 4 and smaller and 100 feet 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. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
  - b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
  - c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.
- 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 trench drains at low points of surface areas to be drained. Set grates of drains flush with finished surface, unless otherwise indicated.
  - F. Assemble and install ASME A112.3.1, stainless-steel channel drainage systems according to ASME A112.3.1. Install on support devices so that top will be flush with surface.
  - G. Assemble non-ASME A112.3.1, stainless-steel channel drainage system components according to manufacturer's written instructions. Install on support devices so that top will be flush with adjacent surface.
  - H. Assemble FRP channel drainage system components according to manufacturer's written instructions. Install on support devices so that top will be flush with adjacent surface.
  - I. Install fixture air-admittance valves on fixture drain piping.
  - J. Install stack air-admittance valves at top of stack vent and vent stack piping.
  - K. Install air-admittance-valve wall boxes recessed in wall.
  - L. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.
  - M. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.
  - N. Install through-penetration firestop assemblies in plastic stacks at floor penetrations.
  - O. Assemble open drain fittings and install with top of hub 1 inch above floor.
  - P. Install deep-seal traps on floor drains and other waste outlets, if indicated.
  - Q. 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.

- R. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.
- S. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.
- T. Install vent caps on each vent pipe passing through roof.
- U. Install wood-blocking reinforcement for wall-mounting-type specialties.
- V. 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.

### **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., 0.0938-inch thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft., 0.0625-inch 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, and 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. Install flashing for piping passing through roofs with counter flashing 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 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.



## SECTION 221323 - SANITARY WASTE INTERCEPTORS

### PART 1 GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Oil and Sediment Waste Interceptors
  - 2. Grease Interceptors
- B. Related Sections:
  - 1. Section 033000 - Concrete: Execution requirements for concrete pads specified by this section.

#### 1.2 REFERENCES

- A. American Society of Mechanical Engineers:
  - 1. ASME RTP-1-2000 – Reinforced Thermoset Plastic Corrosion-Resistant Equipment
  - 2. Section 260519- Low-Voltage Electrical Power Conductors and Cables. Execution requirements for electric connections specified by this section.
- B. IAMPO:
  - 1. IAMPO PS 80-2008
  - 2. ASME A112.4.3 – Grease Interceptors

#### 1.3 SUBMITTALS

- A. Shop Drawings: For each type and size of interceptor indicated. Must include materials of construction, dimensions, rated capacities, retention capacities, locations and size of inlet and outlet pipe, location and size of vent pipe, anchors, lifting points, furnished specialties and accessories.
- B. 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. Oil and Sediment Waste Interceptors
  - 2. Piping connections: Including size, location, and elevation of each.

3. Interface with underground structures and utility services
  4. Relieving Slab.
- C. Product Data: Submit dimensioned drawings of interceptors indicating components and connections to other equipment and piping. Indicate pipe and fitting types.
- D. Manufacturer's Installation Instructions: Submit burial and support requirements.
- E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

#### 1.4 DEFINITIONS

- A. FRP: Fiberglass-reinforced plastic.
- B. PDI: Plumbing and Drainage Institute
- C. OIL AND SEDIMENT WASTE INTERCEPTOR: Elliptical or Round fiberglass (FRP) tank system designed with built-in inlet piping and baffle penetration that introduces wastewater in a tangential laminar flow to reduce disruption of collected hydrocarbon oil, sediment and solids. Tank system is designed to capture and hold waste fluids and solids to maximize waste retention and optimize Stokes Law separation.
1. OIL AND SEDIMENT WASTE INTERCEPTOR OR SEPARATOR: Elliptical or Round fiberglass (FRP) interceptor that is certified to meet IAPMO PS 80-2008 and applicable sections of the latest editions of the Uniform Plumbing Code or the International Plumbing Code. Interceptor is designed to deliver 10 PPM non-emulsified free-floating oil and 350 PPM Total Suspended Solids effluent quality based on inlet peak fixture flow.
  2. CLARIFIER: Elliptical or Round fiberglass (FRP) interceptor that is certified to meet IAPMO PS 80-2008 and applicable sections of the latest editions of the Uniform Plumbing Code or the International Plumbing Code. Interceptor is designed to deliver 10 PPM non-emulsified free-floating oil and 350 PPM Total Suspended Solids effluent quality based on inlet peak fixture flow
  3. 30-YEAR WARRANTY: The unit must have a minimum 30-year published warranty.
- D. GREASE INTERCEPTOR: Elliptical fiberglass (FRP) tank system designed with built-in inlet piping and baffle penetration that introduces wastewater in a tangential laminar flow to reduce disruption of collected grease and solids. Tank system is designed to capture and hold grease and solids to maximize waste retention and optimize Stokes Law separation.
1. GRAVITY GREASE INTERCEPTOR: Elliptical fiberglass (FRP) interceptor that is certified to meet IAPMO/ANSI Z1001-2007 and applicable sections of the

#### SANITARY WASTE INTERCEPTORS

latest editions of the Uniform Plumbing Code and/or the International Plumbing Code. Interceptor is designed to deliver 100 PPM non-emulsified free-floating oil and grease and 350 PPM Total Suspended Solids effluent quality based on inlet peak fixture flow.

2. HYDROMECHANICAL OR PDI CERTIFIED GREASE INTERCEPTOR: Elliptical fiberglass (FRP) interceptor that is certified to meet both PDI G-101 and IAPMO ASME A112.14.3 Standard rated at 100 GPM flow and 200 lbs. grease capacity.
3. CSA CERTIFIED GREASE INTERCEPTOR: Elliptical fiberglass (FRP) interceptor that is certified to meet CSA B481 Standard rated at either 50 GPM and 100 lbs. grease capacity or 100 GPM flow and 200 lbs. grease capacity.
4. 30-YEAR WARRANTY: The unit must have a minimum 30-year published warranty.

## **1.5 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: Submit replacement part numbers and availability.

## **1.6 QUALITY ASSURANCE**

- A. Conform to all of the following:

1. IAMPO PS 80-2008
2. ASME RTP-1-2000 – Reinforced Thermoset Plastic Corrosion-Resistant Equipment.
3. ASME A112.4.3 – Grease Interceptors
4. ANSI Z1001-2013 Prefabricated Gravity Grease Interceptors

- B. Maintain one copy of each document on site.

## **1.7 QUALIFICATIONS**

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience, and with service facilities within 100 miles of Project.
- B. Installer: Company specializing in performing Work of this section with minimum three years documented experience approved by manufacturer.

## **1.8 DELIVERY, STORAGE, AND HANDLING**

- A. Accept Oil and Sediment Waste interceptor on site. Inspect for damage.

- B. Accept Grease interceptor on site. Inspect for damage.
- C. Protect tanks with temporary inlet and outlet caps and/or plugs. Maintain caps and/or plugs in place until installation.

## 1.9 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

## PART 2 PRODUCTS

### 2.1 OIL AND SEDIMENT WASTE, GREASE INTERCEPTORS

- A. Basis of Design: Elliptical or Round Fiberglass (FRP) Oil and Sediment Waste interceptor construction with inlet piping and baffle penetration designed to introduce wastewater in a tangential laminar flow pattern, to be appropriately sized based on anticipated usage and flow rates to meet applicable sanitary sewer discharge limits, including municipal by-laws. System backed by a 30-year manufacturer warranty.
  - 1. Include accessways, tanks, and piping baffle openings to retain hydrocarbon and solids and create tangential laminar wastewater flow.
  - 2. Factory installed Schedule 40 PVC cement welded type socket ports, or straight pipe, fitted into interceptor walls for each pipe connection.
  - 3. Accessway Extension Collar: Fiberglass risers (EC2), 24-inch (EC3), 36-inch optional alternate.
  - 4. Accessway Frames and Covers: Round cover with non-slipcover finish, gasketed and non-vented top design with (**OIL INTERCEPTOR**) lettering cast into cover.
    - a. Cast Iron: AASHTO M306 Traffic load rated. 24 inch- diameter cover with 0.25" gasket. Two closed pick holes. Non-Bolted or Bolted option. Weight 249 lbs. ASTM A48 CL35B. 36-inch optional alternate is acceptable to match fiberglass risers.
    - b. Fiberglass: Pedestrian loading 24-inch diameter cover, bolted and gasketed.
  - 5. Factory installed 4" Sch. 40 PVC top mount suction pipe and port for remote pump-out.
  - 6. Alarm system for high Oil and Sediment Waste accumulation. Include alarm probe to be installed on top of tank accessway and alarm panel with visible or audible alarm and light for indoor wall mount.

7. Watertight Flexible Caulking: Sikaflex 255 or Sikaflex 221 to provide watertight seal at extension collar joints.
- B. Basis of Design: Elliptical Fiberglass (FRP) grease interceptor construction with inlet piping and baffle penetration designed to introduce wastewater in a tangential laminar flow pattern, to be appropriately sized based on anticipated usage and flow rates to meet applicable sanitary sewer discharge limits, including municipal by-laws. System backed by a 30-year manufacturer warranty.
  1. Include accessways, tanks, and piping baffle openings to retain grease and create tangential laminar wastewater flow.
  2. Factory installed Schedule 40 PVC cement welded type socket ports, or straight pipe, fitted into interceptor walls for each pipe connection.
  3. Accessway Extension Collar: Fiberglass risers (EC2), 24-inch (EC3), 36-inch optional alternate.
  4. Accessway Frames and Covers: Round cover with non-slip cover finish, gasketed and non-vented top design with **(GREASE INTERCEPTOR)** lettering cast into cover.
    - a. Cast Iron: AASHTO M306 Traffic load rated. **24 inch-** diameter cover with 0.25" gasket. Two closed pick holes. Non-Bolted or Bolted option. Weight 249 lbs. ASTM A48 CL35B. **36-inch** optional alternate is acceptable to match fiberglass risers.
    - b. Fiberglass: Pedestrian loading **24-inch** diameter cover, bolted and gasketed.
  5. Alarm system for high grease accumulation. Include alarm probe to be installed on top of tank accessway and alarm panel with visible or audible alarm and light for indoor wall mount.
  6. Watertight Flexible Caulking: Sikaflex 255 or Sikaflex 221 to provide watertight seal at extension collar joints.
- C. Manufacturers:
  1. Green Turtle (Basis of Design)
  2. Manzi
  3. Xerxes
- D. Capacity and Characteristics:

1. Green Turtle Proceptor Model: Refer to contract documents.
  2. Number of Tanks – Refer to contract documents.
  3. Oil and Sediment Waste Retention Capacity: Refer to contract documents.
  4. Solids Retention Capacity: Refer to contract documents.
  5. Grease Retention Capacity: Refer to contract documents.
  6. Inlet and Outlet Schedule 40 FRP/PVC Pipe Size: Refer to contract documents.
    - a. Centerline of Inlet to Floor: Refer to contract documents.
    - b. Centerline of Outlet to Floor: Refer to contract documents.
  7. Number of Vent Pipes and Size: Refer to contract documents.
  8. Installation Position: Underground with accessway collar riser to grade.
- E. Fiberglass Accessway Risers:
1. Fiberglass accessway extensions: Fiberglass wound pipe.
    - a. Length: From top of underground tank to underside of access frame at grade.
    - b. Extension Sections: 0.25-inch minimum thickness and 24-inch as a single continuous piece, without joints.
    - c. Sealant: Watertight Flexible Caulking, Sikaflex 255 or Sikaflex 221 or approved alternate to provide watertight seal at extension collar joining to tank on bottom and access frame at top.
- F. Alarm System: The alarm is expressly designed for use in these separators. The unit contains no moving parts, an integrated pulse card (PMC) is mounted directly onto the probe in an explosion proof epoxy coated housing. This alarm panel electronics can be mounted up to 1 km (0.7 mile) away using 2-conductor shielded wire. A relay is included for user-supplied remote devices connection to building automation systems.
- G. Warranty: Furnish Thirty (30) year manufacturer warranty for interceptor(s).
- H. Relieving Slab: All load calculations and material requirements must be certified by a third-party source.
1. Concrete to be 28-day compressive strength to 4000 psi.

2. No. 4 rebar (1/2" diameter), Grade 60 steel per ASTM A615: Connected with tie wire.
3. 4" rebar spacing around all access openings.
4. All penetrations to be sleeved or have slip connections.
5. Minimum 18" from top of slab to top of tank.
6. Extend compacted backfill a minimum of 3' beyond all sides of the interceptor.

**I. Construction:**

The oil and sediment and grease interceptor will be elliptical shape fiberglass (FRP) construction with inlet piping and baffle penetration designed to introduce wastewater in a tangential laminar flow pattern. The interceptor will be built showing conformance to Section 1.6. The interceptor will be water tested at atmospheric pressure.

Interceptor will be unlined. Lined or plated grease interceptors will not be acceptable. Water contacting tank surfaces will be non-porous and exhibit 0% water absorption. All tank connections/fittings will be non-ferrous. Finished oil interceptors will not require sacrificial anode rods and none will be used. Sample tanks that employ anode rods of any type will not be acceptable.

The oil and sediment and grease interceptor is constructed out of fiberglass reinforced plastic (FRP) and the piping arrangement is constructed of polyvinyl chloride (PVC) pipe. The material selected shall be in accordance Section 1.6.

A drop pipe with a tee opening directs wastewater into the mid-section of the oil interceptor. A baffle separates the unit into two or three chambers while the flow distributor regulates flow into the additional chamber(s). A riser pipe in the second or third chamber allows cleaner water to displace out of the oil interceptor. The tank is equipped with vent ports, inspection ports and an access way for regular inspection and maintenance.

**J. Performance:**

Elliptical fiberglass (FRP) oil and sediment interceptor that is certified to conform to Section 1.6, and applicable sections of the latest editions of the International Plumbing Code. Interceptor is designed to deliver 10 PPM non-emulsified free-floating oil and 350 PPM Total Suspended Solids effluent quality based on inlet peak fixture flow.

Elliptical fiberglass (FRP) grease interceptor that is certified to conform to Section 1.6, and applicable sections of the latest editions of the International Plumbing Code. Interceptor is designed to deliver 100 PPM non-emulsified free-floating grease (FOG) and 350 PPM Total Suspended Solids effluent quality based on inlet peak fixture flow.

- K.** Compliance Requirements: Tank system is designed to capture and hold oil and solids to maximize waste retention and optimize Stokes Law separation
1. The oil interceptor shall be an elliptical shape fiberglass (FRP) grease interceptor construction with inlet piping and baffle penetration designed to introduce wastewater in a tangential laminar flow pattern.
    - a. If the tank does not have the required tangential laminar flow pattern, certified third party testing is required to verify that the flow pattern can meet 10 PPM non-emulsified free-floating oil and 350 PPM Total Suspended Solids effluent quality based on inlet peak fixture flow.
    - b. Certified third party verification is required for grease and solids retention capacity as shown in Section 2.1.D.2 & 2.1.D.3
  2. The tank shall have a smooth curved bottom and sides.
  3. Submittals must include the following:
    - a. Tank material specifications and a CAD design showing piping layout, pipe sizes, vent piping, and remote suction piping.
      - 1) The contractor is responsible regarding the coordination of all inlet and outlet piping, venting and excavating for equal substitutions.
    - b. Manway extension material specifications.
    - c. Copy of the published 30-Year Warranty.
    - d. Alarm system expressly designed for use in these separators.
    - e. Certified calculations and CAD drawings of relieving slabs.
    - f. Certified calculations and CAD drawings of Anti-Buoyancy Slab.
      - 1) The use of “deadman” anchors, straps, turnbuckles, shackles, and/or wire rope is not permitted.
  4. All oil and sediment and grease interceptor's packages shall be listed as a complete unit and submittals must show conformance to all Section 2.1 requirements.
    - a. If any of the requirements are not met, then certified third party testing is required.



## SECTION 22 13 29 - SANITARY SEWERAGE AND SUMP 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. Submersible sewage pumps.
2. Submersible sump pumps.

- B. Related Sections include the following:

1. Section 221429 "Sump Pumps" for applications in drainage systems.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

- B. Wiring Diagrams: For power, signal, and control wiring.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For pumps and controls, to include in 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. UL Compliance: Comply with UL 778 for motor-operated water pumps.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Retain shipping flange protective covers and protective coatings during storage.
- B. Protect bearings and couplings against damage.
- C. Comply with pump manufacturer's written rigging instructions for handling.

## 1.7 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

## PART 2 - PRODUCTS

### 2.1 DUPLEX SUBMERSIBLE SEWAGE PUMPS (SE-1) – GARAGE DRAINAGE

- A. Submersible, Quick-Disconnect, Double-Seal Sewage Pumps:
- B. Manufacturers: Subject to compliance with requirements, provide one of the manufacturers listed below:

1. Stancor (Basis of Design)
2. Flygt
3. Grundfos

#### C. Pumps

1. The contractor shall furnish and install where shown on the plans, duplex submersible sewage pump for installation on a model 2613 type rail type removal system as distributed.
2. Pump type: Submersible, end-suction, single-stage, close-coupled, overhung-impeller, centrifugal sewage pump rated 3450 RPM as defined in HI 1.1-1.2 and HI 1.3.
3. Pump Casing: Cast iron, with open inlet, and discharge fittings for connection to guide-rail support.
4. Impeller: The impeller shall be non-clog and shall be made of close grain cast iron, accurately machined to the proper diameter. All impellers are to be statically and dynamically balanced. The pump shall be capable of passing a 2.0" solid.
5. Pump and Motor Shaft: Stainless steel, with factory-sealed, upper and lower permanently grease-lubricated ball bearings.
6. Seals: A double mechanical seal system shall be furnished. The entire double mechanical seal assembly shall be housed in an oil seal chamber filled with clean dielectric oil with oil lifter. Seal surfaces shall be of solid silicon carbide. Carbon ceramic, tungsten carbide or systems that allow the lower seal mechanism to come in contact with the pumped media, shall not be considered equal.
7. Temperature Sensor: The temperature sensor shall be provided and installed on the stator windings, stopping the motor when the internal motor temperature exceeds the insulation rating. Complete with automatic reset.
8. Motor: Pump motor shall be of an air filled design. Oil filled motor shells shall not be considered equal. Motor end bell shall be designed as a terminal box and separated from

the motor shell by combination bearing support and inspection plate. Motors shall be housed in a water tight cast iron shell with extended cooling fins and shall have class 'f' insulation and permanently lubricated double seal ball bearings have a rated life of 17,500 hours. Motors using sleeve type bearings will not be considered equal. Motor shaft shall be 300 series stainless steel with keyway for positive positioning of impeller. Carbon steel shafts are not considered equal.

- a. Motor Housing Fluid: Air
9. Quick Removal System: These units are to be furnished with a sliding guide rail so that the motor and pump end can be raised and lowered in the pit without un-bolting or disturbing the discharge piping. The pump elbows shall be a heavy duty four bolt pattern and provided by the pump manufacturer.
1. Controls
  - a. Duplex control panel shall be housed in a NEMA 4X fiberglass enclosure, wall mounted, and shall include the following items:
    - (2) Fused disconnect switches with lockout handles thru cover
    - (2) Magnetic starters with overload and low voltage protection
    - (2) Hands-Off-Auto selector switches
    - (1) Electric Alternator
    - (1) Control Circuit Transformer, 120 V
    - (2) Pump Running Lights
    - (2) Overload Reset Buttons
    - (1) High Water Alarm with light, alarm buzzer with silence switch and dry contacts for remote monitoring
    - (4) Mercury float switches
2. Guide-Rail Supports:
  - a. Standard: SWPA's "Submersible Sewage Pumping Systems (SWPA) Handbook."
  - b. Guide Rails: Vertical pipes or structural members, made of galvanized steel or other corrosion-resistant metal, attached to baseplate and basin sidewall or cover.
  - c. Baseplate: Corrosion-resistant metal plate, attached to basin floor, supporting guide rails and stationary elbow.
  - d. Pump Yoke: Motor-mounted or casing-mounted yokes or other attachments for aligning pump during connection of flanges.

- e. Movable Elbow: Pump discharge-elbow fitting with flange, seal, and positioning device.
  - f. Stationary Elbow: Fixed discharge-elbow fitting with flange that mates to movable-elbow flange and support attached to baseplate.
  - g. Lifting Cable: Stainless steel; attached to pump and cover at manhole.
3. Basin and Cover
- a. The pump basin shall be constructed of fiberglass, 60" diameter x 120" deep with 42" dia. x 48" deep attached valve vault. The steel cover shall be bolted to the top flange of the basin with gasket seal covers. Pump mounting plates shall be bolted to the steel plates fastened to the bottom of the fiberglass basin. Provide a steel anti-flotation plate mounted on the bottom of the basin for attaching the guide rail bases. Basin shall be lowered 8"-12" underneath concrete above to handle H20 traffic.
4. Traffic Hatches
- a. Provide (2) USF Fabrication model #AHS aluminum hatches to handle drive aisle/parking spot traffic.

## **2.2 DUPLEX SUBMERSIBLE SUMP PUMPS (SP-1) – FOUNDATION DRAINAGE**

- A. Submersible, Quick-Disconnect, Double-Seal Sewage Pumps:**
- B. Manufacturers:** Subject to compliance with requirements, provide one of the manufacturers listed below:
  - 1. Stancor (Basis of Design)
  - 2. Flygt
  - 3. Grundfos
- C. Pumps**
  - 1. The contractor shall furnish and install where shown on the plans, duplex submersible sewage pump for installation on a model 2613 type rail type removal system as distributed.
  - 2. Pump type: Submersible, end-suction, single-stage, close-coupled, overhung-impeller, centrifugal sewage pump rated 340 RPM as defined in HI 1.1-1.2 and HI 1.3.
  - 3. Pump Casing: Cast iron, with open inlet, and discharge fittings for connection to guide-rail support.

4. Impeller: The impeller shall be non-clog and shall be made of close grain cast iron, accurately machined to the proper diameter. All impellers are to be statically and dynamically balanced. The pump shall be capable of passing a 2.2" solid.
5. Pump and Motor Shaft: Stainless steel, with factory-sealed, upper and lower permanently grease-lubricated ball bearings.
6. Seals: A double mechanical seal system shall be furnished. The entire double mechanical seal assembly shall be housed in an oil seal chamber filled with clean dielectric oil with oil lifter. Seal surfaces shall be of solid silicon carbide. Carbon ceramic, tungsten carbide or systems that allow the lower seal mechanism to come in contact with the pumped media, shall not be considered equal.
7. Temperature Sensor: The temperature sensor shall be provided and installed on the stator windings, stopping the motor when the internal motor temperature exceeds the insulation rating. Complete with automatic reset.
8. Motor: Pump motor shall be of an air filled design. Oil filled motor shells shall not be considered equal. Motor end bell shall be designed as a terminal box and separated from the motor shell by combination bearing support and inspection plate. Motors shall be housed in a water tight cast iron shell with extended cooling fins and shall have class 'f' insulation and permanently lubricated double seal ball bearings have a rated life of 17,500 hours. Motors using sleeve type bearings will not be considered equal. Motor shaft shall be 300 series stainless steel with keyway for positive positioning of impeller. Carbon steel shafts are not considered equal.
  - a. Motor Housing Fluid: Air
9. Quick Removal System: These units are to be furnished with a sliding guide rail so that the motor and pump end can be raised and lowered in the pit without un-bolting or disturbing the discharge piping. The pump elbows shall be a heavy duty four bolt pattern and provided by the pump manufacturer.
10. Controls
  - a. Duplex control panel shall be housed in a NEMA 4X fiberglass enclosure, wall mounted, and shall include the following items:
    - (2) Fused disconnect switches with lockout handles thru cover
    - (2) Magnetic starters with overload and low voltage protection
    - (2) Hands-Off-Auto selector switches
    - (1) Electric Alternator
    - (1) Control Circuit Transformer, 120 V
    - (2) Pump Running Lights

- (2) Overload Reset Buttons
- (1) High Water Alarm with light, alarm buzzer with silence switch and dry contacts for remote monitoring
- (4) Mercury float switches

11. Guide-Rail Supports:

- a. Standard: SWPA's "Submersible Sewage Pumping Systems (SWPA) Handbook."
- b. Guide Rails: Vertical pipes or structural members, made of galvanized steel or other corrosion-resistant metal, attached to baseplate and basin sidewall or cover.
- c. Baseplate: Corrosion-resistant metal plate, attached to basin floor, supporting guide rails and stationary elbow.
- d. Pump Yoke: Motor-mounted or casing-mounted yokes or other attachments for aligning pump during connection of flanges.
- e. Movable Elbow: Pump discharge-elbow fitting with flange, seal, and positioning device.
- f. Stationary Elbow: Fixed discharge-elbow fitting with flange that mates to movable-elbow flange and support attached to baseplate.
- g. Lifting Cable: Stainless steel; attached to pump and cover at manhole.

12. Basin and Cover

- a. The pump basin shall be constructed of fiberglass, 60" diameter x 120" deep with 42" dia. x 48" deep attached valve vault. The steel cover shall be bolted to the top flange of the basin with gasket seal covers. Pump mounting plates shall be bolted to the steel plates fastened to the bottom of the fiberglass basin. Provide a steel anti-flotation plate mounted on the bottom of the basin for attaching the guide rail bases. Basin shall be lowered 8"-12" underneath concrete above to handle H20 traffic.

4. Traffic Hatches

- a. Provide (2) USF Fabrication model #AHS aluminum hatches to handle drive aisle/parking spot traffic.

**PART 3 - EXECUTION**

**3.1 EARTHWORK**

- A. Excavation and filling are specified in Section 312000 "Earth Moving."

### **3.2 EXAMINATION**

- A.** Examine roughing-in for plumbing piping to verify actual locations of sanitary drainage and vent piping connections before sewage pump installation.

### **3.3 INSTALLATION**

- A.** Pump Installation Standards:
  1. Comply with HI 1.4 for installation of centrifugal pumps.
  2. Comply with HI 3.1-3.5 for installation of progressing-cavity sewage pumps.
- B.** Equipment Mounting:
  1. Install progressing-cavity sewage 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." Retain one of two subparagraphs below. Retain first for projects in seismic areas; retain second for projects not in seismic areas. Indicate vibration isolation and seismic-control device type and minimum deflection in supported equipment schedule on Drawings.
  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."
- C.** Wiring Method: Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- D.** 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.

### **3.4 CONNECTIONS**

- A.** Comply with requirements for piping specified in Section 221316 "Sanitary Waste and Vent Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B.** Install piping adjacent to equipment to allow service and maintenance.

### **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.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

**C. Tests and Inspections:**

1. 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 motor rotation and unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

**D. Pumps and controls will be considered defective if they do not pass tests and inspections.**

**E. 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 check according to manufacturer's written instructions.

**3.7 ADJUSTING**

- A. Adjust pumps to function smoothly and lubricate as recommended by manufacturer.**
- B. Adjust control set points.**

**3.8 DEMONSTRATION**

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain controls and pumps.**



## SECTION 221413 – STORM DRAINAGE PIPING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
1. Pipe, tube, and fittings.
  2. Specialty pipe fittings.
  3. Encasement for underground metal piping.

#### 1.2 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:
1. Storm Drainage Piping: 10-foot head of water.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Seismic Qualification Certificates: For storm drainage piping, 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. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

- B. Field quality-control reports.

#### 1.5 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF/ANSI 14, "Plastics Piping System 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 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 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 74, Service classes.
- B. Gaskets: ASTM C 564, rubber.
- C. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

### 2.3 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 888 or CISPI 301.
- B. CISPI, Hubless-Piping Couplings:
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. ANACO-Husky.
    - b. Dallas Specialty & Mfg. Co.
    - c. Fernco Inc.
    - d. Matco-Norca, Inc.
    - e. MIFAB, Inc.
    - f. Mission Rubber Company; a division of MCP Industries, Inc.
    - g. Stant.
    - h. Tyler Pipe.
  2. Standards: ASTM C 1277 and CISPI 310.
  3. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop. **Heavy Duty 6 Band minimum.**

## 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 from layout are approved on coordination drawings.
- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping to allow application of insulation.
- J. 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.
- K. 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.
- L. Install storm drainage piping at the following minimum slopes unless otherwise indicated:
  1. Building Storm 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 Storm-Drainage Piping: 1 percent downward in direction of flow.

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.

N. Plumbing Specialties:

1. Install cleanouts at grade and extend to where building storm drains connect to building storm sewers in storm drainage gravity-flow piping. Install cleanout fitting with closure plug inside the building in storm drainage force-main piping. Comply with requirements for cleanouts specified in Section 221423 "Storm Drainage Piping Specialties."

2. Install drains in storm drainage gravity-flow piping. Comply with requirements for drains specified in Section 221423 "Storm Drainage Piping Specialties."

O. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

P. 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."

Q. 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."

R. 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. Hub-and-Spigot, Cast-Iron Soil Piping Gasketed Joints: Join according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.

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-piping coupling joints.

### 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: Unshielded, non-pressure transition couplings.

B. Dielectric Fittings:

1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
2. Dielectric Fittings for up to NPS 4: Use dielectric nipples.
3. 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. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
  2. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
  3. Vertical Piping: MSS Type 8 or Type 42, clamps.
  4. 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.
  5. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
  6. Base of Vertical Piping: MSS Type 52, spring hangers.
- B. Support horizontal piping and tubing within 12 inches of each fitting 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 pipe 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. 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.
  1. Install test tees (wall cleanouts) in conductors near floor, and floor cleanouts with cover flush with floor.
  2. Pit installation option in first subparagraph below should be detailed on Drawings.
  3. Comply with requirements for cleanouts and drains specified in Section 221423 "Storm Drainage Piping Specialties."
- 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 storm drainage piping. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

### **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.
- 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 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 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 until 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 PIPING SCHEDULE

- A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.
- B. Aboveground storm drainage piping NPS 6 and smaller shall be any of the following:
  1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
  2. Hubless, cast-iron soil pipe and fittings; CISPI, hubless-piping couplings; and coupled joints.
- C. Aboveground, storm drainage piping NPS 8 and larger shall be any of the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
  2. Hubless, cast-iron soil pipe and fittings; CISPI, hubless-piping couplings; and coupled joints.
- D. Underground storm drainage piping NPS 6 and smaller shall be any of the following:
1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
- E. Underground, storm drainage piping NPS 8 and larger shall be any of the following:
1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
  2. Hubless, cast-iron soil pipe and fittings; CISPI, hubless-piping couplings; and coupled joints.

□ □ □ □ □

## SECTION 221423 - STORM DRAINAGE PIPING SPECIALTIES

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Roof drains.
2. Miscellaneous storm drainage piping specialties.
3. Cleanouts.
4. Through-penetration firestop assemblies.
5. Flashing materials.

#### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

#### 1.3 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

### PART 2 - PRODUCTS

#### 2.1 METAL ROOF DRAINS

A. Cast-Iron, Large-Sump, General-Purpose Roof Drains:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Josam Company.
  - b. Marathon Roofing Products.
  - c. MIFAB, Inc.
  - d. Smith, Jay R. Mfg. Co.
  - e. Tyler Pipe.
  - f. Watts Water Technologies, Inc.
  - g. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.6.4, for general-purpose roof drains.
3. Body Material: Cast iron.
4. Dimension of Body: Nominal 14-inch diameter.
5. Outlet: Bottom.
6. Dome Material: Cast iron.

## **2.2 MISCELLANEOUS STORM DRAINAGE PIPING SPECIALTIES**

### **A. Conductor Nozzles:**

1. Description: Bronze body with threaded inlet and bronze wall flange with mounting holes.
2. Size: Same as connected conductor.

## **2.3 CLEANOUTS**

### **A. Floor Cleanouts:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Josam Company.
  - b. Oatey.
  - c. Sioux Chief Manufacturing Company, Inc.
  - d. Smith, Jay R. Mfg. Co.
  - e. Tyler Pipe.
  - f. Watts Water Technologies, Inc.
  - g. Zurn Plumbing Products Group; Light Commercial Products Operation.
  - h. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.36.2M, for adjustable housing cast-iron soil pipe with cast-iron ferrule cleanouts.
3. Size: Same as connected branch.
4. Type: Adjustable housing Cast-iron soil pipe with cast-iron ferrule.
5. Body or Ferrule Material: Cast iron.

6. Outlet Connection: Inside calk.
7. Closure: Brass plug with tapered threads.
8. Adjustable Housing Material: Cast iron with set-screws or other device.
9. Frame and Cover Material and Finish: Rough bronze.
10. Frame and Cover Shape: Round.
11. Top-Loading Classification: Medium Duty.
12. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.

**B. Test Tees:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Josam Company.
  - b. MIFAB, Inc.
  - c. Smith, Jay R. Mfg. Co.
  - d. Tyler Pipe.
  - e. Watts Water Technologies, Inc.
  - f. 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 or raised head, brass.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

**C. Wall Cleanouts:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Josam Company.

- b. MIFAB, Inc.
  - c. Smith, Jay R. Mfg. Co.
  - d. Tyler Pipe.
  - e. Watts Water Technologies, Inc.
  - f. 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: 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: Drilled-and-threaded brass plug.
- 6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
- 7. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with screw.

## 2.4 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

### A. Through-Penetration Firestop Assemblies:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. ProSet Systems Inc.
- 2. Standard: ASTM E 814, for through-penetration firestop assemblies.
- 3. Certification and Listing: Intertek Testing Service NA 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.

## 2.5 FLASHING MATERIALS

- A. Copper Sheet: ASTM B 152/B 152M, 12 oz./sq. ft..
- 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.
  - 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 conductor nozzles at exposed bottom of conductors where they spill onto grade.
- C. 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.
- D. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

- E. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- F. Install horizontal backwater valves in floor with cover flush with floor.
- G. Install drain-outlet backwater valves in outlet of drains.
- H. Install test tees in vertical conductors and near floor.
- I. Install wall cleanouts in vertical conductors. Install access door in wall if indicated.
- J. Install trench drains at low points of surface areas to be drained. Set grates of drains flush with finished surface unless otherwise indicated.
- K. Assemble channel drainage system components according to manufacturer's written instructions. Install on support devices so that top will be flush with adjacent surface.
- L. Install through-penetration firestop assemblies in plastic conductors at concrete floor penetrations.
- M. Install sleeve flashing device with each conductor passing through floors with waterproof membrane.

### **3.2 CONNECTIONS**

- A. Comply with requirements for piping specified in Section 221413 "Facility Storm Drainage Piping." 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. Lead Sheets: Burn joints of 6.0-lb/sq. ft. lead sheets, 0.0938-inch thickness or thicker. Solder joints of 4.0-lb/sq. ft. lead sheets, 0.0625-inch 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 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.

Storm Drainage Piping Specialties

- 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.



## SECTION 221429 - SUMP PUMPS (ELEVATORS)

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Submersible sump pumps.
- B. Related Section:
  - 1. Section 221329 "Sanitary Sewerage Pumps" for effluent and sewage pumps.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Wiring Diagrams: For power, signal, and control wiring.

#### 1.3 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For pumps and controls, to include in operation and maintenance manuals.

#### 1.4 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. UL Compliance: Comply with UL 778 for motor-operated water pumps.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Retain shipping flange protective covers and protective coatings during storage.
- B. Protect bearings and couplings against damage.
- C. Comply with pump manufacturer's written rigging instructions for handling.

### PART 2 - PRODUCTS

#### 2.1 SUBMERSIBLE SUMP PUMPS (ESP-1)

- A. Submersible, Fixed-Position, Single-Seal Sump Pumps:
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Stancor, Inc.
    - b. Weil
  - 2. Description: The contractor shall furnish and install a complete pump and Oil-Monitoring control system for each elevator pit, as shown on the drawings. The pumping system shall be capable of pumping water while containing oil. The pump and oil sensor technology control system must comply with ASME 17.1 standards. The system shall function automatically and shall provide a local audible alarm with silence switch and LED indicator lights for EACH of the following events a) the presence of oil in the sump when the pump is signaled to run, b) high liquid in the sump, c) high amps or a locked rotor motor condition, d) electrical power to the panel and e) pump activation. An alarm that sounds only in the event of a high liquid level condition and/or oil detected in the pit shall not be considered equal and will not be accepted. Provide dry contacts for remote monitoring of oil detected, high water alarm, and high amperage/motor overload alert. The Oil Monitoring Control System shall have a minimum of 10 years of proven reliability. The control unit, pump, floats and sensor probe shall be factory assembled as a complete, ready to use system and shall be tested, approved and labeled, for the intended purpose as a system, by a nationally recognized testing laboratory such as ENTELA.

3. Pump Type: The sump pump shall be a heavy duty submersible type, capable of pumping 100 GPM @ 25' TDH. The pump shall be approved to meet UL 778 standards and shall include thermal and overload protection. The motor shall be rated 2 H.P., 3 phase, 60 Hertz, 230/460 volt, and shall be capable of operating continuously or intermittently. The pump shall have a minimum discharge connection size of 2".
4. Pump Casing: Cast iron, with strainer inlet, legs that elevate pump to permit flow into impeller, and vertical discharge for piping connection.
5. Impeller: The pump shall have a semi-open non-clogging Vortex impeller, and shall be designed for floor mounting complete with support legs
6. Pump and Motor Shaft: Stainless steel, with factory-sealed, grease-lubricated ball bearings.
7. Seal: Mechanical.
8. Motor: The motor housing and fastening bolts shall be constructed of 304 Stainless Steel and the mechanical seals shall be housed in a separate oil-filled compartment.
9. Controls:
  - a. The Solid State Oil-Monitoring control system shall be approved to UL508 standards and housed in a gasketed NEMA 4X enclosure with (2) 8-pin twist-lock waterproof electrical receptacles. The control panel shall include a field adjustable switch, with variable sensitivity settings, which is capable of sensing and alarming for emulsified or solid oil. The control shall also include a separate over-current relay and field adjustable motor overload heater with an optional automatic or manual reset button. The factory installed Oil Sensor probe detection system must be hermetically sealed, heavy duty, Stainless Steel with low voltage self-cleaning technology. The oil sensor probe voltage shall not exceed 15 millivolts DC until it comes in contact with water, at which point the oil sensor returns to 5VDC. The low 15 millivolt DC input reduces the potential field and subsequent metal ion exchange, preventing build up of foreign matter on the probe surface. **Oil sensing systems using optical lenses, or standard stainless steel probes, subject to dirt contamination and false alarms are not considered equal.** The pump control float and oil sensing probe are to be factory mounted on the pump and factory tested. The bottom of the sensor probe shall be no higher than 2" from the base of the sump. A probe system that mounts higher than 2" from the base of the sump and does not allow for the full capacity of the sump will not be accepted. Pipe discharge mounted pump floats and oil sensors are not considered equal. The control panel shall have a high decibel warning horn with illuminated red light complete with alarm silencing switch.
  - b. The control panel shall have a reset switch which, when depressed for 5 seconds, will sequence through all functions of the system including oil alert, high water alert, power to the system and pump run. A system that requires personnel to enter the elevator pit to perform periodic test functions will not be considered as equal.
  - c. The system shall include dual float switches for pump activation and high water alarm, with the high water alarm float also acting as a redundant pump run (on) float in the event of the primary pump run float being incapacitated. A system not having a redundant activation switch will not be accepted. Dry contacts for remote monitoring functions shall be clearly marked on the terminal board.
10. Junction Box: Provide a NEMA 6P junction box with a service disconnect switch which will be factory pre-wired to the pump, oil probe and float switches via 16' long cables.

Junction box shall have (1) 8-pin twist-lock for control and (1) SO cable for pump. One for power and one for floats and probe. Contractor to coordinate if longer cables are required. Provide as required by project conditions connecting cable in 25' lengths with 8-pin quick connects on each end to connect the junction box to the control panel. Total cable length shall not exceed 250 feet. Provide factory hard wiring of pump, oil probe and floats into the NEMA 4X junction box. All cables between the pump and junction box shall be 16' long and the electrical cable and plug from the control panel shall be 6' long.

## 2.2 SUMP PUMP CAPACITIES AND CHARACTERISTICS

- A. Unit Capacity: Refer to drawing schedule.
- B. Number of Pumps: Refer to contract documents.
- C. Each Pump:
  - 1. Capacity: Refer to drawing schedule.
  - 2. Total Dynamic Head: Refer to drawing schedule.
  - 3. Speed: Refer to drawing schedule.
  - 4. Discharge Size: Refer to contract documents.
  - 5. Basin: Refer to contract documents.
  - 6. Electrical Characteristics: Refer to contract documents
    - a. Motor Horsepower: Refer to contract documents
    - b. Volts: Refer to contract documents
    - c. Phases: Refer to contract documents
    - d. Hertz: Refer to contract documents
- D. Unit Electrical Characteristics:
  - 1. Full-Load Amperes: Refer to contract documents

## 2.3 MOTORS

- A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 220513 "Common Motor Requirements for Plumbing 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. Motors for submersible pumps shall be hermetically sealed.

## PART 3 - EXECUTION

### 3.1 EARTHWORK

- A. Excavation and filling are specified in Section 310000 "Earthwork."

### 3.2 EXAMINATION

- A. Examine roughing-in for plumbing piping to verify actual locations of storm drainage piping connections before sump pump installation.

### 3.3 INSTALLATION

- A. Pump Installation Standards: Comply with HI 1.4 for installation of sump pumps.

### 3.4 CONNECTIONS

- A. Comply with requirements for piping specified in Section 221413 "Facility Storm Drainage Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.

### 3.5 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, test, and adjust components, assemblies, and equipment installations, including connections.

- B. Perform tests and inspections.
- C. 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 motor rotation and unit operation.
  - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Pumps and controls will be considered defective if they do not pass tests and inspections.
- E. 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 pumps to function smoothly and lubricate as recommended by manufacturer.
- B. Adjust control set points.

**3.8 DEMONSTRATION**

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain controls and pumps.



## SECTION 223300 - ELECTRIC, DOMESTIC-WATER HEATERS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Commercial and Residential storage, electric, domestic-water heaters.
2. Digital Microprocessor-control, electric, tankless, domestic-water heaters.
3. Domestic-water heater accessories.

#### 1.2 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. LEED Submittals:

1. Product Data for Prerequisite EA 2: Documentation indicating that units comply with applicable requirements in ASHRAE/IESNA 90.1, Section 7, "Service Water Heating."

C. Shop Drawings:

1. Wiring Diagrams: For power, signal, and control wiring.

#### 1.3 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of, 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.

#### 1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For electric, domestic-water heaters 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. 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, "Drinking Water System Components - Health Effects."

## 1.6 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

## 1.7 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 and Residential Storage, Electric, Domestic-Water Heaters:

- 1) Storage Tank: 10-year coverage for manufacturing or material defects, leaks and /or the production of rusty water. Tank coverage shall include failure due to scale buildup with no provision or condition for maintenance or inspections and no limitations on water chemistry. Tank warranty does not require inspection and maintenance of anode rods.

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- 2) Stress Corrosion Cracking Warranty – 10-year, non-prorated coverage for failure of tank or heat exchanger due to chloride-induced stress corrosion cracking with no limit to the level of dissolved chlorides in the potable water supply and no exclusion for scale build up
- 3) The heater shall have a first-year service policy, which shall cover labor and freight costs under certain conditions for warranty covered services.
- 4) The heating elements and all heater parts shall have a one-year warranty.

b. Compression Tanks: Five years.

## PART 2 - PRODUCTS

### 2.1 COMMERCIAL AND RESIDENTIAL, ELECTRIC, DOMESTIC-WATER HEATERS

#### A. Commercial, Storage, Electric, Domestic-Water Heaters:

1. **Basis-of-Design Product:** Subject to compliance with requirements, provide product indicated on Drawing P0.02 or comparable product by one of the following:
  - a. Durawatt.
  - b. Hubbell.
  - c. Electric Heater Company (The).
  - d. American Water Heaters.
  - e. Heat Transfer Products, Inc.
  - f. Lochinvar Corporation.
  - g. Rheem Manufacturing Company.
  - h. Smith, A. O. Water Products Co.; a division of A. O. Smith Corporation.
  - i. Bradford White Corporation.
2. Standard: UL 174.
3. Storage-Tank Construction: Steel, vertical arrangement.
  - a. Tappings: ASME B1.20.1 pipe thread.
  - b. Pressure Rating: 150 psig.

- c. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending lining material into tappings.

**4. Factory-Installed Storage-Tank Appurtenances:**

- a. Anode Rod: Replaceable magnesium.
- b. Dip Tube: Required unless cold-water inlet is near bottom of tank.
- c. Drain Valve: ASSE 1005.
- d. Insulation: Comply with ASHRAE/IESNA 90.1 or ASHRAE 90.2.
- e. Jacket: Steel with enameled finish.
- f. Heat-Trap Fittings: Inlet type in cold-water inlet and outlet type in hot-water outlet.
- g. Heating Elements: Two; electric, screw-in immersion type; wired for simultaneous operation unless otherwise indicated. Limited to 12 kW total.
- h. Temperature Control: Adjustable thermostat.
- i. Safety Control: High-temperature-limit cutoff device or system.
- j. Relief Valve: ASME rated and stamped for combination temperature-and-pressure relief valves. 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.

**5. Special Requirements:** NSF 5 construction with legs for off-floor installation.

**B. Thermostat-Control, Electric, Tankless, Domestic-Water Heaters:**

- 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawing P002 or comparable product by one of the following:
  - a. Bosch
  - b. Chronomite Laboratories
- 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: Thermostat.
  - 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:
- a. Refer to Schedule.

## 2.2 DOMESTIC-WATER HEATER ACCESSORIES

### A. Domestic-Water Compression Tanks:

- 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawing P0.02 or comparable product by one of the following:
  - a. Wessel
  - b. Extrol.
  - c. Honeywell International Inc.
  - d. Pentair Pump Group (The); Myers.
  - e. Smith, A. O. Water Products Co.; a division of A. O. Smith Corporation.
  - f. State Industries.
  - g. Taco, Inc.
  - h. AMTROL Inc.
  - i. Flexcon Industries
- 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 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:**
  - a. Working-Pressure Rating: 150 psig.
  - b. Capacity Acceptable: See drawing schedule P0.02.
  - c. Air Precharge Pressure:
- 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.
- C.** Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE/IESNA 90.1 or ASHRAE 90.2.
- D.** Heat-Trap Fittings: ASHRAE 90.2.
- E.** 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.
- F.** Pressure Relief Valves: ASME rated and stamped. Include pressure setting less than domestic-water heater working-pressure rating.
- G.** Vacuum Relief Valves: ANSI Z21.22/CSA 4.4.
- H.** Shock Absorbers: ASSE 1010 or PDI-WH 201, Size "A" water hammer arrester.
- I.** 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.
- J.** Domestic-Water Heater Mounting Brackets: Manufacturer's factory-fabricated steel bracket for wall mounting, capable of supporting domestic-water heater and water.

### **2.3 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 commercial 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.

**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."
  - 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 "General-Duty 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.
- E. 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."
- F. Install thermometers on outlet piping of electric, domestic-water heaters. Comply with requirements for thermometers specified in Section 220519 "Meters and Gages for Plumbing Piping."
- G. Install piping-type heat traps on inlet and outlet piping of electric, domestic-water heater storage tanks without integral or fitting-type heat traps.
- H. Fill electric, domestic-water heaters with water.
- I. 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.

### **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.



## SECTION 224100 - 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:

1. Bathtubs.
2. Faucets.
3. Lavatories.
4. Showers.
5. Bar sinks.
6. Kitchen sinks.
7. Dishwasher air-gap fittings.
8. Disposers.
9. Water closets.
10. Toilet seats.
11. Supply fittings.
12. Waste fittings.

#### 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 lavatories.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

- B. Shop Drawings: Include diagrams for power, signal, and control wiring.

#### **1.4 INFORMATIONAL SUBMITTALS**

- A.** Coordination Drawings: Counter cutout templates for mounting of counter-mounted plumbing fixtures.
- B.** Sample Warranty: For special warranty.

#### **1.5 CLOSEOUT SUBMITTALS**

- A.** Operation and Maintenance Data: For plumbing fixtures and faucets to include in and operation 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.** Faucet Washers and O-Rings: Equal to **10** percent of amount of each type and size installed.
  - 2.** Faucet Cartridges and O-Rings: Equal to **5** percent of amount of each type and size installed.
  - 3.** Flushometer-Tank Repair Kits: Equal to **5** percent of amount of each type installed, but no fewer than **two** of each type.
  - 4.** Toilet Seats: Equal to **5** percent of amount of each type installed.

#### **1.7 WARRANTY**

- A.** Special Warranty: Manufacturer agrees to repair or replace components] 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. Deterioration of metals, metal finishes, and other materials beyond normal use.

### **PART 2 - PRODUCTS**

#### **2.1 PLUMBING FIXTURES**

- A.** Fixtures shall be as specified (or equal) by architect or interior designer. See Architectural PLUMBING FIXTURE SCHEDULE drawing A-400 or Interior drawing IA-001.
  - 1.** Provide fixtures and trim manufactured by one of the following manufacturers:
    - a. Kohler
    - b. American Standard

- c. Sterling
  - d. Crane
  - e. Toto
  - f. Delta
  - g. Elkay
  - h. Just
  - i. Gran Am
  - j. Moen
  - k. Church
  - l. Bemis
2. Fixture: Provide and install all necessary or required fittings, stops, chrome flexible supplies, traps, valves, escutcheons, wax ring, gaskets, anchors, bolts, tub waste and overflow (Soldered Copper), under deck clamps, etc.. for a complete and operational fixture in accordance with manufacturers installation requirements and local code.

## 2.2 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.

## 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 walls, floors, cabinets, and counters for suitable conditions where fixtures will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Install plumbing fixtures level and plumb according to roughing-in drawings.
- B. Install floor-mounted water closets on closet flange attachments to drainage piping.
- C. Install counter-mounting fixtures in and attached to casework.
- D. Install pedestal lavatories on pedestals and secured to wood blocking in wall.
- E. 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 or gate valves if supply stops are not specified with fixture. Comply with valve requirements specified in Section 220523.12 "Ball Valves for Plumbing Piping" and Section 220523.15 "Gate Valves for Plumbing Piping."
- F. Install tanks for accessible, tank-type water closets with lever handle mounted on wide side of compartment.
- G. Install toilet seats on water closets.
- H. 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.
- I. Install shower flow-control fittings with specified maximum flow rates in shower arms.
- J. Install traps on fixture outlets.
  - 1. Exception: Omit trap on fixtures with integral traps.
  - 2. Exception: Omit trap on indirect wastes unless otherwise indicated.
- K. Install disposer in outlet of each sink indicated to have a disposer. Install switch where indicated or in wall adjacent to sink if location is not indicated.
- L. Install dishwasher air-gap fitting at each sink in accordance with local code to have air-gap fitting. Install on countertop at sink. Connect inlet hose to dishwasher and outlet hose to disposer.
- M. Install hot-water dispensers in back top surface of sink or in countertop with spout over sink.
- N. Set bathtubs and shower receptors in leveling bed of cement grout.
- O. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible lavatories and sinks.
- P. Install wall One piece chrome flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings.

- Q.** Seal joints between plumbing fixtures, counters, floors, 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.** Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."
- D.** Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible lavatories and sinks. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

### **3.4 ADJUSTING**

- A.** Operate and adjust plumbing fixtures and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.
- B.** Adjust water pressure at faucets to produce proper flow.

### **3.5 CLEANING AND PROTECTION**

- A.** After completing installation of plumbing fixtures, inspect and repair damaged finishes.
- B.** Clean plumbing fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.
- C.** Provide protective covering for installed plumbing fixtures and fittings.
- D.** Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.



## SECTION 23 05 00 - MECHANICAL GENERAL PROVISIONS

### PART 1 - GENERAL

#### 1.1 GENERAL

- A. Work Included: This section specifies categories of provisions for mechanical work, including:
  - 1. Certain adaptive expansions of requirements specified in Division 01, as uniquely applicable to mechanical work
  - 2. General performance requirements within the mechanical work as a whole, and
  - 3. General work to be performed as mechanical work, because of its close association with mechanical work.
- B. Drawings: Refer to the mechanical, plumbing and electrical drawings for graphic representations, schedules and notations showing mechanical work.
- C. The plans are generally diagrammatic, and the Contractor shall coordinate the work of the different trades in order that interferences between mechanical, electrical, architectural and structural work will be avoided. All necessary offsets in conduit, piping and fittings, etc., required to properly install the work shall be furnished complete in place. Piping, ducts, etc., shall be kept as close as possible to ceilings, walls, columns, etc., in order to take up the minimum amount of space and all offsets, fittings, etc., required shall be furnished and installed without additional expense to the Owner. In case avoidable interference develops, the Architect will decide which equipment shall be relocated regardless of which was first installed and modifications will be made without additional expense to Owner. See also "Coordinated Layouts" as hereafter specified.
- D. Where any device or part of equipment is herein referred to in the singular number (such as "the pump"), such reference shall be deemed to apply to as many devices as are required to complete the installation as shown on the drawings.
- E. Provide all accessories and appurtenances as needed to provide complete, operable, and code-compliant systems, whether these accessories and appurtenances are specifically called for in drawings or specifications.
- F. Specifications: Refer to Division 23 sections for the primary technical specifications of mechanical work.
- G. Alternative Equipment and Systems: The drawings and specifications are based on the equipment noted on the bid documents. Any modifications suggested by the contractor requires approval of both the architect and the engineer and shall be implemented at full responsibility of the contractor for coordination, time and cost.

## 1.2 WORK BY OTHERS:

- A. All exterior wall louvers, where shown on architectural drawings, will be furnished and installed, as indicated under the architectural section of the specifications. Louvers furnished as an integral part of a piece of equipment, such as propeller type fan louver shall be furnished and installed by the Mechanical Contractor. Mechanical Contractor shall be responsible to cover, with insulated (one inch thick) sheet metal panel, all portions of unused louvers furnished for the project.
- B. Concrete foundations are excluded from Division 23 work. Mechanical contractor shall provide layout and set forms for equipment foundations and concrete pads. Coordinate with general contractor.
- C. All electric wiring except automatic temperature/energy management control wiring/interlock wiring/alarm interface wiring unless otherwise noted.
- D. Starters, controllers, pilot lights, etc., for mechanical equipment shall be furnished by the Mechanical Contractor, except starters for equipment that is located in motor control centers or indicated on Division 26 documents; these will be furnished by the Electrical Contractor. All starters will be installed by the Electrical Contractor. Mechanical Contractor must coordinate types, sizes, and electrical characteristics, etc., with Electrical Contractor including starters furnished in the motor control centers. Coordinate interface with temperature/energy management/fire control, for all mechanical equipment.
- E. The Mechanical Contractor shall be responsible for furnishing to the Electrical Contractor a list of all electrical characteristics, ampacities, minimum feeder sizes and electrical disconnect switch sizes for all equipment, and requirements for each motor and shall provide wiring diagrams. The characteristics must be furnished prior to the Electrical Contractor's ordering, furnishing or installing any of his equipment.
- F. All control/energy management/fan-damper/fire control wiring is included in Division 23, including interlock/interconnecting wiring, delays, etc., for all Division 23 equipment.
- G. Furnishing and installing of electrical resistance wiring (heat tape or cable) electric cabinet heaters, unit heaters, finned tube radiation, etc., is included in the mechanical work with final connection to the power source by the Electrical Contractor. The Mechanical Contractor is required to utilize Division 26 power locations indicated. If additional junction boxes, wiring, etc., are required it shall be at the expense of the Division 23 Contractor.
- H. Light fixtures with return air openings will be provided by the Electrical Contractor.
- I. The Electrical Contractor will provide one dedicated 20-amp junction box in each mechanical equipment room for automatic temperature control equipment power and as indicated on plans. Additional junction boxes necessary shall be provided by the mechanical contractor and wired by Division 26 Contractor at no additional cost.

### 1.3 COORDINATION OF MECHANICAL WORK:

- A. General:** Refer to the Division 01 sections for general coordination requirements applicable to the entire work. It is recognized that the contract documents are diagrammatic in showing certain physical relationships that must be established within the mechanical work, and in its interface with other work including utilities and electrical work, and that such establishment is the exclusive responsibility of the Contractor.
1. Arrange mechanical work in a neat, well-organized manner with piping and similar services running parallel with primary lines of the building construction. Hold all work at an elevation to maintain ceiling heights indicated on the Architectural Drawings and not less than 7'-0" (or higher if needed for code compliance) in unfinished areas. All mechanical work should be held as tight to underside of slab as possible.
  2. Locate operating and control equipment properly to provide easy access and arrange entire mechanical work with adequate access for operation and maintenance.
  3. Give right-of-way to piping that must slope for drainage.
  4. Advise other trades of openings required in their work for the subsequent move-in of large units of mechanical work (equipment).
- B. Pipe Sleeves for Structural Elements.** (See Other Division 23 Sections for Additional Sleeving Requirements)
1. The contractor shall furnish and install sleeves in connection with all piping passing through foundations, grade beams, walls, slabs, partitions, or other building construction. Sleeves shall be set in concrete construction before pouring, and in masonry during construction. The Contractor shall be responsible for the locating, setting and anchoring of sleeves in a substantial manner so that they will not become displaced. Contractor shall consult with the Architect and receive his approval for all sleeves. See Division 23 Sections for sleeve seal requirements.
  2. All sleeves installed shall be A500 structural steel. Annular space in pipe sleeves between sleeve and pipe or insulation shall be fire-safe to slab and wall rating. Refer to other Division 23 Sections and Division 1 sections for Fire saving requirements.
  3. Sleeves in exterior walls and grade beams below grade shall be a waterproof type installed with approved caulking between sleeve and piping to make them waterproof.
  4. The Contractor shall cut all new holes in existing floors, walls, etc., required for the passage and accommodation of pipes, conduits, etc., and shall remove all debris caused by this work with approval of Architect. No joint or beams shall be cut in the process without approval. All holes shall be in the fill, and all holes shall be cut by hand or with a core drill; no jackhammer will be allowed. No cutting of any walls or floor shall be done until the condition of such cutting has been approved by the Architect.
  5. A coordinated sleeve plan shall be submitted and shall show dimensionally all openings, sleeves, pipes, etc., through any structural members, and reference all items off of column lines. These sleeve drawings are to be clean drawings not prepared on the contract documents and shall be submitted to the architect for approval. All Divisions 23 and 26 openings shall be included.

## 1.4 COORDINATION DRAWINGS:

### A. Coordination Drawings

1. As soon as practicable after award of the contract, the Contractor shall prepare cross-discipline/composite coordination and layout drawings at not less than 1/4" = 1'-0" scale. These drawings shall be in preliminary composite format showing all mechanical and electrical items to be installed with their dimensional relationship to beams, ceilings, walls, floors, columns, doors, other major architectural and structural features, and each other. The coordinated drawings shall be complete and contain the work requirements of all Division 23 and Division 26 disciplines; i.e., HVAC, Plumbing, Electrical, Fire Protection, Process Piping, Mechanical, etc. In preparing the drawings, minor changes that do not affect the intended function may be made as required to avoid space conflicts, when approved. Items may not be resized, or exposed items relocated without the Architect's written approval.
2. Upon the completion of the preliminary composite layout drawings the Contractor shall submit same for review during a series of meetings, at which all involved trades shall be represented, in order to review and resolve any real or apparent interference's or conflicts.
3. After all interference's or conflicts are resolved, the Contractor shall develop legible, neat, final composite drawings showing the agreed upon routing, layout, etc., of all ductwork, piping, conduits, valves, panels, fixtures, and all other mechanical and electrical equipment and installations. In preparation of final composite drawings large-scale details, as well as cross and longitudinal sections shall be made as required to fully delineate all conditions. Particular attention shall be given to the locations, size, and clearance dimensions of equipment items, shafts, and similar features. The final drawings shall be signed off by; each of the trade contractors, verifying their awareness of the agreement with the indicated routings and layouts and inter-relationship with the adjoining or contiguous work. Thereafter, no unauthorized deviations will be permitted without approval. The contractor shall update the drawings as project documents are revised.

## 1.5 QUALITY ASSURANCE, STANDARDS AND SYMBOLS:

- A. General:** Specifically, for the mechanical work (in addition to standards specified in individual work sections), the following standards and codes are imposed, as applicable to the work in each instance:

1. International Code (Current Editions as applicable to this project)
2. USGBC LEED Standards (Current Editions as applicable to this project)
3. ASHRAE Standard 55 (Current Edition as applicable to this project)
4. ASHRAE Standard 90.1 (Current Edition as applicable to this project)
5. AWS standards for welding.
6. Local plumbing code.
7. NFPA-13 - Sprinkler system, installation.
8. NFPA-14 - Standpipe and hose systems.

- 9.** NFPA-20 - Centrifugal Fire Pumps.
  - 10.** NFPA-24 - Outside protection.
  - 11.** NFPA-54 - National fuel gas code.
  - 12.** Hydraulic Institute Test Code for Centrifugal Pumps.
  - 13.** Hydraulic Institute Test Code for Rotary Pumps.
  - 14.** ASHRAE Standard 27-69, ASHRAE Standard Methods of Testing for Rating Unitary Air Conditioning Equipment.
  - 15.** NFC Pamphlet No. 90A, Standard for the Installation of Air Conditioning Equipment.
  - 16.** AMC Bulletin No. 210, Standard Test Code for Air Moving Devices.
  - 17.** ASHRAE Guide and Data Books: (Latest Edition)
    - a.** Handbook of fundamentals,
    - b.** Equipment,
    - c.** Systems,
    - d.** Applications,
  - 18.** U.L.I. Standard 873, Underwriters; Laboratories, Inc., Standard for Temperature Indicating and Regulating Equipment.
  - 19.** The National Electrical Code.
  - 20.** Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA) manuals for duct construction; flexible duct installation standard; duct liner application standard and duct testing standards.
  - 21.** The rules and regulations of the local electric, voice/data, water, sewer and other applicable utilities.
  - 22.** The Standards of the National Electrical Manufacturer's Association.
  - 23.** The Standards Rules of the Institute of Electrical and Electronics Engineers.
  - 24.** The applicable provisions of the Occupational Safety and Health Act (OSHA) and applicable regulations pertaining to handicapped access.
  - 25.** Local Energy Conservation Code.
  - 26.** Manufacturers' Standardization Society of the Valves and Fittings Industry.
  - 27.** Governing federal and local government ordinances, statutes and referenced codes and standards shall constitute minimum requirements and strict compliance is required unless supplemented or modified by more astringent requirements of the contract documents.
  - 28.** And others hereinafter specified.
- B.** Contractor shall obtain and pay for all permits and inspection certificates required for the successful completion of the job and shall include in this contract all fees incidental thereto.
- C.** Symbols: Except as otherwise indicated, refer to the drawings for definitions of symbols used on the drawings to show Division 23 work.

## **1.6 SUBMITTALS:**

- A.** General: For mechanical work, the following quantities are required for each category of submittal unless specified in Division 1 as requiring more copies. Quantities do not include copies required by governing authorities, or by Contractor for its own purposes.

1. Shop Drawings: 6 sets, including 2 for maintenance manuals.
  2. Product Data: 6 sets, except 4 sets where not required in maintenance manuals.  
(Reference applicable specification section with submittal.)
  3. Samples: 4 sets for final submission.
  4. Certifications: 3 copies.
  5. Test Reports: 3 copies.
  6. Warranties (Guarantees): 5 copies, including 2 for maintenance manuals.
    - a. Maintenance Manuals: 2 final copies, including flow diagrams, maintenance instructions, operating instructions, parts listings, valve schedules, energy management, and copies of other submittals indicated for inclusion.
    - b. Maintenance Manuals: Organize each maintenance manual with index and thumb-tab marker for each section of information; bind in 3-ring or expanding vinyl-covered binder with pockets to contain folded sheets, properly labeled on spine and face of binder.
    - c. Provide list of names, phone number and contact for all equipment vendors.
- B. Provide a conformance summary listing all exceptions, deviations, clarifications or enhancements to the specification on a subparagraph by subparagraph basis. Shop drawings and submittals without this summary will be returned “rejected.”
- C. USGBC LEED Submittals: This project will be LEED certified. Contractor and all subcontractors shall comply with all USGBC LEED submittal requirements. Coordinate requirements with Owner, Architect and project LEED consultant.
- D. This project will be LEED certified and commissioning will be an integral part of the LEED certification process. Contractor and subcontractors shall include and provide all reviews, meetings, subcontractor assistance, and other necessary efforts to achieve LEED Fundamental Commissioning Prerequisite and LEED Enhanced Commissioning Credit.

## 1.7 TEMPORARY FACILITIES:

- A. General: Refer to the Division 01 sections for general requirements on temporary facilities. The following facilities (source, distribution, utilization, operation, maintenance and removal) are hereby defined to be Division 23 work and including alternative temporary use of permanent facilities (if any):
1. Temporary use of mechanical work of this Contract: Contractor shall provide all necessary temporary equipment and/or all filters to enable use of mechanical equipment during construction period as needed and after construction as needed to achieve USGBC LEED flush out requirements.
  2. Temporary water and sewer but excluding drinking water not connected to a piping system.

## **1.8 PRODUCTS, MECHANICAL WORK:**

- A.** General: Refer to Division 01 sections for general requirements on products, materials and equipment. The following provisions expand or modify the requirements as applicable to mechanical work:
- 1.** Product Listing: Prepare the product listing for mechanical work, separately from the listing(s) of products for other work. Include listing of each significant item of equipment and material used in the work; and indicate the generic name, product name, manufacturer, model number, electrical characteristics, related specification section number(s), and estimated date for start of installation. Bulk materials, including pipe and sheet metal, taken from Fabricator's/Installer's stock need not be listed.
    - a.** For principal equipment items, list the power and fuel consumption ratings, the primary output ratings, ampacity, disconnect ratings, and feeder sizes.
    - b.** Submit list within 60 days of Contract award date to Architect, Owner, Engineer, and Division 26 Contractor.
  - 2.** Compatibility: Provide products that are compatible with other products of the mechanical work, and with other work, requiring interface with the mechanical work. Provide products with the proper or correct power characteristics, fuel-burning characteristics and similar adaptations for the project. Coordinate the selections from among options (if any) for compatibility of products.

## **1.9 ADDITIONAL LEED REQUIREMENTS:**

**A. LEED Building General Requirements:**

- 1.** Implement practices and procedures to meet the project's environmental objectives, which include achieving LEED v4 New Construction Certification, with a goal of achieving a Silver rating. Specific project goals which may impact this and the other sections of this specification include: use of recycled-content materials; use of locally-manufactured materials; use of low-emitting materials; use of certified wood products; construction waste recycling; and the implementation of a construction indoor air quality management plan. Ensure that the requirements related to these goals, as defined in this Section and other Sections of the contract documents, are implemented to the fullest extent. Substitutions or other changes to the work shall not be allowed if such changes substantially compromise the stated LEED Building criteria.
  - 2.** Comply with LEED (Leadership in Energy and Environmental Design) Green Building Rating System, Version 3, Silver.
- B.** The following specification sections and references apply to work of this section and are incorporated into the Division 23 requirements:
- 1.** Section 01 81 16 "Facility Environmental Requirements"
  - 2.** Section 01 74 14 "Construction Waste Management Disposal"
  - 3.** Section 01 81 19 "Indoor Air Quality Requirements"

4. Appendix A: LEED CS 2009 Project Checklist
5. Appendix B: LEADERSHIP IN ENERGY AND ENVIRONMENTAL DESIGN (LEED) INSTRUCTIONS FOR OWNER AND CONTRACTOR

## PART 2 - PRODUCTS AND EXECUTION

### 2.1 ELECTRICAL PROVISIONS OF MECHANICAL WORK:

- A. General: The electrical provisions of mechanical work, to be furnished integrally with mechanical work, and can be summarized (but not by way of limitation) to include the following: 1) Motors, 2) Motor starters, 3) Control switch, pilot lights, interlocks and similar devices, 4) Electrical heating coils and devices, heat tape, slab heating, and similar elements in mechanical equipment, 5) Electrical work specified as mechanical work in the HVAC control system, 6) Drip pans to protect electrical work, and 7) where starters are integral with equipment, disconnect shall be provided under Division 26 work.
1. Where mechanical devices are to be incorporated into fabricated electrical units at the factory, furnish devices to the designated factory well in advance of time units are needed at the project.
  2. Starters and controls for mechanical motors that are located in motor control centers shall be furnished by the Division 26 Contractor.
- B. Standards: Where not otherwise indicated, comply with applicable provisions of the National Electrical Code, NEMA standards, and sections of Division 26 of these specifications.
- C. Motors:
1. Manufacturer: U.S. Electrical Motors/Century/Gould/General Electric/Louis Allis, or Westinghouse. Provide motors produced by a single manufacturer to the greatest extent possible and equal in efficiency.
  2. Premium Electric Motor: High efficiency motors shall be provided for all mechanical equipment 3 HP and larger. Motor efficiencies shall be per NEMA standards.
  3. Temperature Rating: Class A insulation, except where otherwise indicated or required for service indicated.
  4. Starting Capability: As required for service indicated, but not less than 5 starts per hour.
  5. Phases and Current: 1/6 HP and smaller is Contractor's option; up to 1/3 HP, capacitor-start single-phase; 1/2 HP and larger, squirrel-case induction polyphase. Provide 2 separate windings on 2-speed polyphase motors. Coordinate with actual current characteristics; refer to Division 26 Sections.
  6. Service Factor: 1.15 for polyphase; 1.35 for single-phase.
  7. Construction: General purpose, continuous duty, Design "B" except "C" for high starting torque applications.
  8. Frames: NEMA No. 48, except 56 for heavy-duty applications.

9. Bearings: Ball or roller, and design for thrust where applicable, shaft seals and greaseable, except provide permanently sealed where not accessible for greasing. Sleeve-type bearings permitted only where indicated for light-duty fractional HP motors. Extend grease lines as required to accessible locations.
10. Enclosure Type: Open drip-proof for normal concealed indoor use, guarded where exposed. Type II for outdoor use, except weather-protected Type I where adequately housed.
11. Overload Protection: Built-in thermal with internal sensing device for stopping motor and for signaling where indicated.
12. Motors controlled by variable frequency drives shall be rated and designed for that application.

**D. Starters, Switches:**

1. Manufacturer: Allen-Bradley, Cutler-Hammer, General Electric, Square D, Siemens, or Westinghouse.
2. Starter characteristics: Provide NEMA Type I general purpose enclosure at all indoor dry locations. Provide NEMA Type 3R at all exterior and damp or wet locations indoors. All starters shall be combination type utilizing a fusible disconnect and magnetically held starter in one common enclosure.
  - a. Provide for 1/2 HP and larger motors, and for smaller motors if automatic control is required. Each starter shall be provided with a modular solid state overload relay or functional equivalent for protection of motors, relays shall include single phase and under voltage protection modules. Overload shall be resettable from front of enclosure.
  - b. Provide each starter with red (stop) green (running) pilot lights, hand off automatic (HOA) switches.
  - c. Provide with minimum of two N.O. and two N.C. auxiliary contacts, exact number required must be coordinated with energy management system and automatic temperature control system.
  - d. All fuses for starter-disconnect switches shall be provided under Division 26 specifications. Coordination between Division 23 supplier of starters and Division 26 supplier of fuses, must be maintained.
  - e. All starters 150 HP and above shall be reduced voltage type, Wye/Delta closed transition.
  - f. Combination starters shall be provided with 120 VAC secondary control transformer, sized for load anticipated and 20% spare capacity. Transformer shall be fused on both the primary and secondary sides.
  - g. Two speed starters shall consist of two magnetic starters electrically and mechanically interlocked and mounted on a common base plate. Each starter shall have auxiliary devices as required for single speed across the line starters. Provide single winding or dual winding type two-speed starters to match the type of multi-speed motor being provided and coordinate all wiring connections with the electrical contractor.
  - h. General Wiring: Comply with applicable provisions of Division 26 Sections.

## **2.2 MECHANICAL SYSTEM IDENTIFICATION:**

### **A. Piping System:**

- 1.** General: Provide adequate marking of piping, including that which is concealed in accessible spaces. Provide color coded valve finder ceiling tacks to indicate location of accessible but hidden or concealed valves. Provide pre-printed color-coded plastic pipe markers or color-coded stencil painted markers. Indicate each pipe system by its generic name (abbreviated) as shown on drawing Symbol lists; except drainage and vent piping may be indicated by color-coding only. Comply with ANSI A13.1 for colors. Include flow and directional arrows to show direction of flow. Arrows to be black on yellow background or white with green background. Refer to Architect for appropriate color and application. See Additional requirements in Section 230553, “Identification for HVAC Piping and Equipment.”
- 2.** Locate markers at terminations of lines and near major branches; near control valves and at equipment connections; where lines pass through walls, floors and ceilings; at access doors where piping is in concealed spaces; and at spacing of not more than 50' along each line for piping. Provide color/identification chart in maintenance manuals.

**CLASSIFICATION OF HAZARDS OF MATERIALS AND DESIGNATION OF COLORS**

CLASSIFICATION	COLOR OF FIELD	COLOR OF LETTERS FOR LEGEND
MATERIALS INHERENTLY HAZARDOUS Flammable or Explosive Chemically Active or Toxic Extreme Temperatures or Pressures	Yellow Yellow Yellow	Black Black Black
MATERIALS OF INHERENTLY LOW HAZARD Liquid or Liquid Admixture Gas or Gaseous Admixture	Green Blue	White White
FIRE QUENCHING MATERIALS Water, Foam, CO <sub>2</sub> , Halon, Etc.	Red	White
Code No.	Legend	Background Color
A4	ACID	Y
A12	AIR	B
A13	AIR VARYING PRESSURE	Y
B4	BOILER FEED	Y
B7	BRINE	GW
C17	CONDENSATE	Y
H6	HIGH-PRESSURE CONDENSATE	Y
L2	LOW-PRESSURE CONDENSATE	Y
D16	DOMESTIC	GW
D17	DRAIN	GW
F6	FIRE PROTECTION WATER	R
S9	SPRINKLER FIRE	R
G1	GAS	Y
H7	HIGH-PRESSURE GAS	Y
L10	LOW-PRESSURE GAS	Y
H3	HEATING	Y
R17	REFRIGERATED LIQUID	Y
R18	REFRIGERATED SUCTION	Y
S23	SANITARY SEWER	GW
H8	HIGH-PRESSURE STEAM	Y
L4	LOW-PRESSURE STEAM	Y
S18	STEAM RETURN	Y
S24	STORM SEWER	GW
C33	CHILLED WATER RETURN	GW

CLASSIFICATION	COLOR OF FIELD	COLOR OF LETTERS FOR LEGEND
C34	CHILLED WATER SUPPLY	GW
C35	CIRCULATING WATER	GW
C39	COLD WATER SUPPLY	GW
C40	CONDENSER WATER	GW
D19	DOMESTIC COLD WATER	GW
D6	DOMESTIC HOT WATER	Y
D12	DRAIN WATER	GW
F6	FIRE PROTECTION WATER	R

B = Blue with White Letters

GW = Green with White Letters

R = Red with White Letters

Y = Yellow with Black Letters

#### **B. Valve Identification:**

1. Tags: Polished brass with 1/4" high stamp- engraved lettering, indicating system service and valve number.
2. Application: Tag every valve, valve-cock and control device in Division 23 work piping systems; exclude check valves, valves within equipment units, hose bibs, faucets and shut-off valves of plumbing fixtures.
3. Valve Schedule: Prepare and submit valve tag schedule (in duplicate), LISTING EACH TAGGED VALVE by location, and tag description. Install each page of the valve schedule in glazed frames, and mount where directed by Owner. Include one copy in the maintenance manuals.
4. Plumbing valve tags to be round and mechanical valve tags to be square.

#### **C. Ductwork:**

1. General: Provide stencil-painted identification on ductwork and housings of the air-handling system, with lettering size sufficient for reading but not less than 3/4" and including arrows to show direction of flow. Indicate service and system number at housings and at primary duct connections and branches. On access doors, indicate service and equipment being accessed. Space identification at 50' intervals along ducts. Where ducts are concealed behind access doors or removable ceilings, identification may be by plasticized tags in lieu of stencil-painted markers.

#### **D. Equipment:**

1. Signs: Provide engraved plastic-laminate signs at locations of Division 23 equipment, control panels, control devices, emergency equipment, dangerous elements of the mechanical work and similar places. Provide text of sufficient clarity and lettering, of sufficient size to convey adequate information at each location, and mount permanently in an appropriate and effective location. Comply with recognized industry standards for color and design.
2. Operational Tags: Where needed for proper and adequate information on operation and maintenance of mechanical systems, provide tags of plasticized card stock, either pre-printed or hand printed to convey the message; example: "DO NOT CLOSE VALVE EXCEPT WHEN BURNER IS OFF".
3. Selection: Refer to instances where either a plastic-laminate sign or plasticized tag might be appropriate, to the Architect for resolution.

## 2.3 ACCESS; CUTTING AND PATCHING:

### A. Access Units:

1. General: The work of this article is limited to the provisions for access through other work for access to mechanical work and does not include internal access provisions (within the mechanical work). In general, furnish or furnish-and-mount required access units in other trades' work prior to their work, so that cutting and patching for the subsequent installation of such access units will not be required. In occupied spaces, provide finished access units of the maximum concealment type, including locks where appropriate, and matching access units provided in the same expanse of finish (for non-mechanical access, if any). Provide rated access doors if access door is mounted in a rated wall.
  - a. Scope: The scope of access units to be furnished or provided as mechanical work includes those units indicated on the mechanical drawings, required or specified in Division 23 sections, and those additional units required for adequate access to mechanical work and not shown or specified individually.
2. Access Doors: Standard welded-steel construction, 16-gauge frames and 14-gauge door panels, 175 degrees concealed spring hinges, rust-inhibitive prime coat, flush cam lock (for screwdriver operation where keyed lock is not required), recessed to receive applied finish where applicable, 5-pin disk tumbler lock where indicated.
3. Removable Access Plates: Where only hand access is sufficient, provide removable plate-type access unit, of minimum size which will facilitate the required access. Provide units of the type, style, design, material and finish appropriate for the location and exposure in each instance. In exposed surfaces of occupied spaces provide round plate units flush floor units and frameless low-profile wall units, primed-for-paint in painted surfaces and polished chrome or stainless-steel finish in other surfaces.
4. Provide plans for approval by Architect showing location of all access panels.

### B. Cutting and Patching:

1. General: Comply with the requirements of Division 01 for the cutting and patching.

## **2.4 EXCAVATING FOR MECHANICAL WORK:**

- A. General:** The work of this article is defined to include whatever excavating and backfilling (but excluding insulating backfill) is necessary to install the mechanical work. Coordinate the work with other excavating and backfilling in the same area, including dewatering, flood protection provisions, and other temporary facilities. Coordinate the work with other work in the same area, including other underground services (existing and new), landscape development, paving, and floor slabs on grade. Coordinate with weather conditions and provide temporary facilities needed for protection and proper performance of excavating and backfilling.
- B. Piping Support:** Support pipe 5" and smaller directly on undisturbed soil. Support pipe 6" and larger, and tanks/vessels, on compacted and shaped sub-base material of depth shown but not less than 6" deep. Compact previously disturbed and unsatisfactory subsoil to provide adequate, uniform support for mechanical work; or excavate and replace with stable sub-base material or lean concrete.
- C. Water-Bearing Pipe:** Except as otherwise specifically indicated, place exterior underground water-bearing pipe (including drainage lines) a minimum of 3'6" below grade (measured to top of pipe).
- D. Roadways:** Where piping is less than 2'-6" below surface of roadway, provide encasement in Class 2500 concrete, 4" minimum coverage all around.
- E. Sequencing:** Delay backfill and encasement of piping until testing of piping system has been completed.

## **2.5 BELT GUARDS:**

- A.** Each belt shall be equipped with and OSHA approved guard. Guards shall enclose all belts and sheaves.
- B.** Guards shall be designed with adequate provision for movement of the motor required to adjust belt tension. Means shall also be provided to permit oiling, use of speed counters and other maintenance and testing operations with the guard in place.

## **2.6 CLOSED TANKS:**

- A. GENERAL:** Unless otherwise specified, closed tanks, except hot water tanks, which are hereinafter specified, shall be constructed of best quality flange steel tested and stamped in accordance with the latest requirements of the American Society of Mechanical Engineers Code (ASME) for Unfired Pressure Vessels. Tanks shall be riveted and caulked or welded as required for specific use. Refer to Division 23 Sections for specific requirements.
- B.** Unless otherwise specified, pressure tanks shall be constructed for 150 pounds working pressure.

- C. If necessary, in order to enter tanks into building, they may be built in sections, and tested after they are installed inside the building.

## 2.7 PAINTING MECHANICAL WORK:

- A. General: The work of this article is defined to include general painting of mechanical work at the project site. Coordinate the painting with the painting of other work of a similar nature and comply with indicated color and color matching requirements. Except as otherwise indicated, paint surfaces of mechanical work which would normally be painted in the application and exposure indicated.
1. General Standards: Except as otherwise indicated, comply with the applicable provisions of other sections for mechanical-work painting. Refer instances of uncertain applicability to the Architect for resolution before proceeding.
- B. Painting Requirements: The painting requirements can be summarized as follows, but not necessarily by way of limitation: (See Contract Documents for additional work).
1. Work buried in soil or encased in concrete or insulation need not be painted (except for protective coatings specified with the piping system).
  2. Painting of mechanical work exposed in occupied spaces of the building (not including machine rooms and maintenance/service spaces), and work exposed on the exterior (outdoors), is not specified as work of this section (not mechanical- work painting).
  3. Paint the following categories of mechanical work which have not been fully-factory finished, except paint over factory finish which is not an acceptable color.
    - a. Accessible ferrous metal (does not include stainless steel), regardless of whether exposed or to be concealed behind ceilings, shaft enclosures or similar finish construction; exclusive of cast iron which is either concealed or set flush with floors or decks.
    - b. Zinc-coated (galvanized) metal surfaces; but excluding surfaces which are concealed, except in "high humidity" areas.
    - c. Aluminum surfaces which have not been specifically anodized as a final finish, and excluding surfaces which are concealed.
    - d. Concrete, but only where adjacent non-- mechanical-work concrete of a similar placement is required to be painted.
    - e. Insulation on piping, ductwork, equipment and similar work; but excluding concealed surface and aluminum-foil-faced insulation.
  4. Paint inside of ductwork black, where it can be seen from occupied spaces through grilles or louvers (under any lighting condition).
  5. Do not paint over nameplates on equipment, sliding-rotating shaft surfaces, non-ferrous hardware/accessories/trim, and similar items where painting would normally be omitted.

6. Paint piping (insulated and plain) in mechanical rooms and similar spaces the color required to comply with color-coding requirements of ANSI A13.1; paint entire exposed lengths of pipe lines the color of "Field" noted in specification Section 230500, Paragraph 2.2A.1.

## **2.8 FOUNDATIONS FOR MACHINERY, ETC.:**

- A. The Contractor is to provide all necessary information so that concrete contractor can provide foundations for all machinery, tanks, etc., including fans, pumps, diesel generator, switchboards, etc. Foundations generally shall be built-up from the structural floor slabs and shall be as specified under Division 03 Section "Cast-in-Place Concrete". All exposed surfaces except where steel protection is indicated, shall be finished with cement mortar troweled smooth with beveled edge.
- B. Machines shall be secured to foundations with anchor bolts of ample size. Bolts shall have bottom plates and pipe sleeves and shall be securely embedded in concrete. All machines shall be grouted under the entire bearing surface for the bed plate of frame. After grout has set, all wedges, shims and jack bolts shall be removed, and the space filled with grout.
- C. Each electric motor shall be mounted on the same foundation as the driven machine.
- D. Foundations for moving machinery, such as fans, pumps, compressor, etc., except as otherwise specified shall be set on standard, factory made inertia bases. Refer to Section 230548 for requirements.
- E. Isolation units shall be as specified in specifications section 230548 "Vibration Isolation".

## **2.9 SIESMIC RESTRAINTS:**

- A. The Contractor is to provide all necessary seismic restraints for equipment, ductwork and piping to meet requirements of seismic classification as shown on structural drawings.

## **2.10 MECHANICAL WORK CLOSEOUT:**

- A. General: Refer to the Division 01 sections for closeout requirements. Maintain a daily log of operational data on mechanical equipment and systems through the closeout period; record hours of operation, assigned personnel, fuel consumption and similar information; submit copy to Owner.
- B. Record Drawings (Review with Owner and Architect) For mechanical work, give special attention to the complete and accurate recording of underground piping and ductwork, other concealed and non-accessible work, branching arrangement and valve location for piping systems, locations of dampers and coils in duct systems, locations of control system sensors and other control devices, and work of change orders.
- C. Record Documents

- 1.** Prepare record documents in accordance with the requirements in Division 01 Section "PROJECT CLOSEOUT." In addition to the requirements specified in Division 01, indicate the following installed conditions:
  - 2.** Ductwork mains and branches, size and location, for both exterior and interior; locations of dampers and other control devices; filters, boxes, and terminal units requiring periodic maintenance or repair.
  - 3.** Mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located (i.e., traps, strainers, expansion compensators, tanks, etc.). Valve location diagrams, complete with valve tag chart. Refer to Division 23 Section "Mechanical Identification." Indicate actual invert and horizontal locations of underground piping.
  - 4.** Equipment locations (exposed and concealed), dimensioned from prominent building lines.
  - 5.** Approved substitutions, contract modifications, and actual equipment materials installed.
  - 6.** Contract modifications, actual equipment and materials installed.
  - 7.** The record copies of final composite drawings shall be retained by the Architect (3 copies) and Contractor as a working reference. The Contractor shall accurately record all revisions which may become necessary during the progress of the work on the record copies. The final composite drawings and any subsequent changes thereto shall be submitted by the Contractor as supplements to other record drawing requirements specified elsewhere.
- D.** "No extra compensation will be paid for relocating any duct, pipe, conduit, etc., that has been installed without proper coordination between all trades involved. If any improperly coordinated work, or work installed that is not in accordance with the approved coordination composites, necessitates additional work by other trades, the costs of all such work shall be solely borne by the contractor responsible."
- E.** "All changes in the Scope of Work due to revisions formerly issued and approved shall be shown on the coordination composite drawings."
- F.** Closeout Equipment/Systems Operations: Sequence operations properly so that work of project will not be damaged or endangered. Coordinate with seasonal requirements and USGBC LEED commissioning requirements. Operate each item of equipment and each system in a test run of appropriate duration with the Architect and/or Owner's Representative present and with the Owner's operating personnel present, to demonstrate sustained, satisfactory performance. Conduct the Systems Demonstration and Tests in conformance with a written Demonstration and Test program, prepared by the contractor and approved by the Architect well in advance of the date scheduled for the demonstration. Adjust and correct operations as required for proper performance. Clean and lubricate each system, and replace dirty filters, excessively worn parts and similar expendable items of the work. Contractor will be required to replace all equipment connected to the closed piping systems damaged due to negligence of removing debris from the piping system.

- G.** Test and Adjustments: All piping that is to be painted shall be thoroughly cleaned to remove dirt and grease or oil. All piping shall be cleaned inside to remove dirt and loose scale, etc. All piping shall be flushed out prior to testing of equipment and all strainers shall be cleaned. Contractor shall provide by-pass piping connections around equipment as required during flushing of systems to prevent damage or clogging of such equipment. All ducts and apparatus casing shall be thoroughly cleaned before fans and filters are operated. After the equipment has been tested, all filters shall be cleaned or replaced.
- H.** After the systems have been completed, and before each system is accepted, capacity and general operating tests on the systems shall be conducted by a competent and experienced Architect and the tests shall demonstrate the specified capacities of the various pieces of equipment. All equipment shall be adjusted so that it will perform as specified and required to give satisfactory operation. The entire temperature control system shall be adjusted and placed in operation by the manufacturer and all adjustments necessary to accomplish the specified results during the first year of operation shall be made without cost to the Owner. Setting of valves, cocks, etc., shall be permanently marked so that they can be restored if disturbed at any time. The Owner will have the right to site test Division 23 equipment and if the equipment cannot meet the capacity requirements, the Contractor must modify or replace the equipment and pay for the original test and a new test to determine compliance with the design conditions. If, however, the site test proves the equipment is operating satisfactory, the Owner will pay for the tests.
- I.** Air duct systems shall be adjusted and balanced so that air quantities at all outlets are as indicated and so that distribution from supply outlets is free from drafts and uniform over the face of each outlet. Setting of dampers and other volume adjusting devices shall be permanently marked so that they can be restored if disturbed at any time. All air duct balancing shall be performed by a separate company, approved by the Architect, other than the installing contractor who has competent personnel and the necessary instruments to conduct the required tests and balances. A written record of the final balanced air quantities shall be submitted to the Architect for approval.
- J.** Upon completion and prior to acceptance of the installation, the contractor shall subject the system to such operating tests as may be required by the Architect to demonstrate satisfactory functions and operating efficiency. Operating tests shall cover a period of not less than eight (8) hours for each system, and all tests shall be conducted at such times as the Architect may direct. All instruments, facilities, and labor required to properly conduct the tests shall be provided by the contractor at no additional cost to the Owner, and all fuel, water and electricity required for tests will be furnished by the Owner.
- K.** In addition to the above close-out requirements, provide all documentation as required by the USGBC LEED Fundamental and Enhanced Commissioning processes.

- L. Operating Instructions:** Conduct a walk-through instruction seminar for the Owner's personnel to be involved in the continued operation and maintenance of mechanical equipment and systems. Explain the identification system, operational diagrams, emergency and alarm provisions, sequencing requirements, seasonal provisions, security, safety, efficiency and similar features of the systems. The following training periods shall apply: Main mechanical system plant, five 8-hour days with manufacturers' technical representatives; Energy Management, 2 people for 2 weeks at the manufacturer's school with 40 hours of scheduled follow-up training at job site; Fire Safety System, i.e., smoke evacuation, fire alarm suppression and interlock controls, five 8-hour days.
- M. Turn-Over of Operation:** At the time of substantial completion, turn over the prime responsibility for operation of the mechanical equipment and systems to the Owner's operating personnel. However, until the time of final acceptance, provide one full-time operating Architect, who is completely familiar with the work, to consult with and continue training the Owner's personnel.
- N. As built drawings:** Contractor shall provide to Owner as follows: 2 sets of prints and 2 copies on CD-ROM of scanned TIF files.
- O. All training shall be video recorded, and copies provided to Owner.**

## **2.11 GUARANTEE:**

- A. General:** The mechanical contractor shall leave the entire mechanical system installed under this contract in proper working order and shall, without charge, replace any work or materials which develop defects, except from ordinary wear and tear, within one year from the date of final acceptance of the Owner for beneficial use. Full service for a period of one year shall also coincide with start of warranty and guarantee period.

## **PART 3 - EXECUTION (NOT USED)**

□ □ □ □ □

## **SECTION 23 05 13 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Section 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 NEMA MG 1 unless otherwise indicated.
- B. Comply with IEEE 841 for severe-duty motors.

#### **2.2 GENERAL MOTOR REQUIREMENTS:**

- 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

#### **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. Rotor: Random-wound, squirrel cage.
- E. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
- F. Temperature Rise: Match insulation rating.

**G.** Insulation: Class F.

**H.** 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.
- I. 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.
  5. All motors operated with variable frequency drives shall be equipped internally by the manufacturer or installed externally by the contractor, maintenance free shaft grounding device to discharge shaft voltage away from the shaft to motor foot with high frequency ground strap made of flat braided, tinned copper. The shaft grounding device and strap shall be AEGIS or approved equal by the engineer.
- C. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

## **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 USED)**



## **SECTION 23 05 17 - 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 water stop 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. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.
- E. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- F. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

G. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.

## 2.2 STACK-SLEEVE FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Jay R. Smith Mfg. Co.
2. Zurn Industries, LLC.

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, available manufacturers offering products that may be incorporated into the Work include, but are not limited to 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 or Stainless steel 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, water stop assembly made for imbedding in concrete slab or wall. Unit has plastic or rubber water stop 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.

## 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.
  - 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 water stop 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:

- a. Piping Smaller Than NPS 6: Cast-iron wall sleeves Galvanized-steel-pipe sleeves.
- b. Piping NPS 6 and Larger: Cast-iron wall sleeves.

2. Exterior Concrete Walls below Grade:

- a. Piping Smaller Than NPS 6: Cast-iron wall sleeves with sleeve-seal system.

(1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

- b. Piping NPS 6 and Larger: Cast-iron wall sleeves with sleeve-seal system.

(1) 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:

- a. Piping Smaller Than NPS 6: Galvanized-steel wall sleeves with sleeve-seal system.

(1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

- b. Piping NPS 6 and Larger: Cast-iron wall sleeves with sleeve-seal system.

(1) 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:

- a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves.

- b. Piping NPS 6 and Larger: Galvanized-steel-pipe sleeves.

5. Interior Partitions:

- a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves.

- b. Piping NPS 6 and Larger: Galvanized-steel-sheet sleeves.



## SECTION 23 05 18 - 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 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 finish and with concealed hinge and setscrew.
- E. Split-Plate, Stamped-Steel Type: With chrome-plated finish, exposed-rivet hinge, and spring-clip fasteners.

#### 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.

### 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. Chrome-Plated Piping: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
- c. Insulated Piping: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge or split-plate, stamped-steel type with exposed-rivet hinge.
- d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
- e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge or split-plate, stamped-steel type with exposed-rivet hinge.
- f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
- g. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge or split-plate, stamped-steel type with exposed-rivet hinge.
- h. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass or split-casting brass type with polished, chrome-plated rough-brass finish.
- i. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge or split-plate, stamped-steel type with exposed-rivet hinge.
- j. Bare Piping in Equipment Rooms: One-piece, cast-brass or split-casting brass type with polished, chrome-plated rough-brass finish.
- k. Bare Piping in Equipment Rooms: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge or split-plate, stamped-steel type with exposed-rivet hinge.

- 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.

### **3.2 FIELD QUALITY CONTROL**

- A. Replace broken and damaged escutcheons and floor plates using new materials.



## **SECTION 23 05 29 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS:**

- A. The requirements of Division 23 Section "Mechanical General Provisions" 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. Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment" for vibration isolation devices.
2. Division 23 Section(s) "Metal 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 Architect, 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.
  - 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

## 1.5 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.
- D. Welding certificates.
- E. Provide a conformance summary listing all exceptions, deviations, clarifications or enhancements to the specification on a subparagraph by subparagraph basis.

## 1.6 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 or stainless steel.

**B. Stainless-Steel Pipe Hangers and Supports:**

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

**C. Copper Pipe Hangers:**

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 or stainless 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 THERMAL-HANGER SHIELD INSERTS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

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.

- 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.

## 2.4 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.

## 2.5 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: Stainless steel.
  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.

## 2.6 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

## 2.7 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: No staining, 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. Fiberglass Pipe-Hanger Installation: Comply with applicable portions of MSS SP-69 and MSS SP-89. Install hangers and attachments as required to properly support piping from building structure.
- D. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.
- E. Fiberglass Strut System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled fiberglass struts.
- F. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- G. Fastener System Installation:

1. Verify suitability of fasteners in two subparagraphs below for use in lightweight concrete or concrete slabs less than 4 inches thick.
2. 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. Obtain owner approval prior to installation; the building is occupied during construction.
3. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

**H. 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 Division 07 Section "Roof Accessories" for curbs.
- I. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- J. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- K. 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.
- L. Install lateral bracing with pipe hangers and supports to prevent swaying.
- M. 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.
- N. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- O. 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.

**P. 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.

### **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. 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 stainless-steel pipe hangers and stainless-steel attachments for hostile environment applications.
- D. Use copper-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing.
- E. Use thermal-hanger shield inserts for insulated piping and tubing.
- F. 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. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F, pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.

3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of non-insulated, stationary pipes NPS 3/4 to NPS 8.
7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of non-insulated, stationary pipes NPS 1/2 to NPS 8.
8. Adjustable Band Hangers (MSS Type 9): For suspension of non-insulated, stationary pipes NPS 1/2 to NPS 8.
9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of non-insulated, stationary pipes NPS 1/2 to NPS 8.
10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of non-insulated, stationary pipes NPS 3/8 to NPS 8.
11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of non-insulated, stationary pipes NPS 3/8 to NPS 3.
12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
14. 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.
15. 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.
16. 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.
17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.
18. 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.
19. 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.

- 20.** 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.
  - 21.** 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.
- G.** 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.
- H.** 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.
  - 6.** Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
    - 7.** Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
    - 8.** Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
    - 9.** Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
    - 10.** Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
    - 11.** Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
    - 12.** C-Clamps (MSS Type 23): For structural shapes.
    - 13.** Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.

14. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
  15. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
  16. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
  17. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
  18. 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.
  19. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
  20. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
  21. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- I. 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.
- J. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
  2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
  3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
  4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.

5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
  9. Horizontal (MSS Type 54): Mounted horizontally.
  10. Vertical (MSS Type 55): Mounted vertically.
  11. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.
- K. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- L. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
- M. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.



## **SECTION 230548 - VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT**

### **PART 1 GENERAL**

#### **1.1 RELATED DOCUMENTS+**

- A. The requirements of Division 23 Section “Mechanical General Provisions” apply to work of this section.
- B. The Contractor is to provide all necessary seismic restraints for equipment, ductwork and piping to meet requirements of seismic classification as shown on the structural drawings.

#### **1.2 SUMMARY**

- A. This Section includes the following:
  1. Neoprene pads.
  2. Neoprene mounts.
  3. Freestanding spring isolators.
  4. Spring vibration isolation hangers

#### **1.3 DEFINITIONS**

- A. IBC: International Building Code.
- B. ICC-ES: ICC-Evaluation Service.

#### **1.4 PERFORMANCE REQUIREMENTS**

- A. Wind-Restrain Loading:
  1. Basic Wind Speed: See Architectural and Structural drawings.
  2. Building Classification Category: See Architectural and Structural drawings.
  3. Minimum 10 lb/sq. ft. 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.
- B. Seismic Restraints:
  1. The Contractor is to provide all necessary seismic restraints for equipment, ductwork and piping to meet requirements of seismic classification as shown on structural drawings.

#### **1.5 SUBMITTALS**

- A. Product Data: For the following:
  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 seismic-restraint component used.
    - a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an agency acceptable to authorities having jurisdiction.
    - b. Annotate to indicate application of each product submitted and compliance with requirements.
  3. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.
- B. Delegated-Design Submittal: For vibration isolation and seismic-restraint details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional Architect responsible for their preparation.
1. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, seismic and wind forces required to select vibration isolators, seismic and wind restraints, and for designing vibration isolation bases.
    - a. Coordinate design calculations with wind load calculations required for equipment mounted outdoors. Comply with requirements in other Division 22 Sections for equipment mounted outdoors.
  2. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification that riser system has been examined for excessive stress and that none will exist.
  3. Vibration Isolation Base Details: Detail overall dimensions, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, base weights, equipment static loads, power transmission, component misalignment, and cantilever loads.
  4. Wind-Restraint Details:
    - a. Design Analysis: To support selection and arrangement of wind restraints. Include calculations of combined tensile and shear loads.
    - b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
    - c. Coordinate vibration isolation details with wind-restraint details required for equipment mounted outdoors. Comply with requirements in other Division 23 Sections for equipment mounted outdoors.
    - d. Preapproval and Evaluation Documentation: By an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

- C. Welding certificates.
- D. Qualification Data: For professional Architect and testing agency.
- E. Field quality-control test reports.
- F. Operation and Maintenance Data: For air-mounting systems to include in operation and maintenance manuals.
- G. Provide a conformance summary listing all exceptions, deviations, clarifications or enhancements to the specification on a subparagraph by subparagraph basis.

## 1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
- B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.
- C. Welding: 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. TYPE 1 (Pads: NP, DNP) Arranged in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment. Fiberglass pads are also acceptable and shall achieve the specified deflection.

1. Resilient Material: Oil- and water-resistant neoprene.
  2. Fiberglass: Pre-compressed Fiberglass with Elastomeric Coating
- C. TYPE 1 (FSN) Mounts: Double-deflection type, with molded, oil-resistant rubber, hermetically sealed compressed fiberglass, or neoprene isolator elements with factory-drilled, encapsulated top plate for bolting to equipment and with baseplate for bolting to structure. Color-code or otherwise identify to indicate capacity range.
1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
  2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.
- D. TYPE 2 (FS) Spring Isolators: 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 for bolting to structure and bonded to 1/4-inch- thick, rubber isolator pad attached to baseplate 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.
- E. TYPE 2 (HSH) (HN) Spring Hangers: 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. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

## **2.2 FACTORY FINISHES:**

- A. Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.
- B. Powder coating on springs and housings.
- C. All hardware shall be galvanized. Hot-dip galvanize metal components for exterior use.
- D. Baked enamel or powder coat for metal components on isolators for interior use.
- E. Color-code or otherwise mark vibration isolation and seismic- and wind-control devices to indicate capacity range.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Examine areas and equipment to receive vibration isolation and seismic- and wind-control devices for compliance with requirements for installation tolerances and other conditions affecting performance.
- 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. Indicate on Drawings, by details, schedules, or a combination of both, the locations where hanger rods for individual pipes and hanger rods for trapeze hangers require hanger rod stiffeners.
- C. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.
- D. Strength of Support and Seismic-Restrain Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

### **3.3 VIBRATION-CONTROL DEVICE INSTALLATION**

- A. Comply with requirements in Division 07 Section "Roof Accessories" for installation of roof curbs, equipment supports, and roof penetrations.
- B. Equipment Restraints:

1. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.

C. Piping Restraints:

1. Comply with requirements in MSS SP-127.
  2. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
  3. Brace a change of direction longer than 12 feet.
- D. Install cables so they do not bend across edges of adjacent equipment or building structure.
- E. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.
- F. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.
- G. 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.
- H. 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.

I. 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 Architect if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer's recommended torque, using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

### **3.4 FIELD QUALITY CONTROL**

- A.** Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B.** Perform tests and inspections.
- C.** Tests and Inspections:
  - 1.** Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
  - 2.** Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
  - 3.** Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
  - 4.** Test at least four of each type and size of installed anchors and fasteners selected by Architect.
  - 5.** Test to 90 percent of rated proof load of device.
  - 6.** Measure isolator restraint clearance.
  - 7.** Measure isolator deflection.
  - 8.** Verify snubber minimum clearances.
  - 9.** If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.
- D.** Remove and replace malfunctioning units and retest as specified above.
- E.** Prepare test and inspection reports.

### **3.5 ADJUSTING**

- A.** Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.
- B.** Adjust active height of spring isolators.
- C.** Adjust restraints to permit free movement of equipment within normal mode of operation.

### **3.6 VIBRATION-CONTROL DEVICE SCHEDULE**

- A.** See Vibration Isolation Schedule on the drawings. Minimum deflection heights shall be determined by manufacturer based on equipment weights.



## **SECTION 23 05 53 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT**

### **PART 1 GENERAL**

#### **1.1 RELATED DOCUMENTS:**

- A. The requirements of Division 23 Section "Mechanical General Provisions" 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. Valve tags.
6. Warning tags
7. Color coding of piping, ductwork and equipment
8. Access door labels

#### **1.3 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.
- F. Provide a conformance summary listing all exceptions, deviations, clarifications or enhancements to the specification on a subparagraph by subparagraph basis.

#### **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.

## PART 2 PRODUCTS

### 2.1 EQUIPMENT LABELS

#### A. Metal Labels for Equipment:

1. Material and Thickness: Brass, 0.032-inch, Stainless steel, 0.025-inch Aluminum, 0.032-inch or anodized aluminum, 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-fourths 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. Letter Color: White.
  3. Background Color: Black.
  4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
  5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
  6. 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-fourths the size of principal lettering.
  7. Fasteners: Stainless-steel rivets or self-tapping screws.
  8. 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), plus 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), plus 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.** Letter Color: White.
- C.** Background Color: Red.
- D.** Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- E.** Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F.** 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-fourths the size of principal lettering.
- G.** Fasteners: Stainless-steel rivets or self-tapping screws.
- H.** Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I.** 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, 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 inches high.

## 2.4 DUCT LABELS/ ACCESS DOORS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8-inch-thick, and having predrilled holes for attachment hardware.
- B. Letter Color: White.
- C. Background Color: Black.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. 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-fourths the size of principal lettering.
- G. Fasteners: Stainless-steel rivets or self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings, duct size, and an arrow indicating flow direction.
- J. Access Doors: Provide access to indicate device.
  - 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. 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, and having predrilled or stamped holes for attachment hardware.
  - 2. Fasteners: Clinched braided stainless-steel cord.
- 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, and a framed version posted in mechanical room.

## 2.6    **WARNING TAGS**

- A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
1. Size: Approximately 4 by 7 inches.
  2. Fasteners: Brass grommet and wire.
  3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
  4. Color: Yellow background with black lettering.

## 2.7    **COLOR CODING OF PIPING, DUCTWORK AND EQUIPMENT**

- A. All piping, ductwork, and equipment shall be color coded as follows: (The manufacturer and listing are only for the purposes of identifying appropriate paint colors.)
1. Service Color Comparable to Cowman Campbell:

a. Hot Water Heating	Buff #514
b. Central Cooling Water	White #300
c. Cold Water Dark	Blue #324
d. Cold Water-Non-Potable	Light Blue #561
e. Hot Water - Potable Bright	Yellow #339
f. Hot Water-Non-Potable Dark	Yellow #341
g. Gas	Green #331
h. Air	Black #321
i. Fire Service	Red #342
j. Waste, Soil Vent, Rain Leader	Brown #329
k. Duct work (including insulated)	Grey #337
l. Equipment & Fans	Grey #337
m. Other Services	Grey #337
  - B. Piping and ducts shall have the name of the service and direction of flow either painted or tagged in place. Steam lines (with pressure greater than 10 psi), gas and air lines will also indicate pressure and temperature.
  - C. Each major piece of equipment or system shall have its name and I.D.# (as specified in contract drawings) either painted or tagged in place.

- D. Each valve shall be tagged to indicate the service, and equipment, I.D.# and temperature of the line controlled.
- E. Color coding will consist of semi-gloss enamel finish coat.
  - 1. Equipment nameplates shall be laminated black plastic with lettering cut through to white background. Plastic strips with raised letters made by a marking device are not acceptable.
  - 2. Valve tags shall be sized 1" x 2-1/2" and constructed of 0.030 inch thick brass inscribed with lettering 5/16 inch high. Laminated plastic tags, constructed similarly to nameplates, will also be acceptable.

## 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 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

### 3.3 PIPE LABEL INSTALLATION

- A. 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.
- B. Pipe Label Color Schedule: Follow ANSI standards.

### **3.4 DUCT LABEL INSTALLATION**

- A. Install plastic-laminated or self-adhesive duct labels with permanent adhesive on air ducts in the following color codes:
  - 1. Blue: For cold-air supply ducts.
  - 2. Green: For exhaust-, outside-, relief-, return-, and mixed-air ducts.
  - 3. ASME A13.1 Colors and Designs: For hazardous material exhaust.
- B. Locate labels near points where ducts enter into concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

### **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 HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

### **3.6 WARNING-TAG INSTALLATION**

- A. Write required message on, and attach warning tags to, equipment and other items where required.

### **3.7 COLOR CODING OF PIPING, DUCTWORK AND EQUIPMENT**

- A. Color coding will occur under three conditions: where equipment and lines are in mechanical areas, finished areas, and concealed.
- B. In mechanical spaces and other maintenance areas, surfaces will be painted.
- C. The following methods shall be used to paint equipment and systems.
  - 1. All surfaces to be painted shall have at least one primer coat and one finish coat.
  - 2. Insulated surfaces shall be coated with an appropriate primer-sealer before applying the finish coat.
  - 3. Zinc coated surfaces shall be properly primed before applying the finish coat.
  - 4. Factory finished surfaces shall not be repainted unless the original finish has been damaged.
  - 5. Stainless steel and chrome plated surfaces shall not be painted.
- D. In finished areas, color banding rather than painting shall be employed with two (2) inch bands appearing every 20 feet and/or at least once in each space. Colored tape shall generally be used, except when unavailable, banding may be painted on.

- E. Where piping and ductwork are concealed, they should be color banded minimally at each provided access point, where the line penetrates a wall or floor, and every 15 feet along horizontal and vertical lines.
- F. One example of taped banding should be located in the vicinity of painted surfaces to indicate the corresponding relationship.
- G. Information appearing on each major piece of equipment or system shall typically be painted in black, two (2) inch, block style lettering.
- H. Nameplates shall be used for equipment too small for two (2) inch lettering.



## **SECTION 23 05 93 - TESTING, ADJUSTING, AND BALANCING FOR HVAC**

### **PART 1 GENERAL**

#### **1.1 RELATED DOCUMENTS:**

- A. The requirements of Division 23 Section "Mechanical General Provisions" apply to this section.

#### **1.2 SUMMARY**

- A. Section Includes:

- 1. Balancing Air Systems: Note that the garage ductwork, common amenity areas, corridor supply ductwork, and one of each typical type of apartment require air balancing. The register settings in the typical apartments shall be duplicated in the other similar apartments.

#### **1.3 DEFINITIONS**

- A. AABC: Associated Air Balance Council.
- B. NEBB: National Environmental Balancing Bureau.
- C. TAB: Testing, adjusting, and balancing.
- D. TABB: Testing, Adjusting, and Balancing Bureau.
- E. TAB Specialist: An entity engaged to perform TAB Work.

#### **1.4 SUBMITTALS**

- A. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation that the TAB contractor and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.
- B. Contract Documents Examination Report: Within 30 days of Contractor's Notice to Proceed, submit the Contract Documents review report as specified in Part 3.
- C. Strategies and Procedures Plan: Within 60 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.
- D. Certified TAB reports.
- E. Sample report forms.
- F. 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.
- G. Provide a conformance summary listing all exceptions, deviations, clarifications or enhancements to the specification on a subparagraph basis.

## 1.5 QUALITY ASSURANCE

- A. TAB Contractor Qualifications: Engage a TAB entity certified by AABC, NEBB or TABB.
1. TAB Field Supervisor: Employee of the TAB contractor and certified by AABC, NEBB or TABB.
  2. TAB Technician: Employee of the TAB contractor and who is certified by AABC, NEBB or TABB as a TAB technician.
- B. TAB Conference: Meet with Architect on approval of the TAB strategies and procedures plan to develop a mutual understanding of the details. Require the participation of the TAB field supervisor and technicians. Provide seven days' advance notice of scheduled meeting time and location.
1. Agenda Items:
    - a. The Contract Documents examination report.
    - b. The TAB plans.
    - c. Coordination and cooperation of trades and subcontractors.
    - d. Coordination of documentation and communication flow.
- C. Certify TAB field data reports and perform the following:
1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
  2. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.
- D. TAB Report Forms: Use standard TAB contractor's forms approved by Architect.
- D. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."

## 1.6 PROJECT CONDITIONS

- A. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

## 1.7 COORDINATION

- A. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.
- B. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

## PART 2 PRODUCTS (NOT USED)

## 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 systems for installed 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 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 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.
- F. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.

- G. Examine test reports specified in individual system and equipment Sections.
- H. Examine HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation. H. Examine operating safety interlocks and controls on HVAC equipment.
- I. 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. Prepare a TAB plan that includes strategies and step-by-step procedures.
- B. Complete system-readiness checks and prepare reports. Verify the following:
  - 1. Permanent electrical-power wiring is complete.
  - 2. Automatic temperature-control systems are operational.
  - 3. Equipment and duct access doors are securely closed.
  - 4. Balance, smoke, and fire dampers are open.
  - 5. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
  - 6. Windows and doors can be closed so indicated conditions for system operations can be met.

### **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" or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" or SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing" and in this Section.
  - 1. Comply with requirements in ASHRAE 62.1-2004, Section 7.2.2, "Air Balancing."
  - 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 Division 23 Section "Air Duct Accessories."

3. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Division 23 Section "HVAC 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. Crosscheck 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.
- 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 Division 23 Section "Metal Ducts."

### **3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS**

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
  1. Measure total airflow.
    - a. Where sufficient space in ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow.
  2. Measure fan static pressures as follows to determine actual static pressure:

- a. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.
    - b. Measure static pressure directly at the fan outlet or through the flexible connection.
    - c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.
    - d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
  3. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
    - a. Report the cleanliness status of filters and the time static pressures are measured.
  4. Measure static pressures entering and leaving other devices, such as sound traps, heat-recovery equipment, and air washers, under final balanced conditions.
  5. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
  6. Obtain approval from Architect for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in Division 23 Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
  7. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.
- B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.
1. Measure airflow of submain and branch ducts.
    - a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
  2. Measure static pressure at a point downstream from the balancing damper and adjust volume dampers until the proper static pressure is achieved.

3. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.
- C. Measure air outlets and inlets without making adjustments.
  1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.
- D. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch volume dampers rather than extractors and the dampers at air terminals.
  1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
  2. Adjust patterns of adjustable outlets for proper distribution without drafts.

### **3.6 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS**

- A. Prepare test reports with pertinent design data, and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against the approved pump flow rate. Correct variations that exceed plus or minus 5 percent.
- B. Prepare schematic diagrams of systems' "as-built" piping layouts.
- C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:
  1. Open all manual valves for maximum flow.
  2. Check liquid level in expansion tank.
  3. Check makeup water-station pressure gage for adequate pressure for highest vent.
  4. Check flow-control valves for specified sequence of operation and set at indicated flow.
  5. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type unless several terminal valves are kept open.
  6. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.
  7. Check air vents for a forceful liquid flow exiting from vents when manually operated.

### 3.7 PROCEDURES FOR CONSTANT-FLOW HYDRONIC SYSTEMS

- A. Measure water flow at pumps. Use the following procedures:
  1. Verify impeller size by operating the pump with the discharge valve closed. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights.
  2. Check system resistance. With all valves open, read pressure differential across the pump and mark pump manufacturer's head-capacity curve. Adjust pump discharge valve until indicated water flow is achieved.
    - a. Monitor motor performance during procedures and do not operate motors in overload conditions.
  3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.
  4. Report flow rates that are not within plus or minus 10 percent of design.
- B. Measure flow at all automatic flow control valves to verify that valves are functioning as designed.
- C. Measure flow at all pressure-independent characterized control valves, with valves in fully open position, to verify that valves are functioning as designed.
- D. Set calibrated balancing valves, if installed, at calculated presetting.
- E. Measure flow at all stations and adjust, where necessary, to obtain first balance.
  1. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.
- F. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than indicated flow.
- G. Adjust balancing stations to within specified tolerances of indicated flow rate as follows:
  1. Determine the balancing station with the highest percentage over indicated flow.
  2. Adjust each station in turn, beginning with the station with the highest percentage over indicated flow and proceeding to the station with the lowest percentage over indicated flow.

3. Record settings and mark balancing devices.
- H. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures including outdoor-air temperature.
- I. Measure the differential-pressure-control-valve settings existing at the conclusion of balancing.
- J. Check settings and operation of each safety valve. Record settings.

### **3.8 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 weekly 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.

### **3.9 FINAL REPORT**

- A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
  1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing Architect.
  2. Include a list of instruments used for procedures, along with proof of calibration.
- B. Final Report Contents: In addition to certified field-report data, include the following:
  1. Fan curves.
  2. Manufacturers' test data.
  3. Field test reports prepared by system and equipment installers.
  4. Other information relative to equipment performance; do not include Shop Drawings and product data.
- C. General Report Data: In addition to form titles and entries, include the following data:
  1. Title page.

2. Name and address of the TAB contractor.
3. Project name.
4. Project location.
5. Architect's name and address.
6. Architect's name and address.
7. Contractor's name and address.
8. Report date.
9. Signature of TAB supervisor who certifies the report.
10. Table of Contents with the total number of pages defined for each section of the report.  
Number each page in the report.
11. Summary of contents including the following:
  - a. Indicated versus final performance.
  - b. Notable characteristics of systems.
  - c. Description of system operation sequence if it varies from the Contract Documents.
12. Nomenclature sheets for each item of equipment.
13. Data for terminal units, including manufacturer's name, type, size, and fittings.
14. Notes to explain why certain final data in the body of reports vary from indicated values.
15. Test conditions for fans and pump performance forms including the following:
  - a. Settings for outdoor-, return-, and exhaust-air dampers.
  - b. Conditions of filters.
  - c. Cooling coil, wet- and dry-bulb conditions.
  - d. Face and bypass damper settings at coils.
  - e. Fan drive settings including settings and percentage of maximum pitch diameter.
  - f. Inlet vane settings for variable-air-volume systems.
  - g. Settings for supply-air, static-pressure controller.
  - h. Other system operating conditions that affect performance.

- D. System Diagrams:** Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
1. Quantities of outdoor, supply, return, and exhaust airflows.
  2. Duct, outlet, and inlet sizes.
  3. Pipe and valve sizes and locations.
  4. Balancing stations.
  5. Position of balancing devices.
- E. Air-Handling-Unit Test Reports:** For air-handling units with coils, include the following:
1. Unit Data:
    - a. Unit identification.
    - b. Location.
    - c. Make and type.
    - d. Model number and unit size.
    - e. Manufacturer's serial number.
    - f. Unit arrangement and class.
    - g. Discharge arrangement.
    - h. Sheave make, size in inches, and bore.
    - i. Center-to-center dimensions of sheave, and amount of adjustments in inches.
    - j. Number, make, and size of belts.
    - k. Number, type, and size of filters.
  2. Motor Data:
    - a. Motor make, and frame type and size.
    - b. Horsepower and rpm.
    - c. Volts, phase, and hertz.
    - d. Full-load amperage and service factor.
    - e. Sheave make, size in inches, and bore.

f. Center-to-center dimensions of sheave, and amount of adjustments in inches.

3. Test Data (Indicated and Actual Values):

- a. Total air flow rate in cfm.
- 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.
- f. Preheat-coil static-pressure differential in inches wg.
- g. Cooling-coil static-pressure differential in inches wg.
- h. Heating-coil static-pressure differential in inches wg.
- i. Outdoor airflow in cfm.
- j. Return airflow in cfm.
- k. Outdoor-air damper position.
- l. Return-air damper position.
- m. Vortex damper position.

F. Apparatus-Coil Test Reports:

1. Coil Data:

- a. System identification.
- b. Location.
- c. Coil type.
- d. Number of rows.
- e. Fin spacing in fins per inch o.c.
- f. Make and model number.
- g. Face area in sq. ft..
- h. Tube size in NPS.
- i. Tube and fin materials.

- j. Circuiting arrangement.
2. Test Data (Indicated and Actual Values):
  - a. Air flow rate in cfm.
  - b. Average face velocity in fpm.
  - c. Air pressure drop in inches wg.
  - d. Outdoor-air, wet- and dry-bulb temperatures in deg F.
  - e. Return-air, wet- and dry-bulb temperatures in deg F.
  - f. Entering-air, wet- and dry-bulb temperatures in deg F.
  - g. Leaving-air, wet- and dry-bulb temperatures in deg F.
  - h. Water flow rate in gpm.
  - i. Water pressure differential in feet of head or psig.
  - j. Entering-water temperature in deg F.
  - k. Leaving-water temperature in deg F.
  - l. Refrigerant expansion valve and refrigerant types.
  - m. Refrigerant suction pressure in psig.
  - n. Refrigerant suction temperature in deg F.
  - o. Inlet steam pressure in psig.
- G. Gas- and Oil-Fired Heat Apparatus Test Reports: In addition to manufacturer's factory startup equipment reports, include the following:
  1. Unit Data:
    - a. System identification.
    - b. Location.
    - c. Make and type.
    - d. Model number and unit size.
    - e. Manufacturer's serial number.
    - f. Fuel type in input data.

- g. Output capacity in Btu/h.
- h. Ignition type.
- i. Burner-control types.
- j. Motor horsepower and rpm.
- k. Motor volts, phase, and hertz.
- l. Motor full-load amperage and service factor.
- m. Sheave make, size in inches, and bore.

H. Electric-Coil Test Reports: For electric furnaces, duct coils, and electric coils installed in central-station air-handling units, include the following:

1. Unit Data:
  - a. System identification.
  - b. Location.
  - c. Coil identification.
  - d. Capacity in Btu/h.
  - e. Number of stages.
  - f. Connected volts, phase, and hertz.
  - g. Rated amperage.
  - h. Air flow rate in cfm.
  - i. Face area in sq. ft..
  - j. Minimum face velocity in fpm.
2. Test Data (Indicated and Actual Values):
  - a. Heat output in Btu/h.
  - b. Air flow rate in cfm.
  - c. Air velocity in fpm.
  - d. Entering-air temperature in deg F.
  - e. Leaving-air temperature in deg F.

f. Voltage at each connection.

g. Amperage for each phase.

**I. Fan Test Reports:** For supply, return, and exhaust fans, include the following:

**1. Fan Data:**

a. System identification.

b. Location.

c. Make and type.

d. Model number and size.

e. Manufacturer's serial number.

f. Arrangement and class.

g. Sheave make, size in inches, and bore.

h. Center-to-center dimensions of sheave, and amount of adjustments in inches.

**2. Motor Data:**

a. Motor make, and frame type and size.

b. Horsepower and rpm.

c. Volts, phase, and hertz.

d. Full-load amperage and service factor.

e. Sheave make, size in inches, and bore.

f. Center-to-center dimensions of sheave, and amount of adjustments in inches.

g. Number, make, and size of belts.

**3. Test Data (Indicated and Actual Values):**

a. Total airflow rate in cfm.

b. Total system static pressure in inches wg.

c. Fan rpm.

d. Discharge static pressure in inches wg.

e. Suction static pressure in inches wg.

**4. Unit Data:**

- a. System and air-handling unit identification.
- b. Location and zone.
- c. Apparatus used for test.
- d. Area served.
- e. Make.
- f. Number from system diagram.
- g. Type and model number.
- h. Size.
- i. Effective area in sq. ft..

**5. Test Data (Indicated and Actual Values):**

- a. Air flow rate in cfm.
- b. Air velocity in fpm.
- c. Preliminary air flow rate as needed in cfm.
- d. Preliminary velocity as needed in fpm.
- e. Final air flow rate in cfm.
- f. Final velocity in fpm.
- g. Space temperature in deg F.

**J. Instrument Calibration Reports:**

**1. Report Data:**

- a. Instrument type and make.
- b. Serial number.
- c. Application.
- d. Dates of use.
- e. Dates of calibration.

### **3.10 INSPECTIONS**

#### **A. Initial Inspection:**

1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the final report.
2. Check the following for each system:
  - a. Measure airflow of at least 10 percent of air outlets.
  - b. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
  - c. Verify that balancing devices are marked with final balance position.
  - d. Note deviations from the Contract Documents in the final report.

#### **B. Final Inspection:**

1. After initial inspection is complete and documentation by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by Architect.
  2. The TAB contractor's test and balance Architect shall conduct the inspection in the presence of Architect.
  3. Architect shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.
  4. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
  5. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.
- C. TAB Work will be considered defective if it does not pass final inspections. If TAB Work fails, proceed as follows:
1. Recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.

2. If the second final inspection also fails, Owner may contract the services of another TAB contractor to complete TAB Work according to the Contract Documents and deduct the cost of the services from the original TAB contractor's final payment.
- D. Prepare test and inspection reports.

### **3.11 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 and winter conditions, perform additional TAB during near-peak summer and winter conditions.



## SECTION 23 07 13 - DUCT INSULATION

### PART 1 GENERAL

#### 1.1 RELATED DOCUMENTS

- A. The requirements of Division 23 Section "Mechanical General Provisions" apply to this section.

#### 1.2 SUMMARY

- A. Related Sections:

1. Division 23 Section "HVAC Piping Insulation."
2. Division 23 Section "Metal Ducts" for duct liners.

- B. All insulation shall comply with ASHRAE 90.1 & IECC.

#### 1.3 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.

- C. Samples: For each type of insulation and jacket indicated. Identify each Sample, describing product and intended use. Sample sizes are as follows:

1. Sheet Form Insulation Materials: 12 inches square.
2. Sheet Jacket Materials: 12 inches square.
3. Manufacturer's Color Charts: For products where color is specified, show the full range of colors available for each type of finish material.

- D. Qualification Data: For qualified Installer.
- E. 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.
- F. Field quality-control reports.
- G. Provide a conformance summary listing all exceptions, deviations, clarifications or enhancements to the specification on a subparagraph by subparagraph basis.

#### **1.4 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.

#### **1.5 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 Division 23 Section "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.

## 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 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.
- 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.
  - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Aeroflex USA, Inc.; Aerocel.
    - b. Armacell LLC; AP Armaflex.
    - c. K-Flex USA; Insul-Sheet, K-Flex Gray Duct Liner, and K-FLEX LS.
- 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, Type III with factory-applied FSK jacket or Type III with factory-applied FSP jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
  - a. CertainTeed Corp.; SoftTouch Duct Wrap.
  - b. Johns Manville; Microlite.
  - c. Knauf Insulation; Friendly Feel Duct Wrap.
  - d. Manson Insulation Inc.; Alley Wrap.
  - e. Owens Corning; SOFTR All-Service Duct Wrap.
- H. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
  1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. CertainTeed Corp.; Commercial Board.
    - b. Fibrex Insulations Inc.; FBX.
    - c. Johns Manville; 800 Series Spin-Glas.
    - d. Knauf Insulation; Insulation Board.
    - e. Manson Insulation Inc.; AK Board.
    - f. Owens Corning; Fiberglas 700 Series.
- I. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied ASJ complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft. or more. Thermal conductivity (k-value) at 100 deg F is 0.29 Btu x in./h x sq. ft. x deg F or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
  1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. CertainTeed Corp.; CrimpWrap.
    - b. Johns Manville; MicroFlex.

- c. Knauf Insulation; Pipe and Tank Insulation.
- d. Manson Insulation Inc.; AK Flex.
- e. Owens Corning; Fiberglas Pipe and Tank Insulation.

## 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 and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
  - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Aeroflex USA, Inc.; Aeroseal.
    - b. Armacell LLC; Armaflex 520 Adhesive.
    - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-75.
    - d. K-Flex USA; R-373 Contact Adhesive.
- C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
  - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.
    - b. Eagle Bridges - Marathon Industries; 225.
    - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.
    - d. Mon-Eco Industries, Inc.; 22-25.
- 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: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

- a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.
  - b. Eagle Bridges - Marathon Industries; 225.
  - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-50.
  - d. Mon-Eco Industries, Inc.; 22-25. highlight this too  
(I cant for some reason)
- E. PVC Jacket Adhesive: Compatible with PVC jacket.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Dow Corning Corporation; 739, Dow Silicone.
    - b. Johns Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
    - c. P.I.C. Plastics, Inc.; Welding Adhesive.
    - d. Speedline Corporation; Polyco VP Adhesive.

## 2.3 SEALANTS

### A. FSK and Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
  - b. Eagle Bridges - Marathon Industries; 405.
  - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44.
  - d. Mon-Eco Industries, Inc.; 44-05.
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, use sealants that have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Use sealants that 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," including 2004 Addenda.

**B. ASJ Flashing Sealants, and Vinyl and PVC Jacket Flashing Sealants:**

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 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, use sealants that have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Use sealants that 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," including 2004 Addenda.

**2.4 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. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
4. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C 1136, Type II.

5. Vinyl Jacket: White vinyl with a permeance of 1.3 perms when tested according to ASTM E 96/E 96M, Procedure A, and complying with NFPA 90A and NFPA 90B.

## 2.5 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. ABI, Ideal Tape Division; 428 AWF ASJ.
  - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
  - c. Compac Corporation; 104 and 105.
  - 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: Subject to compliance with requirements, provide one of the following:
  - a. ABI, Ideal Tape Division; 491 AWF FSK.
  - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
  - c. Compac Corporation; 110 and 111.
  - d. Venture Tape; 1525 CW NT, 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.
- C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. ABI, Ideal Tape Division; 370 White PVC tape.
    - b. Compac Corporation; 130.
    - c. Venture Tape; 1506 CW NS.
  2. Width: 2 inches.
  3. Thickness: 6 mils.
  4. Adhesion: 64 ounces force/inch in width.
  5. Elongation: 500 percent.
  6. Tensile Strength: 18 lbf/inch in width.
- D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. ABI, Ideal Tape Division; 488 AWF.
    - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
    - c. Compac Corporation; 120.
    - d. Venture Tape; 3520 CW.
  2. Width: 2 inches.
  3. Thickness: 3.7 mils.
  4. Adhesion: 100 ounces force/inch in width.
  5. Elongation: 5 percent.

6. Tensile Strength: 34 lbf/inch in width.

## 2.6 SECUREMENTS

### A. Bands:

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. ITW Insulation Systems; Gerrard Strapping and Seals.
  - b. RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs.
2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 1/2 inch with wing seal or closed seal.
3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing seal or closed seal.
4. 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, 0.106-inch- diameter shank, length to suit depth of insulation indicated.
  - a. Products: Subject to compliance with requirements, provide one of the following:
    - (1) AGM Industries, Inc.; CWP-1.
    - (2) GEMCO; CD.
    - (3) Midwest Fasteners, Inc.; CD.
    - (4) Nelson Stud Welding; TPA, TPC, and TPS.
2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
  - a. Products: Subject to compliance with requirements, provide one of the following:
    - (1) AGM Industries, Inc.; CHP-1.

- (2) GEMCO; Cupped Head Weld Pin.
- (3) Midwest Fasteners, Inc.; Cupped Head.
- (4) Nelson Stud Welding; CHP.

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

D. Wire: 0.080-inch nickel-copper alloy.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- a. C & F Wire.

## 2.7 CORNER ANGLES

- A. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch, PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.
- B. 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.
- C. Stainless-Steel Corner Angles: 0.024 inch thick, minimum 1 by 1 inch, stainless steel according to ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316.

## 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.
- 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.
- 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 Division 07 Section "Penetration Firestopping "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 Division 07 Section "Penetration Firestopping."

### **3.5 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION**

- A. Seal longitudinal seams and end joints with manufacturers recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

### **3.6 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 on center.
  - b. On duct sides with dimensions larger than 18 inches, place pins 16 inches on center 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.
- B. Board 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, space 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.** 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. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
6. 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.

### **3.7 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.

### **3.8 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."

### **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 Division 09 painting 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.

### **3.10 FIELD QUALITY CONTROL**

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections:

1. Inspect ductwork, 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 duct system defined in the "Duct Insulation Schedule, General" Article.
- D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

### **3.11 DUCT INSULATION SCHEDULE, GENERAL**

- A. See drawings.



## **SECTION 23 09 93 - AUTOMATIC CONTROL SEQUENCES**

### **PART 1 GENERAL**

#### **1.1 GENERAL**

- A. The requirements of Division 23 Section 230500 "Mechanical General Provisions" apply to this section.

#### **1.2 DESCRIPTION OF WORK:**

- A. Control sequences are hereby defined as the manner and method by which automatic temperature controls function. Requirements for each type of operation are specified in this section.
- B. Operating equipment, devices, and system components required for automatic temperature control systems are specified in other Division 23 Controls and Instrumentation sections of these specifications.
- C. Contractor shall coordinate his work with Divisions 23 and 26 and provide required interface between furnished equipment to accomplish control sequences outlined hereafter.
- D. Provide all sensors and accessories as needed to achieve intent of control sequences and point's lists, whether or not shown on drawings or specifically called for in the sequences.

#### **1.3 SUBMITTALS:**

- A. Shop Drawings: Submit shop drawings for each system automatically controlled, containing the following information:
  1. Schematic flow diagram of system showing fans, pumps, coils, dampers, valves, control devices.
  2. Label each control device with setting of adjustable range of control.
  3. Indicate factory and field wiring and interface required by other Contractors.
  4. Indicate each control panel required, with internal and external piping and wiring clearly indicated. Provide detail of panel face, including controls, size instruments, labeling and its location.
  5. Include verbal description of sequence of operation.
    - a. Maintenance Data: Include copy of shop drawings and submittals in each maintenance manual.
    - b. Provide a conformance summary listing all exceptions, deviations, clarifications or enhancements to the specification on a subparagraph by subparagraph basis.

## PART 2 PRODUCTS

### 2.1 AUTOMATIC CONTROL SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Critical Systems – Delta Controls
  2. Building Automation Systems (BAS)
  3. Schneider Electric

## PART 3 EXECUTION

### 3.1 CONTROL SEQUENCES:

- A. Cabinet Heater: Provide integral thermostat to cycle fan motor and electric element to maintain constant space temperature of 70 degrees F (adj.). Provide integral residual heat sensor to continue fan operation until element temperature falls below preset point.
- B. Electric Wall Heater: Electric wall heaters are furnished with integral thermostats to maintain space temperature set point of 70 degrees (adj.).
- C. Garage Supply and Exhaust Fans: Garage exhaust and supply fans at each level shall be electrically interlocked with the carbon monoxide (CO) and nitrogen dioxide (NO<sub>2</sub>) control panel and its associated CO/NO<sub>2</sub> detectors. See drawings for sequence of operation.
- D. Garage Circulating Fans shall be controlled by central timeclock to run during periods of high occupancy and when the temperature in the parking garage exceeds 80 degrees F (adjustable). Provide four temperature sensors per parking garage level to determine garage temperature.
- E. Unit Heater Control: Provide integral thermostat to cycle fan motor and electric element to maintain constant space temperature of 60 degrees F (adj.). Provide integral residual heat sensor to continue fan operation until element temperature falls below preset point.
- F. Elevator Control Room: A room sensor furnished by the A/C unit manufacturer shall energize cooling/heating unit in stages to maintain setpoint of 80 deg. F (adj.) Unit shall be furnished with accessories as needed for low ambient operation.
- G. Fire Control Room: A room sensor furnished by the A/C unit manufacturer shall energize cooling/heating unit in stages to maintain setpoint of 75 deg. F (adj.). Unit shall be furnished with accessories as needed for low ambient operation.
- H. Main Electrical Room: Exhaust fan shall be energized by cooling-only thermostat to maintain room temperature sensor setpoint of 80 deg. F (adj.). Interlock damper on air intake louver with fan. Electric unit heater with integral thermostat shall energize when room temperature falls below 60 deg F (adj.).

- I. Fire Pump Room: Ventilation fans shall be energized by cooling-only thermostat to maintain room temperature sensor setpoint of 80 deg. F (adj.). Interlock dampers with fan. Electric unit heater with integral thermostat shall energize when room temperature falls below 60 deg F (adj).
- J. DOAS units: See drawings.
- K. Emergency Electric Room: Ventilation fans shall be energized by cooling-only thermostat to maintain room temperature sensor setpoint of 80 deg. F (adj.). Interlock dampers with fan. Electric unit heater with integral thermostat shall energize when room temperature falls below 60 deg F (adj).
- L. Apartment Split Systems: Controlled by programmable thermostat.



## SECTION 231123 - FACILITY NATURAL-GAS PIPING

### PART 1 GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
1. Pipes, tubes, and fittings.
  2. Piping specialties.
  3. Piping and tubing joining materials.
  4. Valves.
  5. Pressure regulators.
  6. Service meters.
  7. Concrete bases.

#### 1.2 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

#### 1.3 PERFORMANCE REQUIREMENTS

- A. Minimum Operating-Pressure Ratings:
1. Piping and Valves: 100 psig minimum unless otherwise indicated.
  2. Service Regulators: 65 psig minimum unless otherwise indicated.
  3. Minimum Operating Pressure of Service Meter: 5 psig.
- B. Natural-Gas System Pressure within Buildings: More than 2 psig but not more than 5 psig.
- C. Delegated Design: Design restraints and anchors for natural-gas piping and equipment, including comprehensive engineering analysis by a qualified Architect, using performance requirements and design criteria indicated.

#### **1.4 ACTION SUBMITTALS**

- A.** Product Data: For each type of the following:
  - 1. Piping specialties.
  - 2. Corrugated, stainless-steel tubing with associated components.
  - 3. Valves. Include pressure rating, capacity, settings, and electrical connection data of selected models.
  - 4. Pressure regulators. Indicate pressure ratings and capacities.
  - 5. Service meters. Indicate pressure ratings and capacities. Include bypass fittings and meter bars supports.
  - 6. Dielectric fittings.
- B.** Shop Drawings: For facility natural-gas piping layout. Include plans, piping layout and elevations, sections, and details for fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to building structure. Detail location of anchors, alignment guides, and expansion joints and loops.
  - 1. Shop Drawing Scale: 1/4 inch per foot.
  - 2. Detail mounting, supports, and valve arrangements for service meter assembly and pressure regulator assembly.
- C.** Delegated-Design Submittal: For natural-gas piping and equipment indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified Architect responsible for their preparation.
  - 1. Detail fabrication and assembly of seismic restraints.
  - 2. Design Calculations: Calculate requirements for selecting seismic restraints.

#### **1.5 INFORMATIONAL SUBMITTALS**

- A.** Coordination Drawings: Plans and details, drawn to scale, on which natural-gas piping is shown and coordinated with other installations, using input from installers of the items involved.
- B.** Site Survey: Plans, drawn to scale, on which natural-gas piping is shown and coordinated with other services and utilities.
- C.** Qualification Data: For qualified Architect.
- D.** Welding certificates.
- E.** Field quality-control reports.

## **1.6 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For pressure regulators and service meters to include in emergency, operation, and maintenance manuals.

## **1.7 QUALITY ASSURANCE**

- A. Steel Support 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.
- 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.

## **1.8 DELIVERY, STORAGE, AND HANDLING**

- A. Handling Flammable Liquids: Remove and dispose of liquids from existing natural-gas piping according to requirements of authorities having jurisdiction.
- B. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- C. Store and handle pipes and tubes having factory-applied protective coatings to avoid damaging coating, and protect from direct sunlight.
- D. Protect stored PE pipes and valves from direct sunlight.

## **1.9 PROJECT CONDITIONS**

- A. Perform site survey, research public utility records, and verify existing utility locations. Contact utility-locating service for area where Project is located.
- B. Interruption of Existing Natural-Gas Service: Do not interrupt natural-gas service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide purging and startup of natural-gas supply according to requirements indicated:
  1. Notify Architect no fewer than two days in advance of proposed interruption of natural-gas service.
  2. Do not proceed with interruption of natural-gas service without Architect's written permission.

## **1.10 COORDINATION**

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

- B. Coordinate requirements for access panels and doors for valves installed concealed behind finished surfaces. Comply with requirements in Section 083113 "Access Doors and Panels."

## PART 2 PRODUCTS

### 2.1 PIPES, TUBES, AND FITTINGS

- A. Steel Pipe: ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.
1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
  2. Wrought-Steel Welding Fittings: ASTM A 234/A 234M for butt welding and socket welding.
  3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
  4. Forged-Steel Flanges and Flanged Fittings: ASME B16.5, minimum Class 150, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
    - a. Material Group: 1.1.
    - b. End Connections: Threaded or butt welding to match pipe.
    - c. Lapped Face: Not permitted underground.
    - d. Gasket Materials: ASME B16.20, metallic, flat, asbestos free, aluminum o-rings, and spiral-wound metal gaskets.
    - e. Bolts and Nuts: ASME B18.2.1, carbon steel aboveground and stainless steel underground.
  5. Protective Coating for Underground Piping: Factory-applied, three-layer coating of epoxy, adhesive, and PE.
    - a. Joint Cover Kits: Epoxy paint, adhesive, and heat-shrink PE sleeves.
  6. Mechanical Couplings:
    - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      - (1) Dresser Piping Specialties; Division of Dresser, Inc.
      - (2) Smith-Blair, Inc.
    - b. Stainless-steel flanges and tube with epoxy finish.

- c. Buna-nitrile seals.
- d. Stainless-steel bolts, washers, and nuts.
- e. Coupling shall be capable of joining PE pipe to PE pipe, steel pipe to PE pipe, or steel pipe to steel pipe.
- f. Steel body couplings installed underground on plastic pipe shall be factory equipped with anode.

**B. Corrugated, Stainless-Steel Tubing:** Comply with ANSI/IAS LC 1.

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. OmegaFlex, Inc.
  - b. Parker Hannifin Corporation; Parflex Division.
  - c. Titeflex.
  - d. Tru-Flex Metal Hose Corp.
- 2. Tubing: ASTM A 240/A 240M, corrugated, Series 300 stainless steel.
- 3. Coating: PE with flame retardant.
  - a. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
    - (1) Flame-Spread Index: 25 or less.
    - (2) Smoke-Developed Index: 50 or less.
- 4. Fittings: Copper-alloy mechanical fittings with ends made to fit and listed for use with corrugated stainless-steel tubing and capable of metal-to-metal seal without gaskets. Include brazing socket or threaded ends complying with ASME B1.20.1.
- 5. Striker Plates: Steel, designed to protect tubing from penetrations.
- 6. Manifolds: Malleable iron or steel with factory-applied protective coating. Threaded connections shall comply with ASME B1.20.1 for pipe inlet and corrugated tubing outlets.
- 7. Operating-Pressure Rating: 5 psig.

**C. Aluminum Tubing:** Comply with ASTM B 210 and ASTM B 241/B 241M.

1. Aluminum Alloy: Alloy 5456 is prohibited.
  2. Protective Coating: Factory-applied coating capable of resisting corrosion on tubing in contact with masonry, plaster, insulation, water, detergents, and sewerage.
  3. Flare Fittings: Comply with ASME B16.26 and SAE J513.
    - a. Copper-alloy fittings.
    - b. Metal-to-metal compression seal without gasket.
    - c. Dryseal threads shall comply with ASME B1.20.3.
- D. Drawn-Temper Copper Tube: Comply with ASTM B 837, Type G.
1. Copper Fittings: ASME B16.22, wrought copper, and streamlined pattern.
  2. Bronze Flanges and Flanged Fittings: ASME B16.24, Class 150.
    - a. Gasket Material: ASME B16.20, metallic, flat, asbestos free, aluminum o-rings, and spiral-wound metal gaskets.
    - b. Bolts and Nuts: ASME B18.2.1, carbon steel or stainless steel.
  3. Protective Coating for Underground Tubing: Factory-applied, extruded PE a minimum of 0.022 inch thick.
- E. Annealed-Temper Copper Tube: Comply with ASTM B 837, Type G.
1. Copper Fittings: ASME B16.22, wrought copper, and streamlined pattern.
  2. Flare Fittings: Comply with ASME B16.26 and SAE J513.
    - a. Copper fittings with long nuts.
    - b. Metal-to-metal compression seal without gasket.
    - c. Dryseal threads complying with ASME B1.20.3.
  3. Protective Coating for Underground Tubing: Factory-applied, extruded PE a minimum of 0.022 inch thick.
- F. Tin-Lined Copper Tube: ASTM B 280, seamless, annealed, with interior tin-plated lining.
1. Flare Fittings: Comply with ASME B16.26 and SAE J513.
    - a. Copper fittings with long nuts.
    - b. Metal-to-metal compression seal without gasket.
    - c. Dryseal threads complying with ASME B1.20.3.

2. Steel Mechanical Couplings: Capable of joining plain-end PE pipe to PE pipe, steel pipe to PE pipe, or steel pipe to steel pipe.
  - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - (1) Dresser Piping Specialties; Division of Dresser, Inc.
    - (2) Smith-Blair, Inc.
  - b. Stainless-steel flanges and tube with epoxy finish.
  - c. Buna-nitrile seals.
  - d. Stainless-steel bolts, washers, and nuts.
  - e. Factory-installed anode for steel-body couplings installed underground.

## 2.2 PIPING SPECIALTIES

### A. Appliance Flexible Connectors:

1. Indoor, Fixed-Appliance Flexible Connectors: Comply with ANSI Z21.24.
2. Indoor, Movable-Appliance Flexible Connectors: Comply with ANSI Z21.69.
3. Outdoor, Appliance Flexible Connectors: Comply with ANSI Z21.75.
4. Corrugated stainless-steel tubing with polymer coating.
5. Operating-Pressure Rating: 0.5 psig.
6. End Fittings: Zinc-coated steel.
7. Threaded Ends: Comply with ASME B1.20.1.
8. Maximum Length: 72 inches

### B. Quick-Disconnect Devices: Comply with ANSI Z21.41.

1. Copper-alloy convenience outlet and matching plug connector.
2. Nitrile seals.
3. Hand operated with automatic shutoff when disconnected.
4. For indoor or outdoor applications.
5. Adjustable, retractable restraining cable.

**C. 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: 40-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating: 125 psig.

**D. 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.

**E. T-Pattern Strainers:**

1. Body: Ductile or malleable iron with removable access coupling and end cap for strainer maintenance.
  2. End Connections: Grooved ends.
  3. Strainer Screen: 40-mesh startup strainer, and perforated stainless-steel basket with 57 percent free area.
  4. CWP Rating: 750 psig.
- F. Weatherproof Vent Cap:** Cast- or malleable-iron increaser fitting with corrosion-resistant wire screen, with free area at least equal to cross-sectional area of connecting pipe and threaded-end connection.

**2.3 JOINING MATERIALS**

- A. Joint Compound and Tape: Suitable for natural gas.
- B. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

- C. Brazing Filler Metals: Alloy with melting point greater than 1000 deg Fcomplying with AWS A5.8/A5.8M. Brazing alloys containing more than 0.05 percent phosphorus are prohibited.

## 2.4 MANUAL GAS SHUTOFF VALVES

- A. See "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles for where each valve type is applied in various services.
- B. General Requirements for Metallic Valves, NPS 2 and Smaller: Comply with ASME B16.33.
1. CWP Rating: 125 psig.
  2. Threaded Ends: Comply with ASME B1.20.1.
  3. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.
  4. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
  5. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1 inch and smaller.
  6. Service Mark: Valves 1-1/4 inches to NPS 2shall have initials "WOG" permanently marked on valve body.
- C. General Requirements for Metallic Valves, NPS 2-1/2and Larger: Comply with ASME B16.38.
1. CWP Rating: 125 psig.
  2. Flanged Ends: Comply with ASME B16.5 for steel flanges.
  3. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
  4. Service Mark: Initials "WOG" shall be permanently marked on valve body.
- D. One-Piece, Bronze Ball Valve with Bronze Trim: MSS SP-110.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. BrassCraft Manufacturing Company; a Masco company.
    - b. Conbraco Industries, Inc.; Apollo Div.

- c.** Lyall, R. W. & Company, Inc. **d.** McDonald, A. Y. Mfg. Co. **e.** Perfection Corporation; a subsidiary of American Meter Company.
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2. Body: Bronze, complying with ASTM B 584.
3. Ball: Chrome-plated brass.
4. Stem: Bronze; blowout proof.
5. Seats: Reinforced TFE; blowout proof.
6. Packing: Separate packnut with adjustable-stem packing threaded ends.
7. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
8. CWP Rating: 600 psig.
9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.
- E. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim: MSS SP-110.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- a. BrassCraft Manufacturing Company; a Masco company.
- b. Conbraco Industries, Inc.; Apollo Div.
- c. Lyall, R. W. & Company, Inc.
- d. McDonald, A. Y. Mfg. Co.
- e. Perfection Corporation; a subsidiary of American Meter Company.
2. Body: Bronze, complying with ASTM B 584.
3. Ball: Chrome-plated bronze.
4. Stem: Bronze; blowout proof.
5. Seats: Reinforced TFE; blowout proof.
6. Packing: Threaded-body packnut design with adjustable-stem packing.

7. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
8. CWP Rating: 600 psig.
9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

F. Two-Piece, Regular-Port Bronze Ball Valves with Bronze Trim: MSS SP-110.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. BrassCraft Manufacturing Company; a Masco company.
  - b. Conbraco Industries, Inc.; Apollo Div.
  - c. Lyall, R. W. & Company, Inc.
  - d. McDonald, A. Y. Mfg. Co.
  - e. Perfection Corporation; a subsidiary of American Meter Company.
2. Body: Bronze, complying with ASTM B 584.
3. Ball: Chrome-plated bronze.
4. Stem: Bronze; blowout proof.
5. Seats: Reinforced TFE.
6. Packing: Threaded-body packnut design with adjustable-stem packing.
7. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
8. CWP Rating: 600 psig.
9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

G. Bronze Plug Valves: MSS SP-78.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- a. Lee Brass Company.
  - b. McDonald, A. Y. Mfg. Co.
2. Body: Bronze, complying with ASTM B 584.
  3. Plug: Bronze.
  4. Ends: Threaded, socket, or flanged as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
  5. Operator: Square head or lug type with tamperproof feature where indicated.
  6. Pressure Class: 125 psig.
  7. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
  8. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

**H. Valve Boxes:**

1. Cast-iron, two-section box.
2. Top section with cover with "GAS" lettering.
3. Bottom section with base to fit over valve and barrel a minimum of 5 inches in diameter.
4. Adjustable cast-iron extensions of length required for depth of bury.
5. Include tee-handle, steel operating wrench with socket end fitting valve nut or flat head, and with stem of length required to operate valve.

**2.5 MOTORIZED GAS VALVES**

**A. Automatic Gas Valves:** Comply with ANSI Z21.21.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. ASCO Power Technologies, LP; Division of Emerson.
  - b. Dungs, Karl, Inc.
  - c. Eaton Corporation; Controls Div.
  - d. Eclipse Combustion, Inc.
  - e. Honeywell International Inc.

f. Johnson Controls.

2. Body: Brass or aluminum.
3. Seats and Disc: Nitrile rubber.
4. Springs and Valve Trim: Stainless steel.
5. Normally closed.
6. Visual position indicator.
7. Electrical operator for actuation by appliance automatic shutoff device.

B. Electrically Operated Valves: Comply with UL 429.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. ASCO Power Technologies, LP; Division of Emerson.
  - b. Dungs, Karl, Inc.
  - c. Eclipse Combustion, Inc.
  - d. Goyen Valve Corp.; Tyco Environmental Systems.
  - e. Magnatrol Valve Corporation.
  - f. Parker Hannifin Corporation; Climate & Industrial Controls Group; Skinner Valve Div.
  - g. Watts Regulator Co.; Division of Watts Water Technologies, Inc
2. Pilot operated.
3. Body: Brass or aluminum.
4. Seats and Disc: Nitrile rubber.
5. Springs and Valve Trim: Stainless steel.
6. 120-V ac, 60 Hz, Class B, continuous-duty molded coil, and replaceable.
7. NEMA ICS 6, Type 4, coil enclosure.
8. Normally closed.
9. Visual position indicator.

## 2.6 PRESSURE REGULATORS

### A. General Requirements:

1. Single stage and suitable for natural gas.
2. Steel jacket and corrosion-resistant components.
3. Elevation compensator.
4. End Connections: Threaded for regulators NPS 2 and smaller; flanged for regulators NPS 2-1/2 and larger.

### B. Service Pressure Regulators: Comply with ANSI Z21.80.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Actaris.
  - b. American Meter Company.
  - c. Fisher Control Valves and Regulators; Division of Emerson Process Management.
  - d. Invensys.
  - e. Richards Industries; Jordan Valve Div.
2. Body and Diaphragm Case: Die-cast aluminum.
3. Springs: Zinc-plated steel; interchangeable.
4. Diaphragm Plate: Zinc-plated steel.
5. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.
6. Orifice: Aluminum; interchangeable.
7. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
8. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to the regulator.
9. Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 150 percent of design discharge pressure at shutoff.
10. Overpressure Protection Device: Factory mounted on pressure regulator.

11. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.
  12. Maximum Inlet Pressure: 100 psig.
- C. Line Pressure Regulators: Comply with ANSI Z21.80.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Actaris.
    - b. American Meter Company.
    - c. Eclipse Combustion, Inc.
    - d. Fisher Control Valves and Regulators; Division of Emerson Process Management.
    - e. Invensys.
    - f. Maxitrol Company.
    - g. Richards Industries; Jordan Valve Div.
  2. Body and Diaphragm Case: Die-cast aluminum.
  3. Springs: Zinc-plated steel; interchangeable.
  4. Diaphragm Plate: Zinc-plated steel.
  5. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.
  6. Orifice: Aluminum; interchangeable.
  7. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
  8. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to the regulator.
  9. Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 150 percent of design discharge pressure at shutoff.
  10. Overpressure Protection Device: Factory mounted on pressure regulator.
  11. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.
  12. Maximum Inlet Pressure: 5 psig.

**D. Appliance Pressure Regulators:** Comply with ANSI Z21.18.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Canadian Meter Company Inc.
  - b. Eaton Corporation; Controls Div.
  - c. Harper Wyman Co.
  - d. Maxitrol Company.
  - e. SCP, Inc.
2. Body and Diaphragm Case: Die-cast aluminum.
3. Springs: Zinc-plated steel; interchangeable.
4. Diaphragm Plate: Zinc-plated steel.
5. Seat Disc: Nitrile rubber.
6. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
7. Factory-Applied Finish: Minimum three-layer polyester and polyurethane paint finish.
8. Regulator may include vent limiting device, instead of vent connection, if approved by authorities having jurisdiction.
9. Maximum Inlet Pressure: 2 psig.

**2.7 SERVICE METERS**

**A. Diaphragm-Type Service Meters:** Comply with ANSI B109.1.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Actaris.
  - b. American Meter Company.
  - c. Invensys.
2. Case: Die-cast aluminum.
3. Connections: Steel threads.

4. Diaphragm: Synthetic fabric.
  5. Diaphragm Support Bearings: Self-lubricating.
  6. Compensation: Continuous temperature and pressure.
  7. Meter Index: Cubic feet.
  8. Meter Case and Index: Tamper resistant.
  9. Remote meter reader compatible.
  10. Maximum Inlet Pressure: 100 psig.
  11. Pressure Loss: Maximum 2.0-inch wg.
  12. Accuracy: Maximum plus or minus 1.0 percent.
- B. Rotary-Type Service Meters: Comply with ANSI B109.3.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. American Meter Company.
    - b. Invensys.
  2. Case: Extruded aluminum.
  3. Connection: Flange.
  4. Impellers: Polished aluminum.
  5. Rotor Bearings: Self-lubricating.
  6. Compensation: Continuous temperature and pressure.
  7. Meter Index: Cubic feet.
  8. Tamper resistant.
  9. Remote meter reader compatible.
  10. Maximum Inlet Pressure: 100 psig.
  11. Accuracy: Maximum plus or minus 2.0 percent.
- C. Turbine Meters: Comply with ASME MFC-4M.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. American Meter Company.
  - b. Invensys.
2. Housing: Cast iron or welded steel.
3. Connection Threads or Flanges: Steel.
4. Turbine: Aluminum or plastic.
5. Turbine Bearings: Self-lubricating.
6. Compensation: Continuous temperature and pressure.
7. Meter Index: Cubic feet.
8. Tamper resistant.
9. Remote meter reader compatible.
10. Maximum Inlet Pressure: 100 psig.
11. Accuracy: Maximum plus or minus 2.0 percent.

D. Service-Meter Bars:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Actaris.
  - b. American Meter Company.
  - c. Lyall, R. W. & Company, Inc.
  - d. McDonald, A. Y. Mfg. Co.
  - e. Mueller Co.; Gas Products Div.
  - f. Perfection Corporation; a subsidiary of American Meter Company.
2. Malleable- or cast-iron frame for supporting service meter.
3. Include offset swivel pipes, meter nuts with o-ring seal, and factory- or field-installed dielectric unions.

4. Omit meter offset swivel pipes if service-meter bar dimensions match service-meter connections.

**E. Service-Meter Bypass Fittings:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Lyall, R. W. & Company, Inc.
  - b. Williamson, T. D., Inc.
2. Ferrous, tee, pipe fitting with capped side inlet for temporary natural-gas supply.
3. Integral ball-check bypass valve.

**2.8 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 available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Capitol Manufacturing Company.
  - b. Central Plastics Company.
  - c. Hart Industries International, Inc.
  - d. Jomar International Ltd.
  - e. Matco-Norca, Inc.
  - f. McDonald, A. Y. Mfg. Co.
  - g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
  - h. Wilkins; a Zurn company.
2. Description:
  - a. Standard: ASSE 1079.
  - b. Pressure Rating: 125 psig minimum at 180 deg F.

- c. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges:

- 1. Manufacturers: Subject to compliance with requirements, [provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Capitol Manufacturing Company.
  - b. Central Plastics Company.
  - c. Matco-Norca, Inc.
  - d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
  - e. Wilkins; a Zurn company.
- 2. Description:
  - a. Standard: ASSE 1079.
  - b. Factory-fabricated, bolted, companion-flange assembly.
  - c. Pressure Rating: 125 psig minimum at 180 deg F.
  - d. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Insulating Kits:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Advance Products & Systems, Inc.
  - b. Calpico, Inc.
  - c. Central Plastics Company.
  - d. 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.

## 2.9 LABELING AND IDENTIFYING

- A. Detectable Warning Tape: Acid- and alkali-resistant, PE film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored yellow.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Examine roughing-in for natural-gas piping system to verify actual locations of piping connections before equipment installation.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Close equipment shutoff valves before turning off natural gas to premises or piping section.
- B. Inspect natural-gas piping according to NFPA 54 to determine that natural-gas utilization devices are turned off in piping section affected.
- C. Comply with NFPA 54 requirements for prevention of accidental ignition.

### 3.3 INDOOR PIPING INSTALLATION

- A. Comply with the International Fuel Gas Code for installation and purging of natural-gas piping.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. 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.
- C. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction, to allow for mechanical installations.
- D. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- E. 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.

- F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- G. Locate valves for easy access.
- H. Install natural-gas piping at uniform grade of 2 percent down toward drip and sediment traps.
- I. Install piping free of sags and bends.
- J. Install fittings for changes in direction and branch connections.
- K. Verify final equipment locations for roughing-in.
- L. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.
- M. Drips and Sediment Traps: Install drips at points where condensate may collect, including service-meter outlets. Locate where accessible to permit cleaning and emptying. Do not install where condensate is subject to freezing.
  - 1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.
- N. Extend relief vent connections for service regulators, line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.
- O. Conceal pipe installations in walls, pipe spaces, utility spaces, above ceilings, below grade or floors, and in floor channels unless indicated to be exposed to view.
- P. Concealed Location Installations: Except as specified below, install concealed natural-gas piping and piping installed under the building in containment conduit constructed of steel pipe with welded joints as described in Part 2. Install a vent pipe from containment conduit to outdoors and terminate with weatherproof vent cap.
  - 1. Above Accessible Ceilings: Natural-gas piping, fittings, valves, and regulators may be installed in accessible spaces without containment conduit.
  - 2. In Floors: Install natural-gas piping with welded or brazed joints and protective coating in cast-in-place concrete floors. Cover piping to be cast in concrete slabs with minimum of 1-1/2 inches of concrete. Piping may not be in physical contact with other metallic structures such as reinforcing rods or electrically neutral conductors. Do not embed piping in concrete slabs containing quick-set additives or cinder aggregate.
  - 3. In Floor Channels: Install natural-gas piping in floor channels. Channels must have cover and be open to space above cover for ventilation.
  - 4. In Walls or Partitions: Protect tubing installed inside partitions or hollow walls from physical damage using steel striker barriers at rigid supports.

- a. Exception: Tubing passing through partitions or walls does not require striker barriers.

**5. Prohibited Locations:**

- a. Do not install natural-gas piping in or through circulating air ducts, clothes or trash chutes, chimneys or gas vents (flues), ventilating ducts, or dumbwaiter or elevator shafts.
  - b. Do not install natural-gas piping in solid walls or partitions.
- Q. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.
- R. Connect branch piping from top or side of horizontal piping.
- S. Install unions in pipes NPS 2 and smaller, adjacent to each valve, at final connection to each piece of equipment. Unions are not required at flanged connections.
- T. Do not use natural-gas piping as grounding electrode.
- U. Install strainer on inlet of each line-pressure regulator and automatic or electrically operated valve.
- V. Install pressure gage [downstream] [upstream and downstream] from each line regulator. Pressure gages are specified in Section 230519 "Meters and Gages for HVAC Piping."
- W. 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."
- X. 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."
- Y. 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 SERVICE-METER ASSEMBLY INSTALLATION**

- A. Install service-meter assemblies aboveground, on concrete bases.
- B. Install metal shutoff valves upstream from service regulators. Shutoff valves are not required at second regulators if two regulators are installed in series.
- C. Install strainer on inlet of service-pressure regulator and meter set.
- D. Install service regulators mounted outside with vent outlet horizontal or facing down. Install screen in vent outlet if not integral with service regulator.

- E. Install metal shutoff valves upstream from service meters. Install dielectric fittings downstream from service meters.
- F. Install service meters downstream from pressure regulators.
- G. Install metal bollards to protect meter assemblies. Comply with requirements in Section 055000 "Metal Fabrications" for pipe bollards.

### **3.5 VALVE INSTALLATION**

- A. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless-steel tubing, aluminum, or copper connector.
- B. Install underground valves with valve boxes.
- C. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.
- D. Install earthquake valves aboveground outside buildings according to listing.
- E. Install anode for metallic valves in underground PE piping.

### **3.6 PIPING JOINT CONSTRUCTION**

- A. Ream ends of pipes and tubes and remove burrs.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Threaded Joints:
  1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
  2. Cut threads full and clean using sharp dies.
  3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.
  4. Apply appropriate tape or thread compound to external pipe threads unless dryseal threading is specified.
  5. 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. Welded Joints:
  1. Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators.
  2. Bevel plain ends of steel pipe.

3. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter.
- F. Flanged Joints: Install gasket material, size, type, and thickness appropriate for natural-gas service. Install gasket concentrically positioned.
- G. Flared Joints: Cut tubing with roll cutting tool. Flare tube end with tool to result in flare dimensions complying with SAE J513. Tighten finger tight, then use wrench. Do not over-tighten.

### **3.7 HANGER AND SUPPORT INSTALLATION**

- A. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."
- B. Comply with requirements for pipe hangers and supports specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
- C. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:
  1. NPS 1 and Smaller: Maximum span, 96 inches; minimum rod size, 3/8 inch.
  2. NPS 1-1/4: Maximum span, 108 inches; minimum rod size, 3/8 inch.
  3. NPS 1-1/2 and NPS 2: Maximum span, 108 inches; minimum rod size, 3/8 inch.
  4. NPS 2-1/2 to NPS 3-1/2: Maximum span, 10 feet; minimum rod size, 1/2 inch.
  5. NPS 4and Larger: Maximum span, 10 feet; minimum rod size, 5/8 inch.
- D. Install hangers for horizontal drawn-temper copper tubing with the following maximum spacing and minimum rod sizes:
  1. NPS 3/8: Maximum span, 48 inches; minimum rod size, 3/8 inch.
  2. NPS 1/2 and NPS 5/8: Maximum span, 72 inches; minimum rod size, 3/8 inch.
  3. NPS 3/4 and NPS 7/8: Maximum span, 84 inches; minimum rod size, 3/8 inch.
  4. NPS 1: Maximum span, 96 inches; minimum rod size, 3/8 inch.
- E. Install hangers for horizontal, corrugated stainless-steel tubing with the following maximum spacing and minimum rod sizes:
  1. NPS 3/8: Maximum span, 48 inches; minimum rod size, 3/8 inch.

2. NPS 1/2: Maximum span, 72 inches; minimum rod size, 3/8 inch.
3. NPS 3/4 and Larger: Maximum span, 96 inches; minimum rod size, 3/8 inch.

### **3.8 CONNECTIONS**

- A. Connect to utility's gas main according to utility's procedures and requirements.
- B. Install natural-gas piping electrically continuous, and bonded to gas appliance equipment grounding conductor of the circuit powering the appliance according to NFPA 70.
- C. Install piping adjacent to appliances to allow service and maintenance of appliances.
- D. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within 72 inches of each gas-fired appliance and equipment. Install union between valve and appliances or equipment.
- E. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.

### **3.9 LABELING AND IDENTIFYING**

- A. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for piping and valve identification.
- B. Install detectable warning tape directly above gas piping, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

### **3.10 PAINTING**

- A. Comply with requirements in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting" for painting interior and exterior natural-gas piping.
- B. Paint exposed, exterior metal piping, valves, service regulators, service meters and meter bars, earthquake valves, and piping specialties, except components, with factory-applied paint or protective coating.
  1. Alkyd System: MPI EXT 5.1D.
    - a. Prime Coat: Alkyd anticorrosive metal primer.
    - b. Intermediate Coat: Exterior alkyd enamel matching topcoat.
    - c. Topcoat: Exterior alkyd enamel semigloss.
    - d. Color: Gray.
  - C. Paint exposed, interior metal piping, valves, service regulators, service meters and meter bars, earthquake valves, and piping specialties, except components, with factory-applied paint or protective coating.

1. Latex Over Alkyd Primer System: MPI INT 5.1Q.
  - a. Prime Coat: Alkyd anticorrosive metal primer.
  - b. Intermediate Coat: Interior latex matching topcoat.
  - c. Topcoat: Interior latex flat.
  - d. Color: Gray.
2. Alkyd System: MPI INT 5.1E.
  - a. Prime Coat: Alkyd anticorrosive metal primer.
  - b. Intermediate Coat: Interior alkyd matching topcoat.
  - c. Topcoat: Interior alkyd flat.
  - d. Color: Gray.
- D. Damage and Touchup: Repair marred and damaged factory-applied finishes with materials and by procedures to match original factory finish.

### **3.11 CONCRETE BASES**

- A. Concrete Bases: Anchor equipment to concrete base according to seismic codes at Project.
1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
  2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inchcenters around the full perimeter of the base.
  3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
  4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  5. Install anchor bolts to elevations required for proper attachment to supported equipment.
  6. Use 3000-psig, 28-day, compressive-strength concrete and reinforcement as specified in Section 033000 "Cast-in-Place Concrete."

### **3.12 FIELD QUALITY CONTROL**

- A. Perform tests and inspections.
- B. Tests and Inspections:

1. Test, inspect, and purge natural gas according to the International Fuel Gas Code and authorities having jurisdiction.
- C. Natural-gas piping will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

### **3.13 DEMONSTRATION**

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain earthquake valves.

### **3.14 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES LESS THAN 0.5 PSIG**

- A. Aboveground, branch piping NPS 1 and smaller shall be one of the following:

1. Corrugated stainless-steel tubing with mechanical fittings having socket or threaded ends to match adjacent piping.
2. Annealed-temper, tin-lined copper tube with flared joints and fittings.
3. Annealed-temper, copper tube with wrought-copper fittings and brazed joints.
4. Aluminum tube with flared fittings and joints.
5. Steel pipe with malleable-iron fittings and threaded joints.

- B. Aboveground, distribution piping shall be one of the following:

1. Steel pipe with malleable-iron fittings and threaded joints.
2. Steel pipe with wrought-steel fittings and welded joints.
3. Drawn-temper copper tube with wrought-copper fittings and brazed joints.

- C. Underground, below building, piping shall be one of the following:

1. Steel pipe with malleable-iron fittings and threaded joints.
2. Steel pipe with wrought-steel fittings and welded joints.

- D. Containment Conduit: Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.

- E. Containment Conduit Vent Piping: Steel pipe with malleable-iron fittings and threaded or wrought-steel fittings with welded joints. Coat underground pipe and fittings with protective coating for steel piping.

### **3.15 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES MORE THAN 0.5 PSIG AND LESS THAN 5 PSIG**

- A.** Aboveground, branch piping NPS 1 and smaller shall be one of the following:
  - 1. Corrugated stainless-steel tubing with mechanical fittings having socket or threaded ends to match adjacent piping.
  - 2. Annealed-temper, tin-lined copper tube with flared joints and fittings.
  - 3. Annealed-temper, copper tube with wrought-copper fittings and brazed joints.
  - 4. Aluminum tube with flared fittings and joints.
  - 5. Steel pipe with malleable-iron fittings and threaded joints.
- B.** Aboveground, distribution piping shall be one of the following:
  - 1. Steel pipe with malleable-iron fittings and threaded joints.
  - 2. Steel pipe with steel welding fittings and welded joints.
  - 3. Drawn-temper copper tube with wrought-copper fittings and brazed joints.
- C.** Underground, below building, piping shall be one of the following:
  - 1. Steel pipe with malleable-iron fittings and threaded joints.
  - 2. Steel pipe with wrought-steel fittings and welded joints.
- D.** Containment Conduit: Steel pipe with wrought-steel fittings and welded joints. Coat underground pipe and fittings with protective coating for steel piping.
- E.** Containment Conduit Vent Piping: Steel pipe with malleable-iron fittings and threaded or wrought-steel fittings with welded joints. Coat underground pipe and fittings with protective coating for steel piping.

### **3.16 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES MORE THAN 5 PSIG**

- A.** Aboveground Piping: Maximum operating pressure more than 5 psig.
- B.** Aboveground, Branch Piping: Steel pipe with steel welding fittings and welded joints.
- C.** Aboveground, distribution piping shall be one of the following:
  - 1. Steel pipe with steel welding fittings and welded joints.
  - 2. Drawn-temper copper tube with wrought-copper fittings and brazed joints.
- D.** Underground, below building, piping shall be one of the following:

1. Steel pipe with malleable-iron fittings and threaded joints.
2. Steel pipe with wrought-steel fittings and welded joints.
- E. Containment Conduit: Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.
- F. Containment Conduit Vent Piping: Steel pipe with malleable-iron fittings and threaded or wrought-steel fittings with welded joints. Coat underground pipe and fittings with protective coating for steel piping.

### **3.17 ABOVEGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE**

- A. Valves for pipe sizes NPS 2 and smaller at service meter shall be one of the following:
  1. One-piece, bronze ball valve with bronze trim.
  2. Two-piece, full-port, bronze ball valves with bronze trim.
  3. Bronze plug valve.
- B. Valves for pipe sizes NPS 2-1/2 and larger at service meter shall be one of the following:
  1. Two-piece, full-port, bronze ball valves with bronze trim.
  2. Bronze plug valve.
  3. Cast-iron, nonlubricated plug valve.
- C. Distribution piping valves for pipe sizes NPS 2 and smaller shall be one of the following:
  1. One-piece, bronze ball valve with bronze trim.
  2. Two-piece, full-port, bronze ball valves with bronze trim.
  3. Bronze plug valve.
- D. Distribution piping valves for pipe sizes NPS 2-1/2 and larger shall be one of the following:
  1. Two-piece, full-port, bronze ball valves with bronze trim.
  2. Bronze plug valve.
- E. Valves in branch piping for single appliance shall be one of the following:
  1. One-piece, bronze ball valve with bronze trim.
  2. Two-piece, full-port, bronze ball valves with bronze trim.
  3. Bronze plug valve.

## **SECTION 23 21 35 - VARIABLE SPEED DRIVES**

### **PART 1 GENERAL**

#### **1.1 GENERAL**

A. The requirements of Section 230500 "Mechanical General Provisions" apply to this Section.

#### **1.2 DESCRIPTION**

A. This specification is to cover a complete Variable Frequency motor Drive (VFD) consisting of a pulse width modulated (PWM) inverter designed for use on a standard NEMA Design B induction motor. It is required that the drive manufacturer have an existing:

1. Sales representative exclusively for HVAC products, with expertise in HVAC systems and controls.
  2. An independent service organization.
- B. The VFD shall have been evaluated by UL and found acceptable for mounting in a plenum or other air handling compartment. Manufacturer shall supply a copy of the UL plenum evaluation upon request.
- C. The VFD shall be tested to UL 508C. The appropriate UL label shall be applied. VFD shall be manufactured in ISO 9001, 2000 certified facilities.
- D. The VFD shall be UL listed for a short circuit current rating of 100 kA and labeled with this rating.
- E. The VFD manufacturer shall supply the VFD and all necessary controls as herein specified. The manufacturer shall have been engaged in the production of this type of equipment for a minimum of twenty years.
- F. Related Documents: Drawings and general provisions of Contract apply to work of this section. The requirements of Division 23 Section "Mechanical General Provisions" apply to this Section.

#### **1.3 QUALITY ASSURANCE**

A. Referenced Standards:

1. Institute of Electrical and Electronic Engineers (IEEE)
  - a. Standard 519-1992, IEEE Guide for Harmonic Content and Control.
2. Underwriters laboratories
  - a. UL508C
3. National Electrical Manufacturer's Association (NEMA)
  - a. ICS 7.0, AC Adjustable Speed Drives

**4. IEC 16800 Parts 1 and 2**

**B. Qualifications:**

1. VFDs and options shall be UL listed as a complete assembly. VFD's that require the customer to supply external fuses for the VFD to be UL listed are not acceptable. The base VFD shall be UL listed for 100 KAIC without the need for input fuses.

**2. Acceptable Manufacturers:**

a. Yaskawa

b. Danfoss/Trane

c. ABB

3. All VFD's on the project shall be by the same manufacturer.

**1.4 SUBMITTALS**

**A. Submittals shall include the following information:**

1. Outline dimensions, conduit entry locations and weight.
2. Customer connection and power wiring diagrams.
3. Complete technical product description include a complete list of options provided
4. Compliance to IEEE 519 – harmonic analysis for particular jobsite including total harmonic voltage distortion and total harmonic current distortion (TDD).
  - a. The VFD manufacturer shall provide calculations; specific to this installation, showing total harmonic voltage distortion is less than 5%. Input line filters shall be sized and provided as required by the VFD manufacturer to ensure compliance with IEEE standard 519. All VFD's shall include a minimum of 5% impedance reactors, no exceptions.

**PART 2 PRODUCTS**

**2.1 VARIABLE FREQUENCY DRIVES**

A. The VFD package as specified herein shall be enclosed in a NEMA 1 enclosure, completely assembled and tested by the manufacturer in an ISO9001 facility. The VFD tolerated voltage window shall allow the VFD to operate from a line of +30% nominal, and -35% nominal voltage as a minimum.

1. Environmental operating conditions: 0 to 40deg C continuous. VFD's that can operate at 40deg C intermittently (during a 24 hour period) are not acceptable and must be oversized. Altitude 0 to 3300 feet above sea level, less than 95% humidity, non-condensing.
2. Enclosure shall be rated UL type 12 and shall be UL listed as a plenum rated VFD. VFD's without these ratings are not acceptable.

**VARIABLE SPEED DRIVES**

**B.** All VFDs shall have the following standard features:

1. The VFD shall convert incoming fixed frequency three-phase AC power into an Variable frequency and voltage for controlling the speed of three-phase AC motors. The motor current shall closely approximate a sine wave. Motor voltage shall be varied with frequency to maintain desired motor magnetization current suitable for the driven load and to eliminate the need for motor de-rating. When properly sized, the VFD shall allow the motor to produce full rated power at rated motor voltage, current, and speed without using the motor's service factor. VFDs utilizing sine weighted/coded modulation (with or without 3rd harmonic injection) must provide data verifying that the motors will not draw more than full load current during full load and full speed operation.
2. The VFD shall include an input full-wave bridge rectifier and maintain a fundamental (displacement) power factor near unity regardless of speed or load.
3. The VFD shall have a dual 5% impedance DC link reactor on the positive and negative rails of the DC bus to minimize power line harmonics and protect the VFD from power line transients. The chokes shall be non-saturating. Swinging chokes that do not provide full harmonic filtering throughout the entire load range are not acceptable. VFDs with saturating (non-linear) DC link reactors shall require an additional 3% AC line reactor to provide acceptable harmonic performance at full load, where harmonic performance is most critical.
4. The VFD's full load output current rating shall meet or exceed NEC Table 430-150. The VFD shall be able to provide full rated output current continuously, 110% of rated current for 60 seconds and 120% of rated torque for up to 0.5 second while starting.
5. The VFD shall provide full motor torque at any selected frequency from 20 Hz to base speed while providing a variable torque V/Hz output at reduced speed. This is to allow driving direct drive fans without high speed de-rating or low speed excessive magnetization, as would occur if a constant torque V/Hz curve was used at reduced speeds. Breakaway current of 160% shall be available.
6. A programmable automatic energy optimization selection feature shall be provided standard in the VFD. This feature shall automatically and continuously monitor the motor's speed and load to adjust the applied voltage to maximize energy savings.
7. The VFD must be able to produce full torque at low speed to operate direct drive fans.
8. Output power circuit switching shall be able to be accomplished without interlocks or damage to the VFD.
9. An automatic motor adaptation algorithm shall measure motor stator resistance and reactance to optimize performance and efficiency. It shall not be necessary to run the motor or de-couple the motor from the load to perform the test.
10. VFD shall minimize the audible motor noise through the used of an Variable carrier frequency. The carrier frequency shall be automatically adjusted to optimize motor and VFD operation while reducing motor noise. VFDs with fixed carrier frequency are not acceptable.

11. All VFDs shall contain integral EMI filters to attenuate radio frequency interference conducted to the AC power line.
  12. All VFDs 25 HP or above shall have utilize a minimum of 18 pulse technology.
  13. Manual Bypass shall be provided for all VFD's. ASD and bypass components shall be mounted inside a common NEMA 1 enclosure, fully pre-wired, and ready for installation as a single UL listed device. Bypass shall include the following:
    - a. Input, output, and bypass contactors, to disconnect power to the ASD, when the motor is running in the bypass mode.
    - b. Thermal overload relay, to protect the motor while operating in the bypass mode.
    - c. Circuit breaker/disconnect switch, with a "through-the-door" handle mechanism.
    - d. Control and safety circuit terminal strip.
    - e. "Drive-Off-Bypass" selector switch.
    - f. Pilot lights for "Power On" and "Fault".
    - g. "Normal/Test" selector switch, to allow testing and adjustment of the ASD, while the motor is running in the bypass mode.
    - h. "Auto/Manual" selector switch, to provide convenient switching between "manual" and "auto" modes.
- C. All VFDs to have the following adjustments:
1. The VFD shall have a manually adjustable carrier frequency that can be adjusted in 0.5 kHz increments to allow the user to select the desired operating characteristics. The VFD shall also be programmable to automatically reduce its carrier frequency to avoid tripping due to thermal loading.
  2. Four independent setups shall be provided.
  3. Four preset speeds per setup shall be provided for a total of 16.
  4. Each setup shall have two programmable ramp up and ramp down times. Acceleration and deceleration ramp times shall be adjustable over the range from 1 to 3,600 seconds.
  5. Each setup shall be programmable for a unique current limit value. If the output current from the VFD reaches this value, any further attempt to increase the current produced by the VFD will cause the VFD to reduce its output frequency to reduce the load on the VFD. If desired, it shall be possible to program a timer which will cause the VFD to trip off after a programmed time period.
  6. If the VFD trips on one of the following conditions, the VFD shall be programmable for automatic or manual reset: external interlock, under-voltage, over-voltage, current limit, over temperature, and VFD overload.

7. The number of restart attempts shall be selectable from 0 through 20 or infinitely and the time between attempts shall be adjustable from 0 through 600 seconds.
8. An automatic “start delay” may be selected from 0 to 120 seconds. During this delay time, the VFD shall be programmable to either apply no voltage to the motor or apply a DC braking current if desired.
9. Four programmable critical frequency lockout ranges to prevent the VFD from operating the load at a speed that causes vibration in the driven equipment shall be provided. Semi-automatic setting of lockout ranges shall simplify the set-up.

**D. Interface features shall include:**

1. Hand, Off and Auto keys shall be provided to start and stop the VFD and determine the source of the speed reference. It shall be possible to either disable these keys or password protect them from undesired operation.
2. There shall be an “Info key on the keypad. The Info key shall include “on-line context sensitive assistance for programming and troubleshooting.
3. The VFD shall be programmable to provide a digital output signal to indicate whether the VFD is in Hand or Auto mode. This is to alert the Building Automation System whether the VFD is being controlled locally or by the Building Automation System.
4. Password protected keypad with alphanumeric, graphical, backlit display can be remotely mounted. Two levels of password protection shall be provided to guard against unauthorized parameter changes.
5. All VFDs shall have the same customer interface. The keypad and display shall be identical and interchangeable for all sizes of VFDs.
6. To set up multiple VFDs, it shall be possible to upload all setup parameters to the VFD’s keypad, place that keypad on all other VFDs in turn and download the setup parameters to each VFD. To facilitate setting up VFDs of various sizes, it shall be possible to download from the keypad only size independent parameters. Keypad shall provide visual indication of copy status.
7. Display shall be programmable to communicate in multiple languages including English, Spanish and French.
8. A red FAULT light, a yellow WARNING light and a green POWER-ON light shall be provided. These indications shall be visible both on the keypad and on the VFD when the keypad is removed.
9. A quick setup menu with factory preset typical HVAC parameters shall be provided on the VFD. The VFD shall also have individual Fan, Pump, and Compressor menus specifically designed to facilitate start-up of these applications.
10. A three-feedback PID controller to control the speed of the VFD shall be standard.

11. This controller shall accept up to three feedback signals. It shall be programmable to compare the feedback signals to a common setpoint or to individual setpoints and to automatically select either the maximum or the feedback signal as the controlling signal. It shall also be possible to calculate the controlling feedback signal as the average of all feedback signals or the difference between a pair of feedback signals.
12. The VFD shall be able to apply individual scaling to each feedback signal.
13. For fan flow tracking applications, the VFD shall be able to calculate the square root of any or all individual feedback signals so that a pressure sensor can be used to measure air flow.
14. The VFD's PID controller shall be able to actively adjust its setpoint based on flow. This allows the VFD to compensate for a pressure feedback sensor which is located near the output of the pump rather than out in the controlled system.
15. The VFD shall have three additional PID controllers which can be used to control damper and valve positioners in the system and to provide setpoint reset.
16. Floating point control interface shall be provided to increase/decrease speed in response to contact closures.
17. Five simultaneous meter displays shall be available. They shall include at a minimum, frequency, motor current, motor voltage, VFD output power, VFD output energy, VFD temperature in degrees, among others.
18. Programmable Sleep Mode shall be able to stop the VFD. When its output frequency drops below set "sleep" level for a specified time, when an external contact commands that the VFD go into Sleep Mode, or when the VFD detects a no-flow situation, the VFD may be programmed to stop. When the VFD's speed is being controlled by its PID controller, it shall be possible to program a "wake-up" feedback value that will cause the VFD to start. To avoid excessive starting and stopping of the driven equipment, it shall be possible to program a minimum run time before sleep mode can be initiated and a minimum sleep time for the VFD.
19. A run permissive circuit shall be provided to accept a "system ready" signal to ensure that the VFD does not start until dampers or other auxiliary equipment are in the proper state for VFD operation. The run permissive circuit shall also be capable of initiating an output "run request" signal to indicate to the external equipment that the VFD has received a request to run.
20. VFD shall be programmable to display feedback signals in appropriate units, such as inches of water column (in-wg), pressure per square inch (psi) or temperature (°F).
21. VFD shall be programmable to sense the loss of load. The VFD shall be programmable to signal this condition via a keypad warning, relay output and/or over the serial communications bus. To ensure against nuisance indications, this feature must be based on motor torque, not current, and must include a proof timer to keep brief periods of no load from falsely triggering this indication.
22. Standard Control and Monitoring Inputs and Outputs

- a. Four dedicated, programmable digital inputs shall be provided for interfacing with the systems control and safety interlock circuitry.
- b. Two terminals shall be programmable to act as either as digital outputs or additional digital inputs.
- c. Two programmable relay outputs, Form C 240 V AC, 2 A, shall be provided for remote indication of VFD status. Each relay shall have an adjustable on delay / off delay time.
- d. Two programmable analog inputs shall be provided that can be either direct-or-reverse acting. Each shall be independently selectable to be used with either an analog voltage or current signal. The maximum and minimum range of each shall be able to be independently scalable from 0 to 10 V dc and 0 to 20 mA. A programmable low-pass filter for either or both of the analog inputs must be included to compensate for noise. The VFD shall provide front panel meter displays programmable to show the value of each analog input signal for system set-up and troubleshooting.
- e. One programmable analog current output (0/4 to 20 mA) shall be provided for indication of VFD status. This output shall be programmable to show the reference or feedback signal supplied to the VFD and for VFD output frequency, current and power. It shall be possible to scale the minimum and maximum values of this output. It shall be possible through serial bus communications to read the status of all analog and digital inputs of the VFD. It shall be possible to command all digital and analog output through the serial communication bus.

### **23. Optional Control and Monitoring Inputs and Outputs**

- a. It shall be possible to add optional modules to the VFD in the field to expand its analog and digital inputs and outputs.
- b. These modules shall use rigid connectors to plug into the VFD's control card.
- c. The VFD shall automatically recognize the option module after it is powered up. There shall be no need to manually configure the module.
- d. Modules may include such items as:
- e. Additional digital outputs, including relay outputs Additional digital inputs
- f. Additional analog outputs, including Ni or Pt temperature sensor inputs
- g. It shall be possible through serial bus communications to control the status of all optional analog and digital outputs of the VFD.

### **24. Standard programmable firefighter's override mode allows a digital input to control the VFD and override all other local or remote commands. It shall be possible to program the VFD so that it will ignore most normal VFD safety circuits including motor overload. The VFD shall display FIREMODE whenever in firefighter's override mode. Fire mode shall allow selection of forward or reverse operation and the selection of a speed source or preset speed, as required to accommodate local fire codes, standards and conditions.**

25. A real-time clock shall be an integral part of the VFD. It shall be possible to use this to display the current date and time on the VFD's display. Ten programmable time periods, with individually selectable ON and OFF functions shall be available. The clock shall also be programmable to control start/stop functions, constant speeds, PID parameter setpoints and output relays. It shall be possible to program unique events that occur only during normal work days, others that occur only on non-work days, and others that occur on specific days or dates. The manufacturer shall provide free PC-based software to set up the calendar for this schedule. All VFD faults shall be time stamped to aid troubleshooting. It shall be possible to program maintenance reminders based on date and time, VFD running hours, or VFD operating hours. The real-time clock shall be able to time and date stamp all faults recorded in the VFD fault log.
26. The VFD shall be able to store load profile data to assist in analyzing the system demand and energy consumption over time.
27. The VFD shall include a sequential logic controller to provide advanced control interface capabilities. This shall include: Comparators for comparing VFD analog values to programmed trigger values. Logic operators to combine up to three logic expressions using Boolean algebra Delay timers A 20-step programmable structure

#### E. Serial Communications

1. The VFD shall include a standard EIA-485 communications port be connected to the following serial communication protocols at no additional cost and without a need to install any additional hardware or software in the VFD: VIA MODBUS Integration Siemens
2. VFD shall have standard USB port for direct connection of Personal Computer (PC) to the VFD. The manufacturer shall provide no-charge PC software to allow complete setup and access of the VFD and logs of VFD operation through the USB port. It shall be possible to communicate to the VFD through this USB port without interrupting VFD communications to the building management system.
3. The VFD shall have provisions for an optional 24 V DC back-up power interface to power the VFD's control card. This is to allow the VFD to continue to communicate to the building automation system even if power to the VFD is lost.

#### F. OPTIONAL FEATURES

1. All optional features shall be built and mounted by VFD manufacturer. All optional features shall be UL listed by the VFD manufacturer as a complete assembly and carry a UL label.
2. All panels shall be marked for their short circuit current rating in compliance with UL.

#### G. SERVICE CONDITIONS

1. Ambient temperature, continuous, full speed, full load operation:
  - a. 14 to 113°F through 125 HP @ 460 and 600 volt, through 60 HP @ 208 volt
  - b. 14 to 104°F 150 HP and larger

- c. 0 to 95% relative humidity, non-condensing.
- d. Elevation to 3,300 feet without derating.
- e. AC line voltage variation, -10 to +10% of nominal with full output.
- f. All power and control wiring shall be done from the bottom.
- g. All VFDs shall be plenum rated.

### **PART 3 EXECUTION**

#### **3.1 INSTALLATION**

- A. Installation shall be the responsibility of the contractor. The contractor shall install the drive in accordance with the recommendations of the VFD manufacturer as outlined in the installation manual.
- B. Power wiring shall be completed by the contractor. The contractor shall complete all wiring in accordance with the recommendations of the VFD manufacturer as outlined in the installation manual.

#### **3.2 START-UP**

- A. Certified factory start-up shall be provided for each drive by a factory authorized service center. A certified start-up form shall be filled out for each drive with a copy provided to the owner, and a copy kept on file at the manufacturer.

#### **3.3 PRODUCT SUPPORT**

- A. Factory trained application engineering and service personnel that are thoroughly familiar with the VFD products offered shall be locally available at both the specifying and installation locations. A 24/365 technical support line shall be available on a toll-free line.
- B. A computer based training CD or 8-hour professionally generated video DVD format) shall be provided to the owner at the time of project closeout. The training shall include installation, programming and operation of the VFD, bypass and serial communication.

#### **3.4 WARRANTY**

- A. Warranty shall be 24 months from the date of certified start-up, not to exceed 30 months from the date of shipment. The warranty shall include all parts, labor, travel time and expenses. There shall be 365/24 support available via a toll free phone number.

#### **3.5 COMMISSIONING**

- A. Provide all material and labor required to fulfill the commissioning requirements as described in specification Section 230800, COMMISSIONING OF HVAC SYSTEMS and elsewhere in the contract package.



## SECTION 23 23 00 - REFRIGERANT PIPING

### PART 1 GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. In cases of proprietary piping systems such as VRF systems, all refrigerant piping shall be furnished per manufacturer's published recommendations and installed per manufacturer approved contractors.

#### 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, refrigerant piping, and 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. All refrigerant piping shall be sized and run in accordance with manufacturer's recommendations. Manufacturer shall certify piping sizes, routing and layout.
4. Show interface and spatial relationships between piping and equipment.
5. Shop Drawing Scale: 1/4 inch equals 1 foot Insert value.

#### **1.4 INFORMATIONAL SUBMITTALS**

- A. Welding certificates.
- B. Field quality-control reports.
- C. Manufacturer certifications for all welders working on the refrigeration systems specified.
- D. Manufacturer training certificates.

#### **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."
- D. Comply with manufacturer required training based on specified equipment.

#### **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-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 K or L.

- B. Wrought-Copper Fittings: ASME B16.22.
- C. Wrought-Copper Unions: ASME B16.22.
- D. Solder Filler Metals: ASTM B 32. Use 95-5 tin antimony or alloy HB solder to join copper socket fittings on copper pipe.
- E. Brazing Filler Metals: AWS A5.8/A5.8M.
- F. 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 STEEL PIPE AND FITTINGS**

- A. Steel Pipe: ASTM A 53/A 53M, black steel with plain ends; type, grade, and wall thickness as selected in piping application articles.
- B. Wrought-Steel Fittings: ASTM A 234/A 234M, for welded joints.
- C. Steel Flanges and Flanged Fittings: ASME B16.5, steel, including bolts, nuts, and gaskets, bevel-welded end connection, and raised face.
- 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. Flanged Unions:
  - 1. Body: Forged-steel flanges for NPS 1 to NPS 1-1/2 and ductile iron for NPS 2 to NPS 3. Apply rust-resistant finish at factory.
  - 2. Gasket: Fiber asbestos free.
  - 3. Fasteners: Four plated-steel bolts, with silicon bronze nuts. Apply rust-resistant finish at factory.
  - 4. End Connections: Brass tailpiece adapters for solder-end connections to copper tubing.
  - 5. Offset Performance: Capable of minimum 3/4-inch misalignment in minimum 7-inch-long assembly.
  - 6. Pressure Rating: Factory test at minimum 400 psig.
  - 7. Maximum Operating Temperature: 330 deg F.

**F. Flexible Connectors:**

1. Body: Stainless-steel bellows with woven, flexible, stainless-steel-wire-reinforced protective jacket.
2. End Connections:
  - a. NPS 2 and Smaller: With threaded-end connections.
  - b. NPS 2-1/2 and Larger: With flanged-end connections.
3. Offset Performance: Capable of minimum 3/4-inch misalignment in minimum 7-inch-long assembly.
4. Pressure Rating: Factory test at minimum 500 psig.
5. Maximum Operating Temperature: 250 deg F.

**2.4 VALVES AND SPECIALTIES**

**A. Diaphragm Packless Valves:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Danfoss Inc.
  - b. Helden Products; Henry Technologies.
  - c. Parker Hannifin Corp.
  - d. Paul Mueller Company.
2. Body and Bonnet: Forged brass or cast bronze; globe design with straight-through or angle pattern.
3. Diaphragm: Phosphor bronze and stainless steel with stainless-steel spring.
4. Operator: Rising stem and hand wheel.
5. Seat: Nylon.
6. End Connections: Socket, union, or flanged.
7. Working Pressure Rating: 500 psig.
8. Maximum Operating Temperature: 275 deg F.

**B. Packed-Angle Valves:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Danfoss Inc.

- b. Heldon Products; Henry Technologies.
  - c. Parker Hannifin Corp.
  - d. Paul Mueller Company.
- 2. Body and Bonnet: Forged brass or cast bronze.
- 3. Packing: Molded stem, back seating, and replaceable under pressure.
- 4. Operator: Rising stem.
- 5. Seat: Nonrotating, self-aligning polytetrafluoroethylene.
- 6. Seal Cap: Forged-brass or valox hex cap.
- 7. End Connections: Socket, union, threaded, or flanged.
- 8. Working Pressure Rating: 500 psig.
- 9. Maximum Operating Temperature: 275 deg F.

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C. Check Valves:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Danfoss Inc.
  - b. Emerson Climate Technologies.
  - c. Heldon Products; Henry Technologies.
  - d. Parker Hannifin Corp.
  - e. Paul Mueller Company.
- 2. Body: Ductile iron, forged brass, or cast bronze; globe pattern.
- 3. Bonnet: Bolted ductile iron, forged brass, or cast bronze; or brass hex plug.
- 4. Piston: Removable polytetrafluoroethylene seat.
- 5. Closing Spring: Stainless steel.
- 6. Manual Opening Stem: Seal cap, plated-steel stem, and graphite seal.
- 7. End Connections: Socket, union, threaded, or flanged.
- 8. Maximum Opening Pressure: 0.50 psig.
- 9. Working Pressure Rating: 500 psig.
- 10. Maximum Operating Temperature: 275 deg F.

**D. Service Valves:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Danfoss Inc.
    - b. Emerson Climate Technologies.
    - c. Helden Products; Henry Technologies.
    - d. Parker Hannifin Corp.
    - e. Paul Mueller Company.
    - f. Refrigeration Sales, Inc.
  2. Body: Forged brass with brass cap including key end to remove core.
  3. Core: Removable ball-type check valve with stainless-steel spring.
  4. Seat: Polytetrafluoroethylene.
  5. End Connections: Copper spring.
  6. 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Danfoss Inc.
    - b. Emerson Climate Technologies.
    - c. Helden Products; Henry Technologies.
    - d. Parker Hannifin Corp.
    - e. Paul Mueller Company.
  2. Body and Bonnet: Plated steel.
  3. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
  4. Seat: Polytetrafluoroethylene.
  5. End Connections: Threaded.
  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. Working Pressure Rating: 400 psig.
  8. 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Danfoss Inc.
    - b. Helden Products; Henry Technologies.
    - c. Parker Hannifin Corp.
    - d. Paul Mueller Company.
  2. Body and Bonnet: Ductile iron and steel, with neoprene O-ring seal.
  3. Piston, Closing Spring, and Seat Insert: Stainless steel.
  4. Seat: Polytetrafluoroethylene.
  5. End Connections: Threaded.
  6. Working Pressure Rating: 400 psig.
  7. Maximum Operating Temperature: 240 deg F.
- G. Thermostatic Expansion Valves: Comply with AHRI 750.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Danfoss Inc.
    - b. Emerson Climate Technologies.
    - c. Helden Products; Henry Technologies.
    - d. Paul Mueller Company.
  2. Body, Bonnet, and Seal Cap: Forged brass or steel.
  3. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
  4. Packing and Gaskets: Non-asbestos.
  5. Capillary and Bulb: Copper tubing filled with refrigerant charge.
  6. Suction Temperature: 40 deg F.
  7. Superheat: Adjustable.

8. Reverse-flow option (for heat-pump applications).
9. End Connections: Socket, flare, or threaded union.
- 10. Working Pressure Rating: 450 psig.**
- H. Hot-Gas Bypass Valves:** Comply with UL 429; listed and labeled by an NRTL.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Danfoss Inc.
    - b. Helden Products; Henry Technologies.
    - c. Parker Hannifin Corp.
  2. Body, Bonnet, and Seal Cap: Ductile iron or steel.
  3. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
  4. Packing and Gaskets: Non-asbestos.
  5. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
  6. Seat: Polytetrafluoroethylene.
  7. Equalizer: Internal.
  8. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch conduit adapter and 24-V ac coil.
  9. End Connections: Socket.
  - 10. Set Pressure: 300 psig.**
  - 11. Throttling Range: Maximum 5 psig.**
  - 12. Working Pressure Rating: 500 psig.**
  - 13. Maximum Operating Temperature: 240 deg F.**
- I. Straight-Type Strainers:**
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Danfoss Inc.
    - b. Helden Products; Henry Technologies.
    - c. Parker Hannifin Corp.
  2. Body: Welded steel with corrosion-resistant coating.

3. Screen: 100-mesh stainless steel.
4. End Connections: Socket or flare.
5. Working Pressure Rating: 500 psig.
6. Maximum Operating Temperature: 275 deg F.

**J. Angle-Type Strainers:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Danfoss Inc.
  - b. Helden Products; Henry Technologies.
  - c. Parker Hannifin Corp.
2. Body: Forged brass or cast bronze.
3. Drain Plug: Brass hex plug.
4. Screen: 100-mesh monel.
5. End Connections: Socket or flare.
6. Working Pressure Rating: 500 psig.
7. Maximum Operating Temperature: 275 deg F.

**K. Moisture/Liquid Indicators:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Danfoss Inc.
  - b. Emerson Climate Technologies.
  - c. Helden Products; Henry Technologies.
  - d. Parker Hannifin Corp.
2. Body: Forged brass.
3. Window: Replaceable, clear, fused glass window with indicating element protected by filter screen.
4. Indicator: Color coded to show moisture content in parts per million (ppm).
5. Minimum Moisture Indicator Sensitivity: Indicate moisture above 60 ppm.
6. End Connections: Socket or flare.

7. Working Pressure Rating: 500 psig.
  8. Maximum Operating Temperature: 240 deg F.
- L. Replaceable-Core Filter Dryers: Comply with AHRI 730.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Danfoss Inc.
    - b. Emerson Climate Technologies.
    - c. Helden Products; Henry Technologies.
    - d. Parker Hannifin Corp.
  2. Body and Cover: Painted-steel shell with ductile-iron cover, stainless-steel screws, and neoprene gaskets.
  3. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
  4. Desiccant Media: Activated alumina.
  5. Designed for reverse flow (for heat-pump applications).
  6. End Connections: Socket.
  7. Access Ports: NPS 1/4 connections at entering and leaving sides for pressure differential measurement.
  8. Maximum Pressure Loss: 2 psig.
  9. Rated Flow: As required.
  10. Working Pressure Rating: 500 psig.
  11. Maximum Operating Temperature: 240 deg F.
- M. Permanent Filter Dryers: Comply with AHRI 730.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Danfoss Inc.
    - b. Emerson Climate Technologies.
    - c. Helden Products; Henry Technologies.
    - d. Parker Hannifin Corp.
  2. Body and Cover: Painted-steel shell.

3. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
4. Desiccant Media: Activated alumina.
5. Designed for reverse flow (for heat-pump applications).
6. End Connections: Socket.
7. Access Ports: NPS 1/4 connections at entering and leaving sides for pressure differential measurement.
8. Maximum Pressure Loss: 2 psig.
9. Rated Flow: As required.
10. Working Pressure Rating: 500 psig.
11. Maximum Operating Temperature: 240 deg F.

N. Mufflers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Danfoss Inc.
  - b. Emerson Climate Technologies.
  - c. Heldon Products; Henry Technologies.
2. Body: Welded steel with corrosion-resistant coating.
3. End Connections: Socket or flare.
4. Working Pressure Rating: 500 psig.
5. Maximum Operating Temperature: 275 deg F.

O. Receivers: Comply with AHRI 495.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - a. Heldon Products; Henry Technologies.
2. Comply with 2010 ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.
3. Comply with UL 207; listed and labeled by an NRTL.
4. Body: Welded steel with corrosion-resistant coating.
5. Tappings: Inlet, outlet, liquid level indicator, and safety relief valve.

6. End Connections: Socket or threaded.
  7. Working Pressure Rating: 500 psig.
  8. Maximum Operating Temperature: 275 deg F.
- P. Liquid Accumulators: Comply with AHRI 495.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Emerson Climate Technologies.
    - b. Helden Products; Henry Technologies.
    - c. Parker Hannifin Corp.
  2. Body: Welded steel with corrosion-resistant coating.
  3. End Connections: Socket or threaded.
  4. Working Pressure Rating: 500 psig.
  5. Maximum Operating Temperature: 275 deg F.

## 2.5 REFRIGERANTS

- A. ASHRAE 34, R-410A: Pentafluoroethane/Difluoromethane.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Arkema Inc.
    - b. DuPont Fluorochemicals Div.
    - c. Genetron Refrigerants; Honeywell International Inc.
    - d. Mexichem Fluor Inc.

## PART 3 EXECUTION

### 3.1 PIPING APPLICATIONS FOR REFRIGERANT R-410A

- 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 or soldered joints.
- B. Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications: Copper, Type L, annealed- or drawn-temper tubing and wrought-copper fittings with brazed or soldered joints.
- C. Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications: Copper, Type L, drawn-temper tubing and wrought-copper fittings with 95-5 tin-antimony soldered joints.

- D. Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications: Copper, Type L, drawn-temper tubing and wrought-copper fittings with Alloy HB soldered joints.
- E. Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications:
  - 1. NPS 5/8 and Smaller: Copper, Type L, annealed- or drawn-temper tubing and wrought-copper fittings with brazed or soldered joints.
  - 2. NPS 3/4 to NPS 1 and Smaller: Copper, Type K, annealed- or drawn-temper tubing and wrought-copper fittings with brazed or soldered joints.
  - 3. NPS 1-1/4 and Smaller: Copper, Type L, drawn-temper tubing and wrought-copper fittings with 95-5 tin-antimony soldered joints.
  - 4. NPS 1-1/2 to NPS 2: Copper, Type L, drawn-temper tubing and wrought-copper fittings with Alloy HB soldered joints.
- F. Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications NPS 2 to NPS 4: Schedule 40, black-steel and wrought-steel fittings with welded joints.
- G. Safety-Relief-Valve Discharge Piping: Copper, Type L, annealed- or drawn-temper tubing and wrought-copper fittings with brazed or soldered joints.
- H. Safety-Relief-Valve Discharge Piping: Copper, Type K, annealed- or drawn-temper tubing and wrought-copper fittings with brazed or soldered joints.
- I. Safety-Relief-Valve Discharge Piping:
  - 1. NPS 5/8 and Smaller: Copper, Type L, annealed- or drawn-temper tubing and wrought-copper fittings with brazed or soldered joints.
  - 2. NPS 3/4 to NPS 1 and Smaller: Copper, Type K, annealed- or drawn-temper tubing and wrought-copper fittings with brazed or soldered joints.
- J. Flame-free refrigerant fittings manufactured by ZoomLock or approved equal is an acceptable alternative fitting method.

### 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 solenoid valves upstream from each expansion valve and hot-gas bypass valve. Install solenoid valves in horizontal lines with coil at top.

- F. 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.
- G. 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.
- H. 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.
- I. 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.
- J. Install filter dryers in liquid line between compressor and thermostatic expansion valve.
- K. Install receivers as required, sized to accommodate pump-down charge.
- L. 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. Provide all accessories for “long line” piping where applicable.
- C. Install refrigerant piping according to ASHRAE 15.
- D. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- E. 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.
- F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- G. Install piping adjacent to machines to allow service and maintenance.

- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Select system components with pressure rating equal to or greater than system operating pressure.
- K. 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.
- L. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.
- M. 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.
- N. Install refrigerant piping in protective conduit where installed belowground.
- O. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.
- P. 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.
- Q. 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.
- 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. Steel pipe can be threaded, but threaded joints must be seal brazed or seal welded.
- H. Welded Joints: Construct joints according to AWS D10.12M/D10.12.
- I. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

### 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. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 2: Maximum span, 10 feet; minimum rod, 3/8 inch.
  2. NPS 2-1/2: Maximum span, 11 feet; minimum rod, 3/8 inch.
  3. NPS 3: Maximum span, 12 feet; minimum rod, 3/8 inch.
  4. NPS 4: Maximum span, 14 feet; minimum rod, 1/2 inch.
- E. 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.

### 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.



## SECTION 23 31 13 - METAL DUCTS

### PART 1 GENERAL

#### 1.1 SUMMARY

**A.** Section Includes:

1. Single-wall rectangular ducts and fittings.
2. Single-wall round ducts and fittings.
3. Sheet metal materials.
4. Duct liner.
5. Sealants and gaskets.
6. Hangers and supports.

**B.** Related Sections:

1. Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
2. Division 23 Section "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.
3. The requirements of Division 23 Section "Mechanical General Provisions" apply to this section.

#### 1.2 PERFORMANCE REQUIREMENTS

- A.** Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.
- B.** Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"
- C.** Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

#### 1.3 SUBMITTALS

**A.** Product Data: For each type of the following products:

1. Liners and adhesives.

2. Sealants and gaskets.
  3. Seismic-restraint devices.
- 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. Coordination Drawings:** Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
  2. Suspended ceiling components.
  3. Structural members to which duct will be attached.
  4. Size and location of initial access modules for acoustical tile.
  5. Penetrations of smoke barriers and fire-rated construction.
  6. Items penetrating finished ceiling including the following:

- a. Lighting fixtures.
  - b. Air outlets and inlets.
  - c. Speakers.
  - d. Sprinklers.
  - e. Access panels.
  - f. Perimeter moldings.
- D.** Field quality-control reports.
- E.** Provide a conformance summary listing all exceptions, deviations, clarifications or enhancements to the specification on a subparagraph by subparagraph basis.

## 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."

### 2.2 SINGLE-WALL ROUND DUCTS AND FITTINGS

- A.** 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: Subject to compliance with requirements, provide products by one of the following:
  - a. [Lindab Inc.](#)
  - b. [McGill AirFlow LLC.](#)
  - c. [SEMCO Incorporated.](#)
  - d. [Sheet Metal Connectors, Inc.](#)
  - e. [Spiral Manufacturing Co., Inc.](#)
- B. 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."
- C. 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."
- D. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

## 2.3 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: G60 for conditioned spaces such as apartment and amenity ductwork.
  2. Galvanized Coating Designation: G90 for unconditioned spaces such as rooftop and garage ductwork and all vertical risers.
- C. Stainless-Steel:

1. Comply with ASTM A 480/A 480M, Type 304 or 316, as indicated in the "Duct Schedule"; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated in the "Duct Schedule".
- D. 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.

## 2.4 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: Subject to compliance with requirements, provide products by one of the following:
    - a. To exceed the minimum requirements set by ASTM C 1071, verify that a particular manufacturer's product can meet the requirements, retain the "Basis-of-Design Product" Subparagraph below, and insert the manufacturer's name and product designation.
    - b. CertainTeed Corporation; Insulation Group.
    - c. Johns Manville.
    - d. Knauf Insulation.
    - e. Owens Corning.
  - f. Retain first subparagraph below to require thermal conductivity exceeding the minimum requirements in ASTM C 1071. Retaining subparagraph may create a restrictive proprietary specification.
  - g. Maximum Thermal Conductivity:
    - (1) Type I, Flexible: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
    - (2) Type II, Rigid: 0.23 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
2. Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.
  - a. 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).

- b. 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."

**B. Insulation Pins and Washers:**

1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
  2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick galvanized steel; with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
- C. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 7-11, "Flexible Duct Liner Installation."
1. 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.
  2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
  3. Butt transverse joints without gaps, and coat joint with adhesive.
  4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
  5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.
  6. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm.
  7. 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.
  8. 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:
    - a. Fan discharges.
    - b. Intervals of lined duct preceding unlined duct.
    - c. Upstream edges of transverse joints in ducts where air velocities are higher than 2500 fpm or where indicated.

9. Secure insulation between perforated sheet metal inner duct of same thickness as specified for outer shell. Use mechanical fasteners that maintain inner duct at uniform distance from outer shell without compressing insulation.
  - a. Sheet Metal Inner Duct Perforations: 3/32-inch diameter, with an overall open area of 23 percent.
10. 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.

## 2.5 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.
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, use sealant that has 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. Solvent-Based Joint and Seam Sealant:**
1. Application Method: Brush on.
  2. Base: Synthetic rubber resin.
  3. Solvent: Toluene and heptane.
  4. Solids Content: Minimum 60 percent.
  5. Shore A Hardness: Minimum 60.
  6. Water resistant.
  7. Mold and mildew resistant.
  8. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  9. VOC: Maximum 395 g/L.
  10. 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."
  11. Maximum Static-Pressure Class: 10-inch wg, positive or negative.
  12. Service: Indoor or outdoor.
  13. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

- E. 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, use sealant that has 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."

F. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

G. Round Duct Joint O-Ring Seals:

- 1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
- 2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
- 3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

## 2.6 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
- B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
- C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "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.

## **PART 3 EXECUTION**

### **3.1 DUCT INSTALLATION**

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.
- B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C. Install round ducts in maximum practical lengths.
- D. Install ducts with fewest possible joints.
- E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.

- K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Division 23 Section "Air Duct Accessories" for fire and smoke dampers.
- L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials.

### **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 DUCT SEALING**

- A. See schedule on drawings.

### **3.4 HANGER AND SUPPORT INSTALLATION**

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
  - 1. Where practical, install concrete inserts before placing concrete.
  - 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
  - 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
  - 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
  - 5. Do not use powder-actuated concrete fasteners for seismic restraints.

- 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 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.

### **3.5 CONNECTIONS**

- A. Make connections to equipment with flexible connectors complying with Division 23 Section "Air Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

### **3.6 START UP**

- A. Air Balance: Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."

### **3.7 DUCT SCHEDULE**

- A. See ductwork schedule on drawings.



## SECTION 233300 - AIR DUCT ACCESSORIES

### PART 1 GENERAL

#### 1.1 SUMMARY

**A.** Section Includes:

1. Backdraft and pressure relief dampers.
2. Manual volume dampers.
3. Control dampers.
4. Fire dampers.
5. Combination fire and smoke dampers with accessories.
6. Flange connectors.
7. Turning vanes.
8. Duct-mounted access doors.
9. Flexible connectors.
10. Flexible ducts.
11. Duct accessory hardware.

**B.** Related Requirements:

1. Division 28 Section "Digital, Addressable Fire-Alarm System" for duct-mounted fire and smoke detectors.
2. The requirements of Division 23 Section "Mechanical General Provisions" apply to this section.

**C.** 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, smoke-damper, combination fire- and smoke-damper, ceiling, and corridor damper installations, including sleeves; and duct-mounted access doors and remote damper operators.
- e. Duct security bars.
- f. Wiring Diagrams: For power, signal, and control wiring.

## 1.2 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. Provide a conformance summary listing all exceptions, deviations, clarifications or enhancements to the specification on a subparagraph by subparagraph basis.

## 1.3 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

# 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.
- B. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304, and having a No. 2 finish for concealed ducts and No.2 finish for exposed ducts.
- C. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- D. 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. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
1. Air Balance Inc.; a division of Mestek, Inc.
  2. American Warming and Ventilating; a division of Mestek, Inc.
  3. Cesco Products; a division of Mestek, Inc.
  4. Greenheck Fan Corporation.
  5. Lloyd Industries, Inc.
  6. Nailor Industries Inc.
  7. NCA Manufacturing, Inc.
  8. Pottoroff.
  9. Ruskin Company.
  10. Vent Products Company, Inc.
- B. Description: Gravity balanced.
- C. Maximum Air Velocity: 1000 fpm.
- D. Maximum System Pressure: 2-inch wg.
- E. Frame: Hat-shaped, 0.094-inch- thick, galvanized sheet steel, with welded corners or mechanically attached.
- F. Blades: Multiple single-piece blades, center pivoted, maximum 6-inch width, 0.050-inch-thick aluminum sheet with sealed edges.
- G. Blade Action: Parallel.
- H. Blade Seals: Neoprene, mechanically locked.
- I. Blade Axles:
1. Material: Galvanized steel.
  2. Diameter: 0.20 inch.
- J. Tie Bars and Brackets: Galvanized steel.
- K. Return Spring: Adjustable tension.

L. Bearings: Steel ball or synthetic pivot bushings.

**M. 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.
4. Chain pulls.
5. Screen Mounting: Front mounted in sleeve.
  - a. Sleeve Thickness: 20 gage minimum.
  - b. Sleeve Length: 6 inches minimum.
6. Screen Mounting: Rear mounted.
7. Screen Material: Galvanized steel.
8. Screen Type: Insect.
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 the following:
  - a. Air Balance Inc.; a division of Mestek, Inc.
  - b. American Warming and Ventilating; a division of Mestek, Inc.
  - c. Flexmaster U.S.A., Inc.
  - d. McGill AirFlow LLC.
  - e. Nailor Industries Inc.
  - f. Pottorff.
  - g. Ruskin Company.
  - h. Trox USA Inc.
  - i. Vent Products Company, Inc.

2. Standard leakage rating.
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. Bearings:
  - a. Molded synthetic.
  - b. 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.
8. Tie Bars and Brackets: Galvanized steel.

## 2.5 CONTROL DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. American Warming and Ventilating; a division of Mestek, Inc.
2. Arrow United Industries; a division of Mestek, Inc.
3. Cesco Products; a division of Mestek, Inc.
4. Greenheck Fan Corporation.
5. Lloyd Industries, Inc.
6. McGill AirFlow LLC.
7. Metal Form Manufacturing, Inc.

8. Nailor Industries Inc.
  9. NCA Manufacturing, Inc.
  10. Pottorff.
  11. Ruskin Company.
  12. Vent Products Company, Inc.
  13. 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. 0.094-inch- thick, galvanized sheet steel.
  2. Mitered and welded corners.
- D. Blades:
1. Multiple blade with maximum blade width of 8 inches.
  2. Parallel- and opposed-blade design.
  3. Galvanized-steel.
  4. 0.064 inch thick single skin.
  5. Blade Edging: Closed-cell neoprene or PVC.
  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 or Oil-impregnated stainless-steel sleeve or Stainless-steel sleeve.
  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 the following:

1. Air Balance Inc.; a division of Mestek, Inc.
2. Arrow United Industries; a division of Mestek, Inc.
3. Cesco Products; a division of Mestek, Inc.
4. Greenheck Fan Corporation.
5. Nailor Industries Inc.
6. NCA Manufacturing, Inc.
7. Pottorff.
8. Prefco; Perfect Air Control, Inc.
9. Ruskin Company.
10. Vent Products Company, Inc.
11. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Type: Static; 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: To match fire rating of wall.

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 or 0.39 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 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.
- K. Heat-Responsive Device: replaceable link and switch package, factory installed, 165 deg F rated.

## 2.7 COMBINATION FIRE AND SMOKE DAMPERS AND ACCESSORIES

- A. All fire/smoke dampers shall be coordinated with the fire alarm protection contractor. Provide all accessories as required by fire alarm protection contractor.

**B. Basis of Design Model:** Ruskin FSD60 series combination fire smoke dampers.

C. Ratings:

1. Fire Resistance: 1-1/2 hours in accordance with UL555.
2. Smoke Rating: FSD60 - Leakage Class I Smoke Damper in accordance with UL555S. A Class 1 smoke damper leaks no more than 8 cubic feet per minute at 4 in. wg. differential pressure.
3. Elevated Temperature Rating: 250 degree F.
4. Air Flow Rating: 2000 fpm.
5. Differential Pressure Rating: 4 in. wg.

D. Construction:

1. Frame: 5 inches x minimum 16 gage roll formed, galvanized steel hat-shaped channel, reinforced at corners. Structurally equivalent to 13 gage U-channel type frame.

2. Blades:

- a. Style: True airfoil-shaped, single piece, double skin.
- b. Action: Opposed.
- c. Material: Minimum 14 gage equivalent thickness, galvanized steel.
- d. Width: Maximum 6 inches.

3. Bearings: Self-lubricating stainless steel sleeve, turning in extruded hole in frame.

4. Seals:

- a. Blade: Inflatable silicone fiberglass material to maintain smoke leakage rating to a minimum of 450°F and galvanized steel for flame seal to 1,900°F . Mechanically attached to blade edge (glue-on or grip type seals are not acceptable).
- b. Jamb: Stainless steel, flexible metal compression type.

5. Linkage: Concealed in frame.
6. Axles: Minimum  $\frac{1}{2}$  inch diameter plated steel, hex-shaped, mechanically attached to blade.
7. Mounting: Vertical and/or Horizontal.
8. Temperature Release Device: Heat-Actuated, Quick Detect.
  - a. Close (in a controlled manner) and lock damper during test, smoke detection, power failure, or fire conditions through actuator closure spring. At no time shall actuator disengage from damper blades.
  - b. Allow damper to be automatically and remotely reset after test or power failure conditions. After exposure to high temperature or fire, inspect damper before reset to ensure proper operation.
  - c. Controlled closing and locking of damper in 7 to 15 seconds to allow duct pressure to equalize. Instantaneous closure is not acceptable.
9. Release Temperature: 165 degrees F.
10. Actuator:
  - a. Type: Electric 120 V, 60 Hz, two-position, fail close.
  - b. Mounting: Internal.
11. Finish: Mill galvanized.

E. ACCESSORIES:

1. Basis of Design Ruskin TS 150EZ Fire Stat:
  - a. UL classified dual temperature device allows the damper to be re-opened after initial closure from high heat.
  - b. Electrically and mechanically locks damper in closed position when duct temperatures exceed 165 degrees F or 212 degrees F.
  - c. Allow damper to remain operable through a high limit temperature sensor for smoke management purposes while temperature is below 250 degrees F or 350 degrees F.
  - d. Blade position indicator switches: Two position indicator switches linked directly to damper blade in order to allow remote indication of damper blade position.
2. Indicator or Auxiliary Switch Packages: Ruskin SP 100 Switch Package – Two position indicator switches linked directly to damper blade to remotely indicate damper blade position.

3. **Basis of Design Ruskin DSD** – Duct Smoke Detector:
  - a. Model: DSDN.
  - b. Mounting: Factory Mounted.
  - c. Type: Photoelectronic.
4. Mounting Angles: minimum 1-1/2 x 1-1/2 inches
5. Factory Sleeve:
  - a. Minimum 20 gage thickness, minimum 17 inches long.
  - b. Silicone caulk factory applied to sleeve at damper frame to comply with leakage rating requirements.
6. Breakaway Connections: Drivemate, Ductmate or TDF.
7. Provide 2 hour rated thermal blanket around sleeve if damper does not line up with rated wall.

## 2.8 FLANGE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Ductmate Industries, Inc.
  2. Nexus PDQ; Division of Shilco Holdings Inc.
  3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Description: Add-on or roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.
- C. Material: Galvanized steel.
- D. Gage and Shape: Match connecting ductwork.

## 2.9 TURNING VANES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Ductmate Industries, Inc.
  2. Duro Dyne Inc.
  3. Elgen Manufacturing.

4. METALAIRE, Inc.
  5. SEMCO Incorporated.
  6. Ward Industries, Inc.; a division of Hart & Cooley, 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.
- C. Manufactured Turning Vanes for Nonmetal Ducts: Fabricate curved blades of resin-bonded fiberglass with acrylic polymer coating; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
- D. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 4-3, "Vanels and Vane Runners," and 4-4, "Vane Support in Elbows."
- E. Vane Construction: Single wall for ducts up to 48 inches and double wall for larger dimensions.

## 2.10 DUCT-MOUNTED ACCESS DOORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. American Warming and Ventilating; a division of Mestek, Inc.
  2. Cesco Products; a division of Mestek, Inc.
  3. Ductmate Industries, Inc.
  4. Elgen Manufacturing.
  5. Flexmaster U.S.A., Inc.
  6. Greenheck Fan Corporation.
  7. McGill AirFlow LLC.
  8. Nailor Industries Inc.
  9. Pottorff.
  10. Ventfabrics, Inc.
  11. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

**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-inchbutt 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.
3. Number of Hinges and Locks:
  - a. Access Doors Less Than 12 Inches Square: No hinges and two sash locks.
  - b. Access Doors up to 18 Inches Square: Two hinges and two sash locks.
  - c. Access Doors up to 24 by 48 Inches: Three hinges and two compression latches.
  - d. Access Doors Larger than 24 by 48 Inches: Four hinges and two compression latches with outside and inside handles.

**C.** Pressure Relief Access Door:

1. Door and Frame Material: Galvanized sheet steel.
2. Door: Single wall with metal thickness applicable for duct pressure class.
3. Operation: Open outward for positive-pressure ducts and inward for negative-pressure ducts.
4. Factory set at 3.0- to 8.0-inch wg.
5. Doors close when pressures are within set-point range.
6. Hinge: Continuous piano.
7. Latches: Cam.
8. Seal: Neoprene or foam rubber.
9. Insulation Fill: 1-inch- thick, fibrous-glass or polystyrene-foam board.

## 2.11 FLEXIBLE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Ductmate Industries, Inc.
  - 2. Duro Dyne Inc.
  - 3. Elgen Manufacturing.
  - 4. Ventfabrics, Inc.
  - 5. Ward Industries, Inc.; a division of Hart & Cooley, 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 3-1/2 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.
- I. Thrust Limits: Combination coil spring and elastomeric insert with spring and insert in compression, and with a load stop. Include rod and angle-iron brackets for attaching to fan discharge and duct.
1. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.
  2. Outdoor 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.
  7. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch movement at start and stop.

## 2.12 FLEXIBLE DUCTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Flexmaster U.S.A., Inc.
  2. McGill AirFlow LLC.
  3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Insulated, Flexible Duct: UL 181, Class 1, black polymer film supported by helically wound, spring-steel wire; fibrous-glass insulation; aluminized vapor-barrier film.
1. Pressure Rating: 4-inch wg positive and 0.5-inch wg negative.
  2. Maximum Air Velocity: 4000 fpm.
  3. Temperature Range: Minus 20 to plus 175 deg F.
  4. Insulation R-Value: To match associated rigid ductwork.

C. Flexible Duct Connectors:

1. Clamps: Nylon strap 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.
- 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 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 and downstream 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. Control devices requiring inspection.
  9. Elsewhere as indicated or required.
- 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.
- K. Label access doors also see Division 23 Section "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 with maximum 12-inch lengths of flexible duct. Do not use flexible ducts to change directions.
- O. Connect flexible ducts to metal ducts with draw bands.
- P. Install duct test holes where required for testing and balancing purposes.

- Q.** Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch movement during start and stop of fans.

### **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.



## SECTION 23 34 16 - CENTRIFUGAL HVAC FANS

### PART 1 GENERAL

#### 1.1 GENERAL

- A. The requirements of Section 230500 "Mechanical General Provisions" apply to this Section.
- B. Work Included: Provide air distribution equipment work as indicated by drawings and schedules, and by requirements of this section.
- C. Types of air distribution equipment required for project include the following:
  - 1. Centrifugal Fans
  - 2. Utility Fans
  - 3. Propeller Fans
  - 4. Power Ventilators
    - a. Centrifugal Roof Ventilators
    - b. Centrifugal Wall Ventilators
  - 5. Ceiling Exhaust Fans
  - 6. Gravity Ventilators
  - 7. In-Line Centrifugal Fans
  - 8. In-Line Cabinet Fans
- D. Refer to other Division 23 sections for vibration isolation used in conjunction with air distribution equipment; not work of this section.
- E. Refer to Division 26 sections for electrical work required in conjunction with air distribution equipment; not work of this section.
- F. Refer to other Division 23 temperature control systems sections in conjunction with air distribution equipment; not work of this section.

#### 1.2 QUALITY ASSURANCE:

- A. AMCA Sound and Air Compliance: Provide air distribution equipment bearing the Air Movement and Control Association, Inc. (AMCA) Certified Ratings Seal.
- B. UL Compliance: Provide air distribution equipment electrical components which have been listed and labeled by Underwriters Laboratories (UL).

### **1.3 SUBMITTALS:**

- A. Product Data: Submit manufacturer's data for air distribution equipment, including specifications, capacity ratings, fan performance curves with operating point clearly indicated, gauges and finishes of materials, dimensions, weights, accessories furnished, and installation instructions.
- B. Shop Drawings: Submit assembly-type shop drawings showing unit dimensions, required clearances, construction details, and field connection details.
- C. Maintenance Data: Submit maintenance instructions, including lubrication instructions, motor and drive replacement, and spare parts lists. Include this data in maintenance manuals.
- D. Provide a conformance summary listing all exceptions, deviations, clarifications or enhancements to the specification on a subparagraph by subparagraph basis.

### **1.4 PRODUCT DELIVERY, STORAGE AND HANDLING:**

- A. Deliver air distribution equipment with factory-installed shipping skids and lifting lugs; pack components in factory-fabricated protective containers.
- B. Handle air distribution equipment carefully to avoid damage to components, enclosures, and finish. Do not install damaged components; replace and return damaged components to air distribution equipment manufacturer.
- C. Store air distribution equipment in clean dry place and protect from weather and construction traffic.

## **PART 2 PRODUCTS**

### **2.1 CENTRIFUGAL FANS:**

- A. General: Provide centrifugal fans of sizes and arrangement as indicated, and of capacities and having accessories as specified or scheduled.
- B. Fan Units: Provide factory-assembled and tested fan units consisting of housing, wheel, fan shaft, bearings, and side support structure. Clean, condition, and prime paint sheet metal parts prior to final assembly. Apply final coat of enamel to exterior surfaces after assembly (unless special coating indicated).
- C. Housings: Provide curved scroll housing; continuous weld construction for all sizes. Provide horizontally split housings, bolted together for sizes 66" and larger. Provide spun inlet cones and duct connections.
- D. Wheels: Provide backwardly inclined plate-type blades for sizes 22" and smaller, non-power-overloading backwardly inclined air foil blades for sizes 24" and larger. Weld blades to wheel rim and hub plate. Key wheels to shafts. True and dynamically balance wheels after assembly.

- E. Shafts: Construct of AISI C 1040 or C 1045 solid hot- rolled steel, turned and polished.
- F. Bearings: Provide heavy-duty, grease-lubricated, precision anti-friction ball or roller, self-aligning, pillow block type bearings selected for minimum average life (AFBMA L 50) of 200,000 hours.
- G. Drive: Provide V-belt drive, selected for 1.4 service factor. Provide adjustable pitch sheave, selected for midpoint at design conditions. Provide drive belt guard.
- H. Accessories: Provide the following accessories:
  - 1. Access Doors: Provide access door in scroll housing, with latch-type handles, flush mounted for uninsulated housings, and raised mounted for insulated housings.
  - 2. Inlet Screens: Provide heavy wire mesh inlet screens on fan inlets, mounted inside of fan bearings.
  - 3. Drain Connections: Provide 3/4" threaded coupling drain connection at lowest point of housing.
  - 4. Heat Slingers: Provide metal disc between bearings and fan wheel, to dissipate heat from shaft.
  - 5. Split Housings: Provide flanged, horizontally split housings.
  - 6. Shaft Seals: For single width fans, provide tight seal around shaft on drive side.
  - 7. Special Coatings: Provide protective coatings on fans as indicated.
- I. Manufacturer: Subject to compliance with requirements, provide centrifugal fans of one of the following:
  - 1. Barry Blower Division, A Marley Company
  - 2. Buffalo Forge Company
  - 3. Chicago Blower Company
  - 4. Greenheck (Basis of Design)
  - 5. New York Blower Company
  - 6. Loren Cook Company
  - 7. Peerless-Winsmith
  - 8. Trane Company
  - 9. Twin City Fan and Blower Company

## 2.2 UTILITY FANS:

- A. General: Provide utility fans of sizes and arrangement as indicated, and of capacities and having accessories as specified or scheduled.
- B. Fan Units: Provide factory-assembled and tested fan units consisting of housing, wheel, fan shaft, bearings, and fan drive. Clean, condition, and prime paint sheet metal parts prior to final assembly. Apply final coat of enamel to exterior surfaces after assembly.
- C. Housings: Construct of heavy-gauge steel with side sheets fastened to scroll sheets by means of continuous weld. Provide round inlet collar, slip joint dis-charge duct connection. Construct housings to be convertible to 8 standard discharges. Provide adjustable motor supports.
- D. Wheels: Provide forward curved or backward inclined wheels as scheduled. Provide swaged hubs. Balance wheels statically and dynamically.
- E. Shafts: Construct of AISC C 1040 ground and polished steel. Apply rust-preventive coating.
- F. Bearings: Provide self-aligning, grease-lubricated, pillow block type bearings, selected for minimum average life (AFBMA L 50) of 200,000 hours.
- G. Motors: Provide open drip-proof motors with ball or sleeve bearings. Provide split phase or capacitor start motors for fractional horsepower, with resilient base. Provide induction motors for integral horsepower, with rigid base.
- H. Drives: Provide direct drives for fractional horsepower motors selected for 1.2 service factor. Provide V-belt drives for integral horsepower motors selected for 1.4 service factor or as indicated on drawings. Provide adjustable pitch sheave, selected for midpoint at design conditions. Provide drive belt guard.
- I. Accessories: Provide the following accessories:
  - 1. Access Doors: Provide gasketed access door, with latch-type handles, in fan housing.
  - 2. Inlet Screens: Provide removable heavy wire mesh inlet screens on fan inlets.
  - 3. Special Coatings: Provide protective coatings on fans as indicated or scheduled.
  - 4. Drain Connections: Provide 3/4" threaded coupling drain connection at lowest point of housing where utility sets are located outdoors and/or where fans are used to supply outdoor air.
  - 5. Weather Hoods: Provide protective weather hood with stamped vents over motor and drive compartment, hinge one side, where fans are located outdoors, or indicated.
  - 6. Where discharge of utility sets are open provide manufacturer's gravity type shutters discharge assembly. Finish to match fan.

J. Manufacturer: Subject to compliance with requirements, provide utility fans of one of the following:

1. Acme Engineering and Manufacturing Corporation
2. Barry Blower Division, A Marley Company
3. Buffalo Forge Company
4. Chicago Blower Corporation
5. Cook Company (Loren)
6. Greenheck (Basis of Design)
7. New York Blower Company
8. Trane Company
9. Twin City Fan and Blower Company

### 2.3 PROPELLER FANS:

- A. General: Provide propeller fans of size and arrangements as indicated, and of capacities and having accessories as specified or scheduled.
- B. Fan Units: Provide factory-fabricated and tested fan units consisting of fan blades, hub, housing, orifice ring, motor, and drive.
- C. Housings: Construct of galvanized sheet steel with flanged edges, and integral orifice ring.
- D. Wheels: Provide welded steel construction fan blades with spun steel spider bolted to cast-iron hub.
- E. Motor and Drives: Provide direct or belt driven fans as scheduled. Provide pillow block bearings for belt driven fans, flange-type bearings for direct driven units. Provide adjustable pitch sheaves, selected for 1.2 service factor for belt driven fans. Provide open, single speed motors unless otherwise indicated. Provide drive guard for belt driven fan to comply with OSHA.
- F. Accessories: Provide the following accessories.
  1. Belt Guards: Provide expanded metal belt guards with reinforced edges.
  2. Gravity Shutters: Provide gravity-type shutters with aluminum blades in steel frames, on discharge side of fan. Frames: 16 gauge; blades: 16 gauge; Axles: 1/2 diameter; Bearings: ball bearings; Linkage: steel; Rated @ 3000 FPM air velocity.
  3. Wire Guard: Provide factory installed wire guard at all fan inlets and fan outlets if not connecting to shutters or louvers.

G. Manufacturer: Subject to compliance with requirements, provide propeller fans of one of the following:

- 1. Acme Engineering and Manufacturing Corporation**
- 2. Cook Company (Loren).**
- 3. Carnes Company**
- 4. Greenheck (Basis of Design)**
- 5. Industrial Air, Inc.**
- 6. New York Blower Company**
- 7. Penn Ventilator Company, Inc.**

#### **2.4 POWER VENTILATORS:**

- A. General: Except as otherwise indicated, provide standard prefabricated power ventilator units of type and size indicated, modified as necessary to comply with requirements, and as required for complete installation.
- B. Centrifugal Roof Ventilators: Provide centrifugal roof type, curb mounted, power ventilators of type, size and capacity as scheduled, and as specified herein.
1. Type: Centrifugal fan, direct or belt driven as scheduled. Provide aluminum housings. Provide square base to suit roof curb. Provide permanent split-capacitor type motor for direct driven fans; capacitor--start, induction-run type motor for belt driven fans.
  2. Electrical: Provide factory-wired non-fusible type disconnect switch at motor in fan housing. Provide thermal overload protection in fan motor. Provide conduit chase within unit for electrical connection.
  3. Provide insulated metal curbs to fit base of roof ventilator, height as indicated, and type to suit roof construction.
  4. Bird Screens: Provide removable bird screens, 1/2" mesh, 16 gauge aluminum or bass wire.
  5. Dampers: Provide gravity-actuated louvered dampers in curb bases unless indicated or noted otherwise.
  6. Manufacturers: Subject to compliance with requirements, provide centrifugal roof ventilators of one of the following:
    - a. **Acme Engineering and Manufacturing**
    - b. **Carnes Company, Division of Wehr Corporation**

- c. Cook (Loren) Company
  - d. Greenheck (Basis of Design)
  - e. Penn Ventilator Company, Inc.
- C. Centrifugal Wall Ventilators: Provide centrifugal wall type power ventilators of type, size, and capacity as scheduled, and as specified herein.
- 1. Type: Centrifugal fan, direct or belt driven as scheduled. Provide spun-aluminum weatherproof housing. Provide wall sleeve, of length to suit wall thickness. Provide permanent split-capacitor type motor for direct driven fans, capacitor-start, induction-run type motor for belt driven fans.
  - 2. Electrical: Provide factory-wired non-fusible type disconnect switch at motor in fan housing. Provide thermal overload protection in fan motor. Provide conduit chase within unit for electrical connection.
  - 3. Bird Screens: Provide removable bird screens, 1/2" mesh, 16 gauge aluminum or brass wire.
  - 4. Dampers: Provide gravity-actuated louvered damper in wall sleeve.
  - 5. Manufacturers: Subject to compliance with requirements, provide centrifugal wall ventilators of one of the following:
    - a. Acme Engineering & Manufacturing Corp.
    - b. Loren Cook Company
    - c. Carnes Company, Division of Wehr Corporation
    - d. Penn Ventilator Company, Inc.
    - e. Greenheck (Basis of Design)

## 2.5 CEILING EXHAUST FANS:

- A. General: Provide ceiling exhaust fans of size and arrangement as indicated, and of capacities and having accessories as scheduled and/or specified.
- B. Fan Units: Provide factory-fabricated and tested fan units consisting of insulated fan housing, backdraft damper, motor and wheel assembly, and inlet grille. Provide units with centrifugal fan wheel and pre-lubricated motor mounted on rubber isolators.
- C. Manufacturer: Subject to compliance with requirements, provide ceiling exhaust fans of one of the following:
- 1. Carnes

2. Loren Cook Company
3. Acme Engineering Manufacturing Company
4. Broan
5. Penn Ventilator
6. Greenheck (Basis of Design)

## 2.6 GRAVITY VENTILATORS:

- A. General: Except as otherwise indicated, provide standard prefabricated gravity ventilator units of type and size indicated, modified as necessary to comply with requirements, and as required for complete installation.
- B. Hooded Gravity Ventilators: Provide gravity ventilators, hooded type, curb mounted, of size, type and capacity as scheduled, and as specified herein.
  1. Type: Stationary, natural draft type. Provide weatherproof housings to match power ventilators in material and finish. Provide square or rectangular base to suit roof curb.
  2. Curbs: Provide insulated metal curb to fit base of gravity ventilator, height as indicated, and type to suit roof construction.
  3. Bird Screens: Provide removable bird screens, 1/2" mesh, 16 gauge aluminum or brass wire.
  4. Dampers: Provide gravity-actuated louvered dampers in curb bases, as indicated or noted otherwise.
- C. Manufacturers: Subject to compliance with requirements, provide products of one of the following:
  1. Acme Engineering & Manufacturing Corporation
  2. Carnes Company, Division of Wehr Corporation,
  3. Cook (Loren) Company
  4. Greenheck (Basis of Design)
  5. Penn Ventilator Company, Inc.

## 2.7 IN-LINE CENTRIFUGAL FANS:

- A. General: Provide in-line centrifugal fans of sizes and arrangement as indicated, and of capacities and having accessories as specified or scheduled.

- B. Fan Units: Provide factory assembled and tested fan units consisting of housing, wheel, fan shaft, bearings, and fan drive. Clean, condition, and prime paint sheet metal parts prior to final assembly. Apply final coat of enamel to exterior surfaces after assembly.
- C. Housing: Construct of heavy-gauge steel with access doors for servicing wheel, bearings, shaft and drive components.
- D. Wheel: All aluminum centrifugal blower type with non-overloading backward inclined blades and tapered inlet shroud. Wheels shall be statically and dynamically balanced.
- E. Motor, drive, shaft, and bearings: The motor and drives shall be isolated from the airstream. All motors are heavy duty, permanently lubricated, sealed ball bearing type. Bearings are permanently sealed pillow block type. All shafts are ground and polished steel. Drives are sized for 165% of motor horsepower and of the cast iron type and keyed to the motor and wheel shaft. Drives are set to the required RPM at the factory.
- F. Manufacturer: Subject to compliance with requirements, provide centrifugal fans of one of the following:
  - 1. Loren Cook Company
  - 2. Greenheck (Basis of Design)
  - 3. Carnes
  - 4. Acme
  - 5. Penn Ventilator Company

## 2.8 IN-LINE CABINET FANS:

- A. General: Provide in-line cabinet fans of size and arrangement as indicated, and of capacities and having accessories as scheduled and/or specified.
- B. Fan Units: Provide factory-fabricated and tested fan units consisting of fan housing, backdraft damper, motor and wheel assembly, and supply and return duct connection collars. Provide units with centrifugal fan wheel and pre-lubricated motor mounted on rubber isolators. Provide a solid state variable speed control switch.
- C. Manufacturer: Subject to compliance with requirements provide fans of one of the following:
  - 1. Carnes
  - 2. Loren Cook Company
  - 3. Acme Engineering Manufacturing Company
  - 4. Broan
  - 5. Penn Ventilator

6. Greenheck (Basis of Design)

**PART 3 EXECUTION**

**3.1 INSPECTION:**

- A. Examine areas and conditions under which air distribution equipment is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

**3.2 INSTALLATION OF AIR DISTRIBUTION EQUIPMENT:**

- A. Install air distribution equipment where indicated, in accordance with equipment manufacturer's installation instructions, and with recognized industry practices, to ensure that equipment complies with requirements and services intended purposes.
- B. Coordinate with other work, including ductwork, floor construction, and electrical work as necessary to interface installation of air distribution equipment with other work.
- C. Install units on vibration isolators or isolation bases, complying with Division 23 section "Vibration Isolation".
- D. Provide flexible connections to equipment.
- E. Roof Mounted Unit Sound Attenuation: All roof mounted units shall be provided with sound attenuating supports on to accomplish NC 35 dB in the residential spaces.

**3.3 ELECTRICAL CONNECTIONS:**

- A. Ensure air distribution equipment is wired properly, with rotation in direction indicated and intended for proper performance.
- B. Provide positive electrical equipment and motor grounding.

**3.4 FIELD QUALITY CONTROL:**

- A. Upon completion of installation of air distribution equipment, and after motor has been energized with normal power source, test equipment to demonstrate compliance with requirements. Where possible, field correct malfunctioning equipment, then retest to demonstrate compliance. Replace equipment which cannot be satisfactorily corrected.

**3.5 BALANCING:**

- A. Refer to Division 23 section "Testing, Adjusting, and Balancing" for air balancing of fan systems; not work of this section.



## **SECTION 233713 - DIFFUSERS, REGISTERS, AND GRILLES**

### **PART 1 GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. The requirements of Section 230500 "Mechanical General Provisions" apply to this Section.

#### **1.2 SUMMARY**

- A. Section Includes:

1. Louver face diffusers.
2. Fixed face registers and grilles
3. VAV Linear slot diffusers
4. Linear slot diffusers

- B. Related Sections:

1. Division 23 Section "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.

#### **1.3 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.

- C. Samples for Verification: For diffusers, registers, and grilles, in manufacturer's standard sizes to verify color selected.

- D. 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.
- E. Source quality-control reports.
- F. Provide a conformance summary listing all exceptions, deviations, clarifications or enhancements to the specification on a subparagraph by subparagraph basis.

## PART 2 PRODUCTS

### 2.1 CEILING DIFFUSERS

A. Louver Face Diffuser:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - a. Carnes.
  - b. Krueger.
  - c. Titus
  - d. Price (Basis of Design).
2. Material: Steel.
3. Finish: Baked enamel, white.
4. Face Size: As indicated on drawings.
5. Face Style: As indicated on drawings.
6. Mounting: As indicated on drawings.
7. Pattern: As indicated on drawings.
8. Dampers: As indicated on drawings.
9. Accessories: As indicated on drawings.

### 2.2 REGISTERS AND GRILLES

A. Fixed Face Register:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - a. Carnes.
  - b. Krueger.

c. Titus

d. Price (Basis of Design).

2. Material: Steel.
3. Finish: Baked enamel, white.
4. Face Size: As indicated on drawings.
5. Face Style: As indicated on drawings.
6. Mounting: As indicated on drawings.
7. Pattern: As indicated on drawings.
8. Dampers: Opposed blade damper.
9. Accessories: As indicated on drawings.

**B. Fixed Face Grille:**

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. Carnes.

b. Krueger.

c. Titus

d. Price (Basis of Design).

2. Material: Steel.
3. Finish: Baked enamel, white.
4. Face Size: As indicated on drawings.
5. Face Style: As indicated on drawings.
6. Mounting: As indicated on drawings.
7. Pattern: As indicated on drawings.
8. Accessories: As indicated on drawings.

**C. VAV Linear Slot Diffusers:**

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. Carnes.

- b. Krueger.
- c. Titus
- d. Price (Basis of Design).

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- 2. Material: Aluminum.
- 3. Finish: Baked enamel, white.
- 4. Mounting: As indicated on drawings.
- 5. Slot Width: See drawings.
- 6. No. of Slots: See drawings.
- 7. Accessories: Insulated plenum.

**D. Linear Slot Diffusers:**

- 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

- a. Carnes.
- b. Krueger.
- c. Titus.
- d. Price (Basis of Design).

- 2. Material: Aluminum.
- 3. Finish: Baked enamel, white.
- 4. Mounting: As indicated on drawings.
- 5. Slot Width: See drawings.
- 6. No. of Slots: See drawings.
- 7. Accessories: Insulated plenum.

**2.3 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 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.



## SECTION 237433 - DEDICATED OUTDOOR-AIR UNITS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:

- 1. Dedicated Outside Air Systems (DOAS)

#### 1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design vibration isolation and restraint details, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, furnished specialties, and accessories.

- B. Sustainable Design Submittals:

- 1. Product Data: For ventilation equipment, indicating compliance with ASHRAE 62.1, Section 5 - "Systems and Equipment."

- C. 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.

- D. Delegated-Design Submittal: For DOAS equipment 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 DOAS equipment.

- 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.

- 3. Design Calculations: Calculate requirements for selecting vibration isolators and for designing vibration isolation bases.

## 1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans, elevations, and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
  - 1. Suspended ceiling components.
  - 2. Structural members to which equipment or suspension systems will be attached.
- B. Qualification Certificates: For DOAS equipment, 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.

## 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For DOAS equipment to include in 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. Filters: One set of each type of filter specified.
  - 2. Fan Belts: One set of belts for each belt-driven fan in energy recovery units.

## 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. ARI Compliance:
  - 1. Capacity ratings for air coils shall comply with ARI 410, "Forced-Circulation Air-Cooling and Air-Heating Coils."
- C. ASHRAE Compliance:
  - 1. Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

- D. NRCA Compliance: Roof curbs for roof-mounted equipment shall be constructed according to recommendations of NRCA.
- E. UL or ETL Compliance:

## 1.9 COORDINATION

- A. Coordinate layout and installation of DOAS equipment and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.
- B. Coordinate sizes and locations of concrete bases with actual equipment provided.
- C. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

## 1.10 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of DOAS equipment that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period for Dedicated Outdoor Air Units: one year for entire unit. Five years for compressors.
  - 2. Warranty Period for Gas Heat Exchangers: 10 years.

# PART 2 - PRODUCTS

## 2.1 DOAS UNIT:

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Daikin (Basis of design)
2. Petra
3. Innovent

- A. Unit Construction:
  - 1. Base: Manufacturer's standard base shall be constructed of minimum 15 gage galvanized steel with 22 gage integral floor pan. All floor seams shall have a raised rib joint. Penetrations through the floor shall have a minimum 3/8" raised rib around each opening. Base shall have an overhang over the top of a roof curb to prevent water infiltration.
  - 2. Panels: Manufacturer's standard casing shall be constructed of minimum 2-inch, foam-injected, double-wall panels.
    - a. Individual panels shall be constructed so that there is no metal-to-metal contact between the interior and exterior sheet metal of each panel.

- b. Interior side of panel shall be 22 gage G-90 galvanized steel . Exterior side of panel shall be 22 gage pre-painted steel rated for 750 hours of salt spray exposure in accordance with ASTM B117 and ASTM D1654.
  - c. Insulation shall be 2 lb/ft<sup>3</sup> injected foam insulation with a minimum R-value of 12. Foam sheet or fiberglass insulation are not acceptable due to reduced durability of panel and increased chance for rust forming between the panels. Insulation water absorption must be no more than 0.038 lb/ft per ASTM D2842 and show "no growth" per ASTM G21 biocide testing. Interior sheet metal shall encase insulation so that it is not exposed to the airstream.
- 3. Access doors shall be provided for access to all internal components requiring regular maintenance or inspection. Access door construction and materials shall be identical to unit casing. Access doors shall have stainless steel hinges . Access doors shall be sealed with a full-perimeter D-shaped gasket constructed of EPDM sponge rubber.
  - 4. Roof shall be pitched and include a minimum  $\frac{1}{2}$ " overhang around the perimeter of the unit.
  - 5. Outdoor Air Inlet: Outdoor units shall be provided with a factory provided, field-assembled weather hood.
  - 6. Unit discharge shall be horizontal side connection.
  - 7. Unit shall include lifting eyes for use during rigging.
  - 8. Motorized dampers – Outside Air
    - a. Frame shall be constructed of a 16 gage galvanized steel hat-channel.
    - b. Damper leakage shall be no more than 1.5 cfm/sq.ft. at 1 in.wg static pressure as tested in accordance with AMCA standard 500.
- B. DX Cooling Coil:
- 1. Coil shall be rated in accordance to AHRI standards, designed to withstand 250 psig working pressure at 300 degrees F, and pressure tested to 600 psig.
  - 2. Coil shall be a minimum of 4 or 6 rows deep with maximum fin density of 10 fins per inch.
  - 3. Refrigeration systems with more than one circuit shall have interlaced evaporator coils.
  - 4. Coil casing shall be constructed of 16 gage galvanized steel.
  - 5. Coil tubes shall be constructed of 1/2" diameter, 0.016" thick seamless copper tubing.
  - 6. Coil fins shall be constructed of 0.0060" thick aluminum.
  - 7. Drain pan
    - a. Drain pan shall be constructed of a minimum of 18 gage 201 stainless steel.
    - b. Drain pan shall be double-sloped to ensure condensate removal from unit.
    - c. Drain pan shall extend a minimum of 8" past the evaporator coil to ensure condensate retention.
- C. Refrigeration – Unit shall be provided with factory piped, charged, and tested packaged air-cooled direct expansion refrigeration system.
- 1. Refrigeration systems 10 nominal tons and above shall be equipped with two stages of capacity control, each stage on an independent refrigerant circuit.

2. Refrigeration systems 30 nominal tons and above shall be equipped with four stages of capacity control, two stages per independent circuit.
  3. Refrigeration system shall be provided with thermal expansion valve (TXV) incorporating adjustable superheat.
- D. Compressors:
1. Compressors shall be hermetic scroll type and include the following items:
    - a. Suction and discharge service valves.
    - b. Suction and discharge isolation valves.
    - c. Reverse rotation protection.
    - d. Oil level adjustment.
    - e. Oil filter.
    - f. Filter drier
    - g. Short cycling control.
    - h. High and low pressure limits.
    - i. Crankcase heaters.
  2. Compressors shall be installed in a separate compartment, above the unit floor, and isolated from the surrounding environment by double wall foam injected panels and access doors.
  3. Compressors shall be installed using manufacturer's recommended rubber vibration isolators.
  4. Capacity control shall be provided through the use of a single Digital Scroll™ compressor if unit has fewer than 6 compressors. Additional compressors, if required, shall be fixed stage scroll compressors. Units with 6 or more compressors can use compressor staging of fixed speed compressors.
- E. Hot Gas Reheat and Liquid Subcooling:
1. Hot-gas reheat coil shall be separated from the evaporator coil by a minimum of 6" in the direction of airflow to prevent the re-evaporation of condensate, provide room for coil cleaning, and allow control system to monitor evaporator coil leaving dew point temperature.
  2. Provide Liquid Subcooling coil directly downstream of the DX coil to provide additional free cooling at the DX coil. If liquid subcooling coils are not available, provide wrap around heat pipe coils to take load off the DX coil. Size coils large enough such that the scheduled fan BHP is not exceeded.
  3. Coil shall be rated in accordance to AHRI standards, designed to withstand 250 psig working pressure at 300 degrees F, and pressure tested to 600 psig.
  4. Coil casing shall be constructed of 16 gage galvanized steel.
  5. Coil tubes shall be constructed of 5/16" diameter, 0.012" thick seamless copper tubing.
  6. Coil fins shall be constructed of 0.0060" thick aluminum fins.
  7. Hot-gas reheat shall be controlled through a factory-supplied and controlled modulating 3-way valve.
- F. Air Cooled Condenser:

1. Air cooled condenser coil shall be unit mounted.
  2. Provide condenser coils with galvanized casing, seamless copper tubes, and aluminum fins.
  3. Coil shall be rated in accordance to AHRI standards, designed to withstand 250 psig working pressure at 300 degrees F, and pressure tested to 600 psig.
  4. Coil casing shall be constructed of 16 gage galvanized steel.
  5. Coil tubes shall be constructed of 5/16" diameter, 0.012" thick seamless copper tubing.
  6. Coil fins shall be constructed of 0.0060" thick aluminum fins.
  7. Condenser coils shall be mounted at a minimum 30 degree angle from vertical to help prevent hail damage.
  8. Condenser coils shall include factory provided and installed condenser coil guards.
- G. Condensing Fans – Low ambient: (VFD controlled – AHPC 1.0)
1. Condensing section shall be equipped with 1140 rpm direct-drive condensing fans.
  2. Condensing fan assembly shall be statically and dynamically balanced in accordance with AMCA Standard 204-05.
  3. Condensing fan assembly shall consist of aluminum-bladed propeller fan wheel, formed-channel base, formed inlet venturi, and coated steel basket guard on the discharge.
  4. A factory-supplied variable frequency drive shall be provided to modulate a single condensing fan to maintain refrigerant pressure in the condensing section.
  5. All additional condensing fans shall enable/disable to maintain refrigerant pressure in the condensing section.
- H. Supply Airflow Blowers:
1. Fan assemblies shall be DWDI airfoil fans.
  2. A variable frequency drive (VFD) shall be provided for each fan section. VFD shall be mounted, wired, and programmed by the equipment manufacturer. VFD shall be located in an enclosed compartment outside of the supply or exhaust air stream.
  3. Fan wheel shall be tested in accordance to AMCA 210. Fan speed shall not exceed 2400 RPM.
  4. Fan motor shall be VFD rated, ODP type, EPACT compliant, and shall be of premium efficiency (PE).
- I. Gas Heating:
1. Unit shall be provided with AGA-certified, forced-draft, 20:1 turndown indirect gas furnace.
  2. Furnace assembly shall include the following items:
    - a. Electronic modulating gas valve.
    - b. Two-speed combustion fan.
    - c. 321 stainless steel primary and secondary heat exchanger.
- J. Filters:
1. Outdoor air filters

- a. Outdoor air filter rack shall accommodate factory-provided 2" MERV 8 pre filters and MERV 13 after filters.
- b. Filter sections shall be accessible through a foam-injected, double-wall, hinged access door with quarter-turn latches.

K. Electrical:

1. Unit shall be constructed with an integral electrical and control center isolated from supply airflow, exhaust airflow, compressors, and heating elements. The control center shall control all aspects of the unit operation. VFDs with overload protection shall be provided for each fan bank.
2. Units shall be wired according to NEC and listed per ETL. ETL listing shall cover all components of the ventilator and not be limited to the control panel. All major electrical components shall be UL or ETL listed.
3. Units shall be factory wired with a dual point power connection. See drawings for more information.
4. Unit shall be provided with phase and brown out protection which shuts down all motors in the unit if the electrical phases are more than 7% out of balance on voltage, the voltage is more than 7% under design voltage, or on phase reversal.
5. The following items shall be provided and wired within the control center by the factory:
  - a. Non-fused disconnect.
  - b. Sub-circuit fusing.
  - c. Low voltage transformers.
  - d. Controls as specified in this section.
  - e. Control circuit fusing.
  - f. Terminal block.
  - g. Supply Fan motor Variable Frequency Drives (VFDs).
6. Electrical panel must house all high voltage components such as terminal blocks, variable frequency drives, and fuse blocks.
7. All electrical power and controls wiring shall run in chase located between unit ceiling and roof to minimize interior wall penetrations and allow for ease of access.
8. Options
  - a. Control panel shall include a factory supplied and mounted 115V GFCI convenience outlet receptacle with a 12A circuit breaker. Outlet shall be powered by the main power or others in the field.
  - b. Unit shall include a factory supplied, mounted, and wired electric heating element in the control panel to maintain a minimum of 0F in the panel.

L. Controls:

1. Units shall include factory supplied, mounted, wired, and tested stand-alone microprocessor controls.
2. Microprocessor controller shall be factory-programmed for discharge air control and use an internal 7-day time clock.

3. Microprocessor controller shall include local liquid crystal display (LCD) for user interface. Microprocessor controller remote LCD shall be mounted in a weather-proof enclosure and accessible without exposing the operator to high voltage wiring or having to turn off or circumvent the main disconnect.
  4. The following sensors shall be factory supplied, mounted, and wired inside the unit:
    - a. Outdoor air humidity sensor.
    - b. Outdoor air temperature sensor.
    - c. Evaporator coil leaving air temperature sensor.
    - d. Supply air filter pressure monitoring switch and/or magnehelic gauge.
    - e.
  5. The following devices shall be factory-supplied for field installation and wiring:
    - a. Supply air temp temperature sensor.
    - b. Wall-mounted room air temperature sensor with manual adjuster.
    - c. Wall-mounted room air humidity sensor.
  6. Microprocessor controller shall include BACnet MSTP communications for building management system interface.
  7. Microprocessor controller shall include a Web UI interface for remote web-based access of all unit digital and analog inputs and outputs. Web UI shall include unit scheduling, point trending capabilities, and an alarm history.
- M. Roof Curb: Refer to Section 077200 "Roof Accessories" for roof curbs and equipment supports.
1. Roof Curb: 18 gage galvanized steel with perimeter gasket and factory-installed 2" x 2" wood nailing; Insulated with 1" foil faced rigid board insulation. Curb shall be provided with vibration isolation and height shall be 14 inches. Roof curb shall ship fully assembled.

## 2.2 FACTORY VERIFICATION TESTING

- A. Unit shall be thoroughly run tested prior to shipment from the factory.
- B. Factory run test report shall be provided at the request of the engineer, contractor, or owner.
- C. Testing Procedures
  1. Unit shall be subjected to and pass a dielectric (hipot) test.
  2. All motorized dampers shall be cycled one full stroke while installed in the unit using the factory-provided motorized actuators.
  3. Supply fan
    - a. Visually inspect ramp-up, ramp-down, and rotation direction of fan when enabled.
    - b. Verify fan pressure proving switch operation.

- c. Measure and record current draw through supply fan motor(s).
  - 4. Indirect gas furnace
    - a. Indirect gas furnace shall be run tested while installed inside unit with 8.5 in.wg of natural gas.
  - 5. Condensing fans
    - a. Ensure fans rotate freely without obstruction.
    - b. Energize fans and ensure proper rotation.
- D. Test report shall be provided prior to unit startup and available from the factory upon request.

### 2.3 CAPACITIES AND CHARACTERISTICS

- A. As indicated on the drawing schedules.
- B. General: Provide factory built and factory-tested units as indicated, of sizes and capacities as scheduled, and as specified herein.
- C. The unit shall be specifically engineered and designed for the desired application. Outdoor/rooftop units shall include a weather-proof cabinet design to ensure unit integrity against elements of nature. Units designed for indoor construction shall have the exterior painted with a cabinet design suited to indoor/mechanical room installations.
- D. All units shall comply with IECC and IMC, with ARI 360 “Standard for commercial and industrial unitary air conditioning equipment”, with ASHRAE 15 “Safety code for mechanical refrigeration”. All unit(s) shall be UL or ETL listed certified. Units with listed components only shall not be acceptable.

## PART 3 - EXECUTION

### 3.0 INSPECTION:

- A. Examine areas and conditions under which packaged units are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

### 3.1 INSTALLATION OF OUTDOOR AIR UNITS:

- A. Install self-contained A/C units where indicated, in accordance with equipment manufacturer's written instructions, and with recognized industry practices, to ensure that units comply with requirements and serve intended purposes.
- B. Coordinate with other work, including ductwork, floor construction, roof decking, and piping, as necessary to interface installation of air handling units with other work. Install units on vibration mounts as indicated or specified. Comply with manufacturer's indicated installation method if any.

- C. Locate units as indicated, level and shim units, and anchor to structure.
- D. Protect units with protective covers during balance of construction.

3.2 GROUNDING:

- A. Provide positive equipment ground for packaged unit components.
- B. Upon completion of installation of the DOAS units, start-up and operate equipment to demonstrate capability and compliance with requirements. Field correct malfunctioning units, then retest to demonstrate compliance. Start-up shall be by an authorized manufacturer's representative. A written report shall be provided to the owner.

3.3 EXTRA STOCK:

- A. Provide one complete set of filters for each packaged unit. Install new filters at completion of system work, and prior to testing, adjusting and balancing work. Obtain receipt from Owner that new filters have been installed.

3.4 CLEANING

- A. Clean work.
- B. After construction is completed, including painting, clean exposed surfaces of units. Vacuum clean coils and inside of cabinets.
- C. Touch-up marred or scratched surfaces of factory-finished cabinets, using finish materials available from manufacturer.
- D. Install new filters.

3.5 WARRANTY:

- A. Provide Whole Units Part Warranty for the duration of one year from start-up. Warrant that all products are free from defects in material and workmanship and have the capacities and rating set forth in manufacturer's catalogs and bulletins.

END OF SECTION

## SECTION 238126 - DUCTLESS SPLIT SYSTEM HEAT PUMP UNITS

### PART 1 GENERAL

#### 1.1 SUMMARY

- A. Extent of air-cooled split system heat pump unit work is indicated on drawings and schedules, and by requirements of this section. Each system is defined to include (but not by way of limitation), indoor unit complete with insulated indoor casing, cooling coil, electric heating coil, drain pans, filter and filter rack, evaporator fan and motor and outdoor unit complete with housing, condenser fans and motor, compressor, condenser coil and factory furnished controls and thermostat.
- B. Types of air-cooled split heat pump systems required for project include the following:
  - 1. Wall mounted ductless indoor unit with outdoor condensing unit.
- C. Refer to other Division 23 sections for refrigerant and condensate drain piping required with air-cooled split system heat pump units; not work of this section.
- D. Refer to Division 26 sections for electrical connections required for air-cooled split system heat pump units; not work of this section.
- E. The requirements of Division 23 Section "Mechanical General Provisions" apply to this section.

#### 1.2 QUALITY ASSURANCE:

- A. Manufacturers: Firms regularly engaged in manufacture of air-cooled split system heat pump units of types and capacities required, whose projects have been in satisfactory use in similar service for not less than 5 years.
- B. Available Manufacturers: Subject to compliance with requirements manufacturers offering air cooled split system heat pump units which may be incorporated in the work include, but are not limited to, the following:
  - 1. **Ductless Split System**
    - a. **Daikin (Basis of Design)**
    - b. **Samsung**
    - c. **Carrier**
- C. NFPA Compliance: Comply with applicable provisions of ANSI/NFPA 70 "National Electric Code", pertaining to construction and installation of electrically operated components of air cooled split system heat pump units.
- D. Flame-Smoke Ratings: Except as otherwise indicated, provide air cooled split system heat pump unit thermal insulation with flame spread index of 25 or less, fuel- contributed index of 50 or less, and smoke-developed index of 50 or less.

- E. AMCA Standards: Comply with Air Movement and Control Association (AMCA) standards as applicable to testing and rating fans.
- F. SMACNA Compliance: Comply with Sheet Metal and Air- Conditioning Contractors National Association (SMACNA) ductwork construction standards as applicable to air handling units.
- G. ASHRAE Compliance: Provide refrigerant coils complying with construction and testing standards of ANSI/ASHRAE 15 "Safety Code for Mechanical Refrigeration".
- H. Industry Standards: Except as otherwise indicated, comply with ASHRAE recommendations pertaining to air cooled split system heat pump units.
- I. ARI Certification: Provide air cooled split system heat pump units which comply with Air-Conditioning and Refrigeration Institute (ARI) Standard 210 and display ARI's certification symbols.
- J. UL Compliance: Provide electric components for air cooled split system heat pump units which have been listed and labeled by Underwriters' Laboratories.

### **1.3 SUBMITTALS:**

- A. Product Data: Submit manufacturer's specifications for air cooled split system units showing dimensions, weights, capacities, ratings, fan performance with operating point clearly indicated, motor electrical characteristics, gages and finishes of materials, and installation instructions.
- B. Maintenance Data: Submit maintenance instructions, including lubrication instructions, filter replacement, motor and drive replacement, spare parts lists, compressor replacement, refrigerant charging and refrigerant flow metering device size. Include this date in maintenance manuals.
- C. Provide a conformance summary listing all exceptions, deviations, clarifications or enhancements to the specification on a subparagraph by subparagraph basis.

### **1.4 PRODUCT DELIVERY, STORAGE AND HANDLING:**

- A. Deliver air cooled split system heat pump units with factory-installed shipping skids and lifting lugs; pack components in factory-fabricated protective containers.
- B. Handle air cooled split system heat pump units carefully to avoid damage to components, enclosures, and finish. Do not install damaged components; replace and return damaged components to unit manufacturer.
- C. Store air cooled split system heat pump units in clean dry place and protect from weather and construction traffic.

## **PART 2 PRODUCTS**

### **2.1 DUCTLESS SPLIT SYSTEMS INDOOR UNITS**

- A. Wall-Mounted, Evaporator-Fan Components:

1. Cabinet: Enameled steel with removable panels on front and ends in color selected by Architect, and discharge drain pans with drain connection.
2. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 210/240.
3. Fan: Direct drive.
4. Fan Motors:
  - a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."
  - b. Multi-tapped, multispeed with internal thermal protection and permanent lubrication.
  - c. Enclosure Type: Totally enclosed, fan cooled.
  - d. NEMA Premium (TM) efficient motors as defined in NEMA MG 1.
  - e. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 26 Sections.
  - f. Unit-mounted disconnect switches.
5. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.
6. Condensate Pump:
  - a. Provide condensate pump with all high wall type indoor units.
7. 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.

## 2.2 DUCTLESS SPLIT SYSTEM OUTDOOR UNIT

- A. The outdoor unit shall be equipped with multiple circuit boards that shall perform all functions necessary for operation. The outdoor unit shall have a powder coated finish. The outdoor unit shall be completely factory assembled, piped and wired. Each unit shall be run tested at the factory.
  1. Both refrigerant lines from the outdoor unit to indoor unit shall be insulated.

2. The outdoor unit shall have an accumulator.
  3. The outdoor unit shall auto-restart after power loss.
  4. The outdoor unit shall have a high-pressure safety switch, fuse, over-current protection, over-voltage protection, temperature limit protection logic, compressor overload sensing, and crank case heater.
  5. The outdoor unit shall be capable of operating in outside ambient temperatures between 23 deg F in cooling mode without additional low ambient controls.
  6. Provide control circuit between the indoor unit and the outdoor unit.
  7. The outdoor unit shall supply power to indoor unit.
- B. Unit Cabinet – The chassis shall be fabricated of galvanized steel, bonderized and finished with a powder coated baked enamel. Pipe connections at the outdoor unit shall be made inside the unit chassis. Refrigerant pipes can exit through the front, side, rear, or bottom sides of the outdoor unit.
- C. Fan – Outdoor unit shall be furnished with one direct drive variable speed propeller type fan. The fan shall be provided with a raised guard to prevent contact with moving parts. The unit shall have horizontal discharge airflow. Fan motor shall be ECM type. Motor shall have inherent protection, permanently lubricated bearings, and completely variable speed. The motor shall be mounted for quiet operation.
- D. Refrigerant – The condensing unit shall utilize R-410a refrigerant. The unit shall be fully charged for system line set lengths up to 25 feet. Additional charge shall be added as required for length greater than 25 feet. The condensing unit shall have a single EVV (electronic expansion valve) to control refrigerant flow to the indoor unit.
- E. Coil - The outdoor coils shall be all aluminum, flat fin, micro channel. The coil shall be protected with an integral guard. Refrigerant flow from outdoor unit shall be controlled by means of a capacity modulation capable, inverter driven, twin BLDC rotary compressor.
- F. Compressor - The compressor shall be an inverter driven, DC voltage, twin BLDC rotary compressor. A crankcase heating device shall be factory mounted in/on the compressor. Compressor shall have a variable modulation technology to modulate capacity. Compressor shall be equipped with an internal thermal overload, and shall be mounted to avoid the transmission of vibration.

## 2.3 ACCESSORIES

- A. Thermostat: Low voltage with subbase to control compressor and evaporator fan.
- B. Thermostat: Wired remote Controller to remotely control compressor and evaporator fan, with the following features:
- C. Compressor time delay.
- D. 24-hour time control of system stop and start.

- E. Liquid-crystal display indicating temperature, set-point temperature, time setting, operating mode, and fan speed.
- F. Fan-speed selection including auto setting.
- G. Automatic-reset timer to prevent rapid cycling of compressor.
- H. Refrigerant Line Kits: Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized, and sealed; factory-insulated suction line with flared fittings at both ends.
- I. Drain Hose: For condensate.

### **PART 3 EXECUTION**

#### **3.1 INSPECTION:**

- A. Examine areas and conditions under which air cooled split system heat pump units are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

#### **3.2 INSTALLATION OF AIR HANDLING UNITS:**

- A. Install air cooled split system heat pump units where indicated, in accordance with equipment manufacturer's written instructions, and with recognized industry practices, to ensure that units comply with requirements and serve intended purposes.
- B. Coordinate with other work, including ductwork, floor construction, roof decking, and piping, as necessary to interface installation of air cooled split system heat pump.
- C. Install units as indicated, comply with manufacturer's indicated installation method if any.

#### **3.3 GROUNDING:**

- A. Provide positive equipment ground for air cooled split system heat pump unit components.

#### **3.4 TESTING:**

- A. Upon completion of installation of air cooled split system heat pump units, startup and operate equipment to demonstrate capability and compliance with requirements. Field correct malfunctioning units, then retest to demonstrate compliance.

#### **3.5 EXTRA STOCK:**

- A. Install new filters at completion of air handling system work prior to testing, adjusting, and balancing work.

#### **3.6 UNIT GUARANTEE AND INSTALLATION SUPERVISION:**

- A. Installation of indoor and outdoor heat pump units shall be certified as acceptable by the unit manufacturer or his representative.
- B. The unit manufacturer or his representative shall supervise the charging of the refrigerant systems.

- C. Outdoor and indoor units have one year guarantee after date of acceptance of installation by the owners. The compressor has an additional 4 year guarantee.

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## SECTION 238126 VARIABLE REFRIGERANT FLOW (VRF) SPLIT SYSTEM AIR CONDITIONING UNITS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Extent of Variable Refrigerant Flow (VRF) air cooled split system work is indicated on drawings and schedules, and by requirements of this section. Each system is defined to include (but not by way of limitation), multiple indoor units complete with insulated indoor casing, cooling coil, drain pans, filter and filter rack, evaporator fan and motor and outdoor unit complete with housing, condenser fans and motor, compressor, condenser coil and factory furnished controls and thermostat.
- B. VRF Types of air handling units required for project include the following:
  - 1. Wall or Ceiling Mounted Ductless Split System
  - 2. Vertical Mounted Ducted Dx Air Handler
  - 3. 4-Way Blow Cassette
  - 4. VRF System Outdoor Unit
  - 5. Branch Controller Box
- C. Piping
  - 1. Piping to multiple indoor units requires additional piping components. The VRF equipment manufacturer's Y joint fittings must be used to branch the main refrigerant lines.
  - 2. The VRF equipment manufacturer's Tee fittings must be used to connect outdoor units when multiple module systems are being installed (systems with more than one outdoor unit).
- D. Refer to other Division 23 sections for refrigerant and condensate drain piping required in connection with air-cooled split system heat pump units; not work of this section.
- E. Refer to Division 26 sections for electrical connections required for air-cooled split system heat pump units; not work of this section.
- F. The requirements of Division 23 Section "Mechanical General Provisions" apply to this section.
- G. Best practice guidelines for the Installation of VRF piping.
  - 1. General
    - a. General Contractor (GC) shall have a dedicated VRF foreman responsible for assuring that the VRF piping and all the equipment and components are installed per the manufacturer recommendations. The foreman should be on site anytime piping is installed.

- b. Mechanical contractor (MC) shall have a dedicated VRF foreman responsible for assuring that the VRF piping and all the equipment and components are installed per the manufacturer recommendations. Each mechanic shall sign off for his day's works and the foremen shall sign off as a checksum.
  - c. MC to provide a resume of each person installing VRF piping and component's, how long has the employee been with the MC and list the types of systems and brand they have installed as related to VRF.
  - d. MC shall provide a list of all technicians who will be installing the VRF system and demonstrate compliance with the manufacturer's guidelines for required training within the last 24 months.
  - e. Anyone involved in the installation of the VRF systems or piping must have completed a VRF installation training course, conducted by the manufacturer of the equipment being installed within the last 24 months.
  - f. Installing technicians must be an employee of the MC, no day laborers are allowed.
  - g. Include in the bid process the manufacturers location and quantity of spare parts available on the shelf.
  - h. Include in the bid process a list of the manufacturers qualified technicians that are approved to work on the system.
  - i. Installing contractor will confirm best practices for installing all piping, including but not limited to employment of tubing cutters and reamers. Provide a schematic showing the flow of nitrogen through the system whenever brazing is performed. Record the pressure setting of the nitrogen regulator.
  - j. Installing contractor shall submit a detailed plan for tracking pipe lengths, expansion joints where required. Lengths will be indicated on floor plan. ANY deviations must be approved by the manufacturer prior to installation. At the end of each shift the installing tech will sign and date the tracking sheet for conformance.
  - k. Provide a clear diagram on who is providing the energy consumption hardware for tenant billing, and who and how the system is installed.
  - l. Ownership must witness all piping pressure tests.
  - m. Ownership must witness all evacuation process.
  - n. MC shall follow vacuum pump manufacture recommendations for oil changes. Used oil shall be disposed of properly.
  - o. Proper evacuation hoses must be used for evacuation. Charging hoses are not acceptable. Any test using charging hoses will automatically be failed.
2. Kick Off meeting. Meeting to include the owner, GC, MC, VRF manufacturer, Cx agent:
    - a. Attendees to include: GC, MC, Sales Engineer, MEP Engineer, Owner, Factory Recognized Startup Service Technician.
    - b. Dedicated foremen from GC and MC to be present at the meeting.
    - c. Confirm project expectations and schedule.
    - d. Review VRF piping installation best practices and manufacturer recommendations.
    - e. Review the submittal requirements.
    - f. Confirm the factory is performing start-up.
    - g. Confirm piping installation length and thickness to be used on the project.
    - h. Confirm manufacturers pre-start up forms are being followed.
    - i. Establish the required inspections procedure and schedule. Review the GC/MC provided QA/QC inspection schedule.

3. Submittals:
  - a. Provide drawing with VRF piping layout with the VRF submittal.
  - b. Provide a fully coordinated VRF piping plan coordinated with other trades.
  - c. Provide a VRF controls submittal that identifies control settings in all devices. Devices will be associated by indoor unit number, room number of the space they serve.
  - d. Submittals noted above will be updated frequently, anytime when piping lengths are changing, and used as a basis for producing as-builts
  - e. MC to present a refrigeration piping quality control plan including all inspections, pipe testing and testing procedure.
  - f. Provide as-built dimensions of the VRF piping ahead of the piping pressure test.
4. Turn-over Package at project completion:
  - a. Provide an as-built plan showing lengths of piping installed including fittings.
  - b. Provide a final refrigerant charge for each system.
  - c. Provide a VRF database file for all components installed such as Nav controllers, branch selector boxes out door units, indoor units.
  - d. Provide a color coded diagram of all field wiring.
  - e. All settings in the Nav controller will be documented as well as central and remote controllers.
  - f. Provide two weeks of trend logs to indicate system is functioning properly.
  - g. Any/all piping changes (in the field or otherwise) to the record submittal will require a manufacturer approved piping submittal update.
5. Warranty:
  - a. 5 year labor and installation warranty from the contractor to be included in the base bid for complete VRF system including piping installation.
  - b. The GC (not the mechanical contractor) is responsible for long term quality issues.

## 1.2 QUALITY ASSURANCE:

- A. Manufacturers: Firms regularly engaged in manufacture of variable refrigerant flow air cooled split system heat pump units of types and capacities required, whose projects have been in satisfactory use in similar service for not less than 5 years.
- B. The units shall be listed by ETL and shall bear the ETL label.
- C. The VRF systems shall be installed by a manufacturer qualified installing contractor. Installing contractor must have attended a manufacturer installation training and must be an acceptable installing contractor by the manufacturer prior to installing the VRF system.
- D. All wiring shall conform to the National Electrical Code (NEC).
- E. Basis of design equipment manufacturer is Daikin and the plans and specifications indicate the requirements and coordination with that manufacturers requirements, other acceptable manufacturers listed shall comply with the plans and specified requirements and detail all required elements and changes required for their systems and equipment. At the time of bid the contractor shall indicate the manufacturer he is including in his bid and all required coordina-

tion, revisions, changes and piping routing as part of his bid for evaluation by the Owner and design team. Contractor shall include in the alternate basis of design manufacturer pricing all costs associated with re-engineering utilizing the design mechanical engineer, architect, structural engineer, and all other required consultants.

- F. Available Manufacturers: Subject to compliance with requirements manufacturers offering variable refrigerant flow air cooled split system heat pump units which may be incorporated in the work include, but are not limited to, the following:
  - 1. Daikin (Basis of Design)
  - 2. Samsung
  - 3. Trane/Mitsubishi
- G. NFPA Compliance: Comply with applicable provisions of ANSI/NFPA 70 "National Electric Code", pertaining to construction and installation of electrically operated components of VRF air cooled split system heat pump units.
- H. Flame-Smoke Ratings: Except as otherwise indicated, provide VRF air cooled split system heat pump unit thermal insulation with flame spread index of 25 or less, fuel- contributed index of 50 or less, and smoke-developed index of 50 or less.
- I. AMCA Standards: Comply with Air Movement and Control Association (AMCA) standards as applicable to testing and rating fans.
- J. SMACNA Compliance: Comply with Sheet Metal and Air- Conditioning Contractors National Association (SMACNA) ductwork construction standards as applicable to air handling units.
- K. ASHRAE Compliance: Provide refrigerant coils complying with construction and testing standards of ANSI/ASHRAE 15 "Safety Code for Mechanical Refrigeration".
- L. Industry Standards: Except as otherwise indicated, comply with ASHRAE recommendations pertaining to air cooled split system heat pump units.
- M. ARI Certification: Provide air cooled split system heat pump units which comply with Air-Conditioning and Refrigeration Institute (ARI) Standard 210 and display ARI's certification symbols.
- N. UL Compliance: Provide electric components for air cooled split system heat pump units which have been listed and labeled by Underwriters' Laboratories.
- O. The manufacturer shall certify the installation, operation, performance and provide certification letter as part of the close out documentation. The contractor shall engage the manufacturer during the installation to do site visits and verify compliance with the plans, specifications and compliance with manufacturers recommended installation requirements.

### 1.3 SUBMITTALS:

- A. Product Data: Submit manufacturer's specifications for VRF air cooled split system units showing dimensions, weights, capacities, ratings, fan performance with operating point clear-

- ly indicated, motor electrical characteristics, gages and finishes of materials, and installation instructions.
- B. Maintenance Data: Submit maintenance instructions, including lubrication instructions, filter replacement, motor and drive replacement, spare parts lists, compressor replacement, refrigerant charging and refrigerant flow metering device size. Include this date in maintenance manuals.
  - C. Provide a conformance summary listing all exceptions, deviations, clarifications or enhancements to the specification on a subparagraph by subparagraph basis.
  - D. Manufacturer shall submit detailed refrigerant piping diagrams and routing plans and certify that the piping systems are sufficient for the systems installed, and sized properly based on the capacities scheduled.
  - E. All contractor's personnel working on the VRF systems shall be certified by the manufacturer as having completed the training requirements.

#### 1.44 PRODUCT DELIVERY, STORAGE AND HANDLING:

- A. Deliver VRF air cooled split system heat pump units with factory-installed shipping skids and lifting lugs; pack components in factory-fabricated protective containers.
- B. Handle VRF air cooled split system heat pump units carefully to avoid damage to components, enclosures, and finish. Do not install damaged components; replace and return damaged components to unit manufacturer.
- C. Store VRF air cooled split system heat pump units in clean dry place and protect from weather and construction traffic.

### PART 2 - PRODUCTS

#### 2.1. VRF SPLIT SYSTEMS INDOOR UNITS

- A. Horizontal, ceiling mounted ducted indoor unit:
  - 1. Medium static fan coil shall be a built-in ceiling concealed fan coil unit, operable with refrigerant R-410A, equipped with an electronic expansion valve, direct-drive DC (ECM) type fan with auto CFM adjustment at commissioning, for installation into the ceiling cavity. It is constructed of a galvanized steel casing with sound absorbing foamed polystyrene and polyethylene insulation. Computerized PID control shall be used to control superheat to maintain room temperature. The unit shall be equipped with a programmed drying mechanism that dehumidifies while limiting changes in room temperature. Included as standard equipment, a condensate drain pan and drain pump kit that pumps to 18-3/8" from the drain pipe opening. The indoor units sound

pressure shall range from 29 dB(A) to 43 dB(A) at low speed measured 5 feet below the ducted unit.

2. The indoor unit shall be completely factory assembled and tested. Included in the unit is factory wiring, piping, electronic proportional expansion valve, control circuit board, fan motor thermal protector, flare connections, condensate drain pan, condensate drain pump, condensate safety shutoff and alarm, self-diagnostics, auto-restart function, 3-minute fused time delay, and test run switch. The unit shall be equipment with automatically adjusting external static pressure logic that is selectable during commissioning. This adjusts the airflow based on the installed external static pressure.
  3. Indoor unit and refrigerant pipes will be charged with dehydrated air prior to shipment from the factory.
  4. The indoor units shall be equipped with a condensate pan and condensate pump. The condensate pump provides up to 18-3/8" of lift from the center of the drain outlet and has a built in safety shutoff and alarm.
  5. Fans:
    - a. The fan shall be direct-drive DC (ECM) type fan, statically and dynamically balanced impeller with three fan speeds available.
    - b. The unit shall be equipment with automatically adjusting external static pressure logic selectable during commissioning.
    - c. The fan motor shall be thermally protected.
    - d. The fan motor shall be equipped as standard with adjustable external static pressure (ESP) settings.
  6. The indoor units shall be equipped with a return air thermistor.
  7. Coil:
    - a. Coils shall be of the direct expansion type constructed from copper tubes expanded into aluminum fins to form a mechanical bond. The coil shall be of a waffle louver fin and high heat exchange, rifled bore tube design to ensure highly efficient performance.
    - b. The coil shall be a 3 row cross fin copper evaporator coil with 15 fpi design completely factory tested. The refrigerant connections shall be flare connections and the condensate will be 1-1/4" outside diameter PVC. A thermistor will be located on the liquid and gas line.
- B. Vertical, closet mounted ducted indoor unit:
1. Unit shall be a vertical air handling unit, operable with refrigerant R-410A, equipped with an electronic expansion valve and direct-drive ECM type fan with auto CFM

adjustment, for installation within a conditioned space. It shall have top discharge air and bottom return air. Computerized PID control shall be used to control superheat to maintain room temperature. The unit shall be equipped with a programmed drying mechanism that dehumidifies while limiting changes in room temperature. Contractor shall provide support for the unit to allow bottom airflow intake.

2. The indoor unit components shall be completely factory assembled and tested. Included in the unit is factory wiring, piping, electronic proportional expansion valve, control circuit board, fan motor thermal protector, brazed connections, self-diagnostics, auto-restart function, 3-minute fused time delay, and test run switch. Indoor unit and refrigerant pipes will be charged with dehydrated air prior to shipment from the factory. The cabinet shall be constructed with sound absorbing, foil-faced insulation to control air leakage.
  3. Indoor unit and refrigerant pipes will be charged with dehydrated air prior to shipment from the factory.
  4. Fans:
    - a. The fan shall be direct-drive DC (ECM) type fan, statically and dynamically balanced impeller with three fan speeds available.
    - b. The unit shall be equipped with automatically adjusting external static pressure logic selectable during commissioning.
    - c. The fan motor shall be thermally protected.
    - d. The fan motor shall be equipped as standard with adjustable external static pressure (ESP) settings.
  5. Coil:
    - a. Coils shall be of the direct expansion type constructed from copper tubes expanded into aluminum fins to form a mechanical bond. The coil shall be of a waffle louver fin and high heat exchange, rifled bore tube design to ensure highly efficient performance.
    - b. The coil shall be a minimum 3 row cross fin copper evaporator coil with 15 fpi design completely factory tested. The refrigerant connections shall be flare connections and the condensate will be 1-1/4" outside diameter PVC. A thermistor will be located on the liquid and gas line.
- C. 4 Way Blow Cassette
- A. General: Indoor unit shall be a ceiling cassette fan coil unit, operable with R-410A refrigerant, equipped with an electronic expansion valve, for installation into the ceiling cavity equipped with a decoration panel grille. The decoration panel shall be a four-way air distribution type, with fresh white (Munsell N9.5) or Silver color, impact resistant with a washable decoration panel. The supply air is distributed via mo-

torized louvers which can be horizontally and vertically adjusted from 0° to 90°. Computerized PID control shall be used to control superheat to deliver a comfortable room temperature condition. The unit shall be equipped with a programmed drying mechanism that dehumidifies while limiting changes in room temperature when used with remote controls. The indoor units sound pressure shall range from 25.5 dB(A) to 33 dB(A) at low speed measured at 5 feet below the unit.

B. Indoor Unit:

1. The cassette unit shall be completely factory assembled and tested. Included in the unit is factory wiring, piping, electronic proportional expansion valve, control circuit board, flare connections, condensate drain pan, condensate drain pump, condensate safety shutoff and alarm, self-diagnostics, auto-restart function, 3-minute fused time delay, and test run switch.
2. Indoor unit and refrigerant pipes will be charged with dehydrated air prior to shipment from the factory.
3. The 4-way supply air flow can be field modified to 3-way and 2-way (adjacent sides) airflow to accommodate various installation configurations including corner installations.
4. Return air shall be through the concentric panel, which includes a resin net mold resistant filter.
5. The indoor units shall be equipped with a condensate pan and condensate pump. The condensate pump provides up to 24-13/16" of lift, measured from the drain outlet, and has a built in safety shutoff and alarm.
6. The indoor units shall be equipped with a return air thermistor.

C. Unit Cabinet:

1. Three auto-swing positions shall be available to choose from via field setting.
2. Fresh air intake shall be possible by way of direct duct installation to the side of the indoor unit cabinet.
3. The cabinet shall be constructed with sound absorbing foamed polystyrene and polyethylene insulation.

D. Decoration Panel:

The unit shall be compatible with three optional decoration panels:

1. Decoration panel – white.
  - i. The decoration panel shall be a four-way air distribution type and constructed of impact resistant polymer.
  - ii. The decoration panel dimensions shall measure 24-7/16" x 24-7/16" and shall fit into a standard 2x2 ceiling grid with no overlap of adjacent tiles.
  - iii. The four air discharge outlet louvers shall be independently motorized and controllable. Each louver shall have a visual indicator to easily identify the louver and simplify the airflow configuration.
  - iv. The louver outlets shall be capable of closure to allow for 3-way and 2-way air distribution.
  - v. The decoration panel shall be a low profile design, extending 5/16" below the ceiling.
  - vi. The decoration panel color shall be fresh white (Munsell N9.5).

E. Optional Space and Presence sensor kit:

1. The space and presence sensor shall be color matched to the decoration panel.
  2. The sensor kit shall be capable of sensing occupancy within the space and automatically controlling the indoor unit set point in response to the detection of occupancy.
  3. The sensor kit shall be capable of automatically adjusting the direction of individual air discharge outlet louvers in response to the detection of occupants in the vicinity of the unit.
  4. The sensor kit shall be capable of automatically adjusting the direction of individual air discharge outlet louvers in response to the sensed floor temperature.
- F. Fan:
1. The fan shall be driven by a direct-drive DC motor with statically and dynamically balanced impeller and shall have three user-selectable speeds available: high, medium, and low.
  2. The fan motor shall operate on 208/230 volts, 1 phase, 60 hertz with a motor output of 50W.
  3. Auto fan mode shall be selectable.
- G. Filter:
1. The return air shall be filtered by means of a washable long-life filter with mildew proof resin.
- H. Coil:
1. Coils shall be of the direct expansion type constructed from copper tubes expanded into aluminum fins to form a mechanical bond.
  2. The coil shall be of a waffle louver fin and high heat exchange, rifled bore tube design to ensure highly efficient performance.
  3. The coil shall be a 2-row cross fin copper evaporator coil with 22 FPI design completely factory tested.
  4. The refrigerant connections shall be flare connections and the condensate will be 1 -1/32 inch outside diameter PVC.
  5. A condensate pan shall be located under the coil.
  6. A condensate pump with a 24-13/16" lift, measured from the drain outlet, shall be located below the coil in the condensate pan with a built in safety alarm.
  7. A thermistor will be located on the liquid and gas line.
- I. Electrical:
1. A separate power supply will be required of 208/230 volts, 1 phase, 60 hertz.
- J. Control:
1. The unit shall have controls provided by the manufacturer to perform input functions necessary to operate the system.
  2. The unit shall be compatible with a Daikin Intelligent Touch Manager advanced multi-zone controller.
- D. Ceiling Evaporator-Fan Components:
1. Cabinet: Enameled steel with removable panels on front and ends and discharge drain pans with drain connection.

2. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 210/240.
3. Retain "Electric Coil" Subparagraph below for heat-pump units and supplemental electric heat. Fan: Direct drive, centrifugal.
4. Fan Motors:
  - a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."
  - b. Multitapped, multispeed with internal thermal protection and permanent lubrication.
  - c. Enclosure Type: Totally enclosed, fan cooled.
  - d. NEMA Premium (TM) efficient motors as defined in NEMA MG 1.
  - e. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 26 Sections.
  - f. Mount unit-mounted disconnect switches on exterior of unit.
5. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.
6. Condensate Drain Pans:
  - a. Fabricated with two percent 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.
    - b. Drain Connection: Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on one or both ends of pan.
    - c. Pan-Top Surface Coating: Asphaltic waterproofing compound.
    - d. Provide condensate pump .
7. 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.

## 2.2 VRF SPLIT SYSTEM OUTDOOR UNIT

- A. The outdoor unit shall be equipped with multiple circuit boards that shall perform all functions necessary for operation. The outdoor unit shall have a powder coated finish. The outdoor unit shall be completely factory assembled, piped and wired. Each unit shall be run tested at the factory. The outdoor unit shall have the following:
  1. Outdoor unit shall have a sound rating no higher than 64dB.
  2. Simultaneous heating and cooling for all indoor units.
  3. Rotational Defrost capability.
  4. All three refrigerant lines from the outdoor unit to the heat recovery box shall be insulated.
  5. The outdoor unit shall have an accumulator.
  6. The outdoor unit shall auto-restart after power loss.
  7. Soft start function.
  8. Night quite mode.
  9. Current control.
  10. High-pressure safety switch, fuse, over-current protection, over-voltage protection, temperature limit protection logic, compressor overload sensing, and crank case heater.
  11. Advanced oil recovery cycle logic operation
  12. Low ambient operation down to -13°F in cooling and heating modes.
  13. The control circuit between the indoor units, and the outdoor unit shall be 0.5VDC - 7VDC completed using stranded, annealed copper conductor, two-core, 16 AWG, shielded cable.
  14. The outdoor unit shall supply power to indoor unit via 14 AWG X 3 power wire.
  15. The outdoor unit shall have a removable EEPROM that stores system programming information, unit name, and other data.
- B. Unit Cabinet – The chassis shall be fabricated of galvanized steel, bonderized and finished with a powder coated baked enamel. Pipe connections at the outdoor unit shall be made inside the unit chassis. Refrigerant pipes can exit through the front, side, rear, or bottom sides of the outdoor unit.
- C. Fan – Outdoor unit shall be furnished with direct drive variable speed propeller type fan. The fan shall be provided with a raised guard to prevent contact with moving parts. The unit shall have vertical discharge airflow. Fan motor shall be BLDC (ECM) type. Motor shall have inherent protection, permanently lubricated bearings, and completely variable speed. The motor shall be mounted for quiet operation.

- D. Refrigerant – The condensing unit shall utilize R-410a refrigerant. Provide outdoor refrigerant kits for module connection. The heat recovery outdoor unit shall have outdoor unit pump-down operation capability allowing storage of refrigerant while opening sealed refrigerant pipe system outside of outdoor unit chassis while performing service. The outdoor unit refrigerant storage shall be greater than the supplied factory R-410A charge. Unit shall have individual outdoor module pump-out operation capability allowing the majority of refrigerant in an outdoor unit to be pumped out. The pump-out feature shall allow service of sealed refrigerant system within an outdoor unit chassis.
- E. Coil - The outdoor coil shall be of nonferrous construction with lanced or corrugated plate fins on copper tubing. The coil shall be protected with an integral guard. Refrigerant flow from the outdoor unit shall be controlled by means of capacity modulation capable, flash injected, DC inverter, scroll compressor
- F. Compressor - The compressor shall be modulation capable, flash injected, DC inverter, scroll type. A crankcase heaters shall be factory mounted on the compressors. Compressor shall have a variable modulation technology to modulate capacity. Compressor shall have flash injection technology to control refrigerant flow rates and refrigerant condensing temperatures. Compressors shall be equipped with an internal thermal overload, and shall be mounted to avoid the transmission of vibration.
- G. Electrical – The outdoor unit shall be controlled by integral microprocessors. The control circuit between the indoor units, the heat recovery boxes, and the outdoor units shall be 0.5VDC – 7VDC completed using stranded, annealed copper conductor, two-core, 16 AWG, shielded cable to provide total integration of the system.

### 2.3 ZONE CONTROLS

- A. Thermostats: Low voltage controller shall have a LCD (Liquid Crystal Display) that shows set point, room temperature, mode of operation (on/off/cool/heat), and fan speed. Wire remote controller to remotely control refrigerant valves and evaporator fan, with the following features:
  1. On/Off, Operation Mode (Cool, Heat, Fan, Dry and Auto).
  2. 24-hour time control of system stop and start.
  3. Liquid-crystal display indicating temperature, set-point temperature, time setting, operating mode, and fan speed.
  4. Fan-speed selection including auto setting.
  5. Independent Heating and Cooling setpoints.

### 2.4 BRANCH CONTROLLER BOX

- A. The Branch Controller shall include multiple branches to allow simultaneous heating and cooling by allowing either hot gas refrigerant to flow to indoor unit(s) for heating or subcooled liquid refrigerant to flow to indoor unit(s) for cooling.
- B. The BC (Branch Controller) Controllers shall be specifically used with R410A VRF systems.

- C. The BC Controller shall be completely factory assembled, piped and wired. Each unit shall be run tested at the factory. This unit shall be mounted indoors, with access and service clearance provided for each controller.
- D. BC Unit Cabinet:
  - 1. The casing shall be fabricated of galvanized steel.
  - 2. Each cabinet shall house a liquid-gas separator and multiple refrigeration control valves.
- E. Refrigerant
  - 1. R410A refrigerant shall be required.
- F. Refrigerant valves:
  - 1. The unit shall be furnished with single or multiple branch circuits which can individually accommodate up to 54,000 BTUH and up to three indoor units. Branches may be twinned to allow more than 54,000 BTUH.
  - 2. Each branch shall have multiple two-position valves to control refrigerant flow.
  - 3. Linear electronic expansion valves shall be used to control the variable refrigerant flow.
- G. Integral Drain Pan:
  - 1. An Integral drain pan and drain shall be provided if required by the manufacturer. If a drain connection is required, the contractor shall be responsible for routing all the drain lines through the building to risers that connect to the waste water system.
- H. Electrical:
  - 1. The unit electrical power shall be 208/230 volts, 1 phase, 60 Hertz.
  - 2. The unit shall be capable of satisfactory operation within voltage limits of 187-228 (208V/60Hz) or 207-253 (230/60Hz).
  - 3. The BC Controller shall be controlled by integral microprocessors

## 2.5 SYSTEM WIDE CONTROLS

- A. Provide a Control System to integrate all VRF equipment
  - 1. The contractor shall wire all outdoor units, indoor units branch selector boxes and power meters using a 2-conductor, 24VDC twisted pair shielded cable per the VRF manufacturers requirements to a central cloud based control panel (CBCP) to provide total VRF integration. The panel shall be a complete network appliance designed to monitor and control the VRF system at the supervisory level. The panel shall utilize open standard protocols, shall communicate with 3<sup>rd</sup> party communicating equipment and provide for enterprise connectivity to perform control sequences and functions as specified. The panel shall communicate all data to the cloud.
  - 2. As a minimum, the CBCP hardware shall:
    - a. Be provided by the VRF Manufacturer as part of the system with all hardware and software necessary to facilitate and implement monitoring and control of the VRF system and 3<sup>rd</sup> party communicating equipment through a single network connection.
    - .

- b. Integrate with building environmental systems and 3<sup>rd</sup> party applications via an open and documented interface as required to monitor and control HVAC equipment identified in the contract drawings including integration of, but not limited to;
    - i) VRF System Components.
    - ii) Make Up Air Handling Units (DOAS Units)
    - iii) Energy Recovery Units (ERU)
    - iv) Fluid Cooler and Pump Package
  - c. Provide system alarms and analytics for building environmental management and notification
  - d. Gather and store instantaneous and historic trend data that is consistent across multi-vendor systems
  - e. Utilize web & mobile applications for improved serviceability
3. Provide a tenant billing option capable of calculating VRF Controls Network equipment energy usage in kWh based on the energy consumption of the outdoor unit(s) divided among the associated indoor units. This software is used in conjunction with the CBCP panel and one or more Watt Hour Meters (WHM). The power proportional distribution results data shall be available at the panel, or on a PC with the use of the web access. Data is saved in the CSV format. Results can be stored up to 5 years.
  4. Provide for complete monitoring & control of the VRF system as described herein. Systems that monitor only, require additional system devices to communicate, or fail to retain a supervisory role throughout all modes of system operation are not acceptable.
  5. The CBCP software shall:
    - a. Be accessed through a standard web-browser interface. No additional programming tools are required.
    - b. Have the ability to securely connect directly to the Web through the buildings infrastructure.
      - i) System IP addresses and system security shall be discussed with and coordinated through the owners IT team.
      - ii) The CBCP shall not send BACnet data outside the network to prevent security vulnerabilities. Any data sent outside the network must be encrypted using TLS version 1.2 or later.
    - c. Must use the Project Haystack naming conventions to map BACnet objects as per the point lists directly between the CBCP through BACnet/IP or MS/TP.
    - d. Provide the user the ability to:
      - i) Create single or multiple setup configurations
      - ii) Adjust fan changeover from intermittent operation to constant operation

- iii) Adjust the system dead-band span between heating and cooling modes
- iv) Provide for dual set point temperature adjustment
- v) Allow for system trending and analysis
- vi) Read system error codes in plain English language format
- vii) Integrate with 3<sup>rd</sup> party equipment through open systems protocols

6. The VRF manufacturer's representative will be required to perform the following:
  - a. Provide System startup for a complete and functional package.
  - b. Provide up to eight (8) hours of integration coordination with 3<sup>rd</sup> party vendors.

B.

## PART 3 - EXECUTION

### 3.1 INSPECTION:

- A. Examine areas and conditions under which air cooled split system heat pump units are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION OF AIR HANDLING UNITS:

- A. Install air cooled split system heat pump units where indicated, in accordance with equipment manufacturer's written instructions, and with recognized industry practices, to ensure that units comply with requirements and serve intended purposes.
- B. Coordinate with other work, including ductwork, floor construction, roof decking, and piping, as necessary to interface installation of air cooled split system heat pump.
- C. Install units as indicated, comply with manufacturer's indicated installation method if any.

### 3.3 GROUNDING:

- A. Provide positive equipment ground for air cooled split system heat pump unit components.

### 3.4 TESTING:

- A. Upon completion of installation of air cooled split system heat pump units, startup and operate equipment to demonstrate capability and compliance with requirements. Field correct malfunctioning units, then retest to demonstrate compliance.

### 3.5 EXTRA STOCK:

- A. Install new filters at completion of air handling system work, and prior to testing, adjusting, and balancing work. Obtain receipt from Owner that new filters have been installed.

3.6 UNIT GUARANTEE AND INSTALLATION SUPERVISION:

- A. Installation of indoor and outdoor heat pump units shall be certified as acceptable by the General Contractor.
- B. The unit manufacturer or his representative shall supervise the charging of the refrigerant systems.
- C. Outdoor and indoor units have ten-year guarantee after date of start-up.

END OF SECTION 23 8127

## **SECTION 238234 - ELECTRIC HEATING TERMINAL UNITS**

### **PART 1 GENERAL**

#### **1.1 SUMMARY**

- A. Work Included: Provide electric heating terminal work as indicated by drawings and schedules, and by requirements of this section.
- B. Types of electrical heating terminals in this section include the following:
  - 1. Propeller unit heaters
  - 2. Cabinet heaters
  - 3. Wall heater
- C. Refer to other Division 26 sections for electrical power wiring work required in conjunction with heating terminals; not work of this section.
- D. The requirements of Division 23 Section "Mechanical General Provisions" apply to this section.

#### **1.2 QUALITY ASSURANCE:**

- A. Manufacturers: Firms regularly engaged in manufacture of electrical heating terminal units, of types, ratings and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer: Qualified with at least 3 years of successful installation experience on projects with electrical heating terminal installation work similar to that required for project.
- C. Compliance: Comply with applicable heating terminal installation requirements of NEC pertaining to installation of space heating equipment and appliances.
- D. UL Compliance: Comply with applicable requirements of UL 1042, "Electric Baseboard Heating Equipment". Provide heating terminals which are UL listed and labeled.
- E. NEPA Compliance: Comply with applicable requirements of NFPA 90A pertaining to installation of A C systems.

#### **1.3 SUBMITTALS:**

- A. Product data: submit manufacturer's specifications for packaged heating and cooling units showing dimensions, weights, capacities, ratings, fan performance with operating point clearly indicated, motor electrical characteristics, gauges and finishes of materials, installation instructions, and controls. Deliver copy to electrical contractor for coordination.
- B. Maintenance Data: Submit maintenance instructions, including lubrication instructions, refrigerant charging, filter replacement, motor and drive replacement, and spare parts lists. Include this data in maintenance manuals.

- C. Provide a conformance summary listing all exceptions, deviations, clarifications or enhancements to the specification on a subparagraph basis.

## PART 2 PRODUCTS

### 2.1 PROPELLER UNIT HEATERS:

#### A. Materials and Equipment:

1. General: Except as otherwise indicated, provide manufacturer's standard electric propeller unit heater materials and components as indicated by published product information, designed and constructed as recommended by manufacturer, and as required for complete installation.

#### B. Heating Elements:

1. General: Except otherwise indicated, provide manufacturer's standard elements of the indicated duty and rating for the indicated capacity, consisting of resistance elements in steel sheath with extended fins, or in spiral sheath.
2. Electric Heating Capacity: Size element as indicated on the drawings.

#### C. Casings:

1. General: Provide casings braced and reinforced to provide required stiffness, and containing heating element supports. Provide rounded corners. Phosphatize and paint casings inside and out with one coat of baked-on enamel zinc plate hardware. Include fan orifice (venturi) in casing, as well as threaded hanger connections (weld nuts). Fabricate from 18-gauge steel.

#### D. Air Deflectors:

1. General: Provide manufacturer's standard air deflectors of the following types.
  - a. 2-way horizontal louvers for horizontal units.
  - b. Louver outlets for vertical units.

#### E. Motors:

1. General: Provide totally enclosed shaded pole or permanent split capacitor motors, class "B" insulation, resiliently mounted, tap wound with built-in thermal overload protection, sleeve bearings or permanently lubricated ball bearings. Current characteristics as indicated on the drawings.
2. Temperature Control: Provide an integral (or wall mounted if indicated on plans), thermostat.
3. Fan Switches: Provide summer fan switch for circulating air in non-heating conditions when desired. Provide a fan delay switch to purge residual heat once the heating element has cycled off.

4. Internal Wiring: Provide high temperature, heat- resistant wiring in flexible metal conduit from Units shall be fused in accordance with NEC devices.
- F. Fans:
1. General: Provide aluminum propeller fans, balanced statically and dynamically of indicated capacity. Provide fans suitable for standard or sparkproof application.
  2. Vibration Isolation: Refer to Division 23 section "Vibration Isolation".
- G. Manufacturer: Subject to compliance with requirements, provide propeller unit heaters on one of the following:
1. REDD-I
  2. Q-MARK (Basis of Design)
  3. Trane Co.
  4. Indeeco
- 2.2 CABINET HEATERS:**
- A. Materials and Equipment:
1. General: Except as otherwise indicated, provide electric cabinet heater manufacturer's standard materials and components as indicated by published product information, designed and constructed as recommended by the manufacturer, and as required for a complete installation. Cabinet heaters to be provided with internal thermostat overcurrent, protection and disconnecting means.
- B. Heating Elements:
1. General: Except as otherwise indicated, provide manufacturer's standard elements of the indicated duty and rated for the indicated capacity, consisting of resistance elements in steel sheath with extended fins, or in spiral sheath.
  2. Electric Heating Capacity: Size element as indicated on the drawings.
- C. Cabinets:
1. General: Provide cabinets braced and reinforced to provide required stiffness, and containing adjustable heating element supports. Provide 1/2" thick, 2-lb. density, glass fiber insulation on interior of the front panel. Phosphatize and paint cabinets inside and out with one coat of baked-on primer. Include discharge louvers. Provide cabinets with removable front panels secured by slide bolt, camlock or Phillips head screws. Fabricate from 16-gauge galvanized steel.
  2. Cabinet Finish: Provide factory finish as selected by the architect (submit for approval).
  3. Arrangement of unit shall be as indicated.
- D. Motors:

1. General: Provide permanent split capacitor motors, resiliently mounted, tap wound with built-in thermal overload protection, and of the permanently lubricated type. Current characteristics as indicated.
  2. Motor Controls & Temperature Controls: Provide a (unit mounted or remote wall mounted where indicated), multi-speed motor control switch with an "OFF" position and integral thermostat.
  3. Internal Wiring: Provide high temperature, heat-resistant wiring in flexible metal conduit from terminal junction box to electrical devices. Provide fuses in motor and control circuit wiring.
- E. Fans:
1. General: Provide double width, double inlet centrifugal fans, balanced statically and dynamically, of the indicated capacity. Connect fan to a single or double extended motor shaft, with fan, housing and motor mounted as an integral assembly on a motor board.
  2. Construction:
    - a. Wheels: Talc-filled polypropylene or aluminum.
    - b. Housing: Galvanized steel.
    - c. Motorboard: Galvanized steel.
- F. Vibration Isolation: Provide devices of the types and sizes recommended by manufacturer, except as otherwise indicated.
- G. Manufacturer: Subject to compliance with requirements provide cabinet heaters of one of the following:

1. REDD-I
2. Q-MARK (Basis of Design)
3. Trane Co.
4. Indeeco

### 2.3 WALL HEATERS:

- A. Architectural design grille shall be 16 gauge steel, with closely spaced downflow discharge bars. Finish shall be durondic brown baked enamel, with satin finished aluminum frame. Grille attachment screws shall be at bottom of grille frame to discourage tampering.
- B. Built-in comfort thermostat shall have adjustment range between 55 degrees and 85 degrees F, with manually set "no heat" position. Thermostat shall be tamper-resistant; adjustment accomplished by inserting narrow blade screwdriver through front bar grille.
- C. Heating elements shall be steel finned metal sheath elements.

- D. Fan motor shall be totally enclosed and permanently lubricated for long life and low maintenance.
- E. Heater shall contain automatic reset thermal overheat protector to disconnect power in event of overheating due to accidental blockage.
- F. Heater shall contain built-in fan delay switch to energize fan motor only after elements are heated to prevent discharge of unheated air. When heat shuts off, switch shall de-energize fan motor only after residual heat has been dissipated.
- G. Heater shall contain built-in double-pole disconnect switch for added safety during maintenance.
- H. Built-in power control relay for providing a means of remotely interrupting the heater for night temperature setback, or for controlling the heater from a pilot duty wall mounted comfort thermostat shall be optional.
- I. Manufacturer: Subject to compliance with requirements, provide wall heaters of one of the following:
  - 1. REDD-I
  - 2. Q-MARK (Basis of Design)
  - 3. Trane Co.
  - 4. Indeeco

### PART 3 EXECUTION

#### 3.1 INSTALLATION OF HEATING TERMINALS:

- A. Install heating terminals as indicated, in accordance with equipment manufacturer' written instructions, and with recognized industry practices, to ensure that heating terminal equipment fulfills requirements. Comply with applicable installation requirements of NEC and NECA's "Standard of Installation".
- B. Coordinate with electric work, including wiring/cabling work, as necessary to interface installation of electric heating terminals with other work. Clean dust and debris from each heating terminal as it is installed to ensure cleanliness.
- C. Comb out damaged fins where bent or crushed before covering elements with enclosures.
- D. Touch-up scratched or marred heating terminal enclosure surfaces to match original finishes.

#### 3.2 GROUNDING:

- A. Provide equipment grounding connections, sufficiently tight to assure a permanent and effective ground, for heating terminals as indicated.

**3.3 TESTING:**

- A. Upon completion of installation of heating terminals and after building circuitry has been energized, test heating terminals to demonstrate capability and compliance with requirements. Where possible field correct malfunctioning units, then retest to demonstrate compliance.

□ □ □ □ □

## **SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. Section Includes:
1. Building wires and cables rated 600 V and less.
  2. Connectors, splices, and terminations rated 600 V and less.

#### **1.2 DEFINITIONS**

- A. VFC: Variable frequency controller.

#### **1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product.

#### **1.4 INFORMATIONAL SUBMITTALS**

- A. Field quality-control reports.

#### **1.5 QUALITY ASSURANCE**

- A. Testing will be performed by the electrical subcontractor.

### **PART 2 - PRODUCTS**

#### **2.1 CONDUCTORS AND CABLES**

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Alcan Products Corporation; Alcan Cable Division.
  2. Alpha Wire.
  3. Belden Inc.
  4. Encore Wire Corporation.

5. General Cable Technologies Corporation.
  6. Southwire Incorporated.
- 
- B. Copper Conductors: Comply with NEMA WC 70/ICEA S-95-658
  - C. Aluminum Conductors: Comply with NEMA WC 70/ICEA S-95-658
  - D. Conductor Insulation: Comply with NEMA WC 70/ICEA S-95-658 for Type THHN-2-THWN-2.
  - E. Multiconductor Cable: Comply with NEMA WC 70/ICEA S-95-658 for metal-clad cable, Type MC with ground wire.

## 2.2 CONNECTORS AND SPLICES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  1. AFC Cable Systems, Inc.
  2. Gardner Bender.
  3. Hubbell Power Systems, Inc.
  4. Ideal Industries, Inc.
  5. Ilsco; a branch of Bardes Corporation.
  6. NSi Industries LLC.
  7. O-Z/Gedney; a brand of the EGS Electrical Group.
  8. 3M; Electrical Markets Division.
  9. Tyco Electronics.
- 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 CONDUTOR MATERIAL APPLICATIONS

- A. Feeders: Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

- B. Aluminum conductors for feeders 100A and larger.
- C. Branch Circuits: 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. Service Entrance: Type THHN-2-THWN-2, single conductors in raceway.
- B. Exposed Feeders: Type THHN-2-THWN-2, single conductors in raceway.
- C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN-2-THWN-2, single conductors in raceway.
- D. Feeders Concealed in Concrete, below Slabs-on-Grade, and underground: Type THHN-2-THWN-2, single conductors in raceway.
- E. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-2-THWN-2, single conductors in raceway or Metal-clad cable, Type MC may be used where permitted by code.
- F. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and underground: Type THHN-2-THWN-2, single conductors in raceway.
- G. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh and strain relief device at terminations to suit application.

### **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 that 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.
- 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.

### 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 078400 "Firestopping."

### 3.8 FIELD QUALITY CONTROL

- A. Testing Agency: Testing will be performed by the electrical subcontractor
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. 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.
- D. 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.

Cables will be considered defective if they do not pass tests and inspections.



## **SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. Section includes grounding and bonding systems and equipment.

#### **1.2 ACTION SUBMITTALS**

- A. Product Data: For each type of product indicated.

#### **1.3 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. Grounding arrangements and connections for separately derived systems.
- B. Qualification Data: For testing agency and testing agencies field supervisor.
- C. Field quality-control reports.

#### **1.4 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 017823 "Operation and Maintenance Data," include the following:
    - a. Instructions for periodic testing and inspection of grounding features at test wells grounding connections for separately derived systems based on NETA MTS.
      - 1) Tests shall determine if ground-resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if values do not.
      - 2) Include recommended testing intervals.

## 1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Testing will be performed by the electrical subcontractor.
- 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 UL 467 for grounding and bonding materials and equipment.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Burndy; Part of Hubbell Electrical Systems.
  - 2. Dossert; AFL Telecommunications LLC.
  - 3. ERICO International Corporation.
  - 4. Fushi Copperweld Inc.
  - 5. Galvan Industries, Inc.; Electrical Products Division, LLC.
  - 6. Harger Lightning and Grounding.
  - 7. ILSCO.
  - 8. O-Z/Gedney; A Brand of the EGS Electrical Group.
  - 9. Robbins Lightning, Inc.
  - 10. Siemens Power Transmission & Distribution, Inc.

### 2.2 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 UL 467 for grounding and bonding materials and equipment.

### 2.3 CONDUCTORS

- A. Insulated Conductors: 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, 24 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.

## 2.4 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 compression -type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

## 2.5 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad; 3/4 inch by 10 feet.

## PART 3 - EXECUTION

### 3.1 APPLICATIONS

- A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.
- B. 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.
- C. 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 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.
- 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, Heat-Tracing, and Anti-Frost Heating 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.
- E. 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.

### 3.4 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. When required per NEC 250 as supplemental ground.
  - 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.
  - 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. Concrete-Encased Grounding Electrode (Ufer Ground): Fabricate according to NFPA 70; use a minimum of 20 feet of bare copper conductor not smaller than No. 4 AWG.
  - 1. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building's grounding grid or to grounding electrode external to concrete.
- I. Concrete-Encased Grounding Electrode (Ufer Ground): Fabricate according to NFPA 70; using electrically conductive coated steel reinforcing bars or rods, at least 20 feet long. If reinforcing is in multiple pieces, connect together by the usual steel tie wires or exothermic welding to create the required length.

### 3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Testing will be performed by the electrical subcontractor.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections
- D. 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. 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.
    - b. Perform tests by fall-of-potential method according to IEEE 81.
  - 4. Prepare dimensioned Drawings locating each test well, 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.

- E. Grounding system will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.
- G. 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: 1 ohm(s).
- H. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

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## **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. This Section includes the following:
  - 1. Hangers and supports for electrical equipment and systems.
  - 2. Construction requirements for concrete bases.
- B. Related Sections include the following:
  - 1. Section 260548 "Vibration and Seismic Controls for Electrical Systems" for products and installation requirements necessary for compliance with seismic criteria.

#### **1.3 DEFINITIONS**

- A. EMT: Electrical metallic tubing.
- B. IMC: Intermediate metal conduit.
- C. RMC: Rigid metal conduit.

#### **1.4 PERFORMANCE REQUIREMENTS**

- A. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- C. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

## 1.5 ACTION SUBMITTALS

- A. Product Data: For the following:
  - 1. Steel slotted support systems.
- B. Shop Drawings: Show fabrication and installation details and include calculations for the following:
  - 1. Trapeze hangers. Include Product Data for components.
  - 2. Steel slotted channel systems. Include Product Data for components.
  - 3. Equipment supports.

## 1.6 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

## 1.7 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Comply with NFPA 70.

## 1.8 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified together with concrete Specifications.
- B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Section 077200 "Roof Accessories."

## PART 2 - PRODUCTS

### 2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
  - 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. Allied Tube & Conduit
    - b. Cooper B-Line, Inc.; a division of Cooper Industries.

- c. ERICO International Corporation.
- d. GS Metals Corp.
- e. Thomas & Betts Corporation.
- f. Unistrut; Tyco International, Ltd.
- g. Wesanco, Inc.

- 2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4. Use for exterior and damp locations.
  - 3. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4. Use for interior locations.
  - 4. Channel Dimensions: Selected for applicable load criteria.
- B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.
- C. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored 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 malleable iron.
- E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- F. 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. 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) 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 in which used.

- 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) 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.
- 3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
- 4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
- 5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
- 6. Toggle Bolts: All-steel springhead type.
- 7. Hanger Rods: Threaded steel.

## 2.2 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 except if requirements in this Section are stricter.
- B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch (6 mm) in diameter.
- C. Multiple Raceways: 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 single-bolt conduit clamps or [two-bolt conduit clamps].

- D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch (38-mm) and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

### **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, EMT, IMC, and RMC may be supported by openings through structure members, as permitted in 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 (90 kg).
- 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 (100 mm) thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches (100 mm) thick.
  6. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
  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 reinforcing bars.

### **3.3 INSTALLATION OF FABRICATED METAL SUPPORTS**

- A. Comply with installation requirements in Section 055000 "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.

### 3.4 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated but not less than 4 inches (100 mm) 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 (20.7-MPa), 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Section 033000 "Cast-in-Place Concrete."
- C. Anchor equipment to concrete base.
  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 (0.05 mm).
- B. Touchup: Comply with requirements in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting" 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.



## **SECTION 260533 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

Section Includes:

1. Metal conduits, tubing, and fittings.
2. Nonmetal conduits and fittings.
3. Metal wire-ways and auxiliary gutters.
4. Surface raceways.
5. Boxes, enclosures, and cabinets.

#### **1.3 DEFINITIONS**

ARC: Aluminum rigid conduit.

GRC: Galvanized rigid steel conduit.

IMC: Intermediate metal conduit.

EMT: Electrical Metallic Tubing.

PVC: Rigid Polyvinyl Chloride Conduit

## 1.4 ACTION SUBMITTALS

Product Data: For surface raceways, wire ways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

LEED Submittals:

6. Product Data for Credit IEQ 4.1: For solvent cements and adhesive primers, documentation including printed statement of VOC content.
7. Laboratory Test Reports for Credit IEQ 4: For solvent cements and adhesive primers, 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."

Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

## 1.5 INFORMATIONAL SUBMITTALS

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:

8. Structural members in paths of conduit groups with common supports.
9. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.

Qualification Data: For professional engineer.

Seismic Qualification Certificates: For enclosures, cabinets, and conduit racks and their mounting provisions, including those for internal components, from manufacturer.

10. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
11. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
12. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

13. Detailed description of conduit support devices and interconnections on which the certification is based and their installation requirements.

Source quality-control reports.

## PART 2 - PRODUCTS

### 2.1 METAL CONDUITS, TUBING AND FITTINGS

**Manufacturers:** Subject to compliance with requirements, provide products by the following:

1. AFC Cable Systems, Inc.
2. Allied Tube & Conduit.
3. Anamet Electrical, Inc.
4. Electri-Flex Company.
5. O-Z/Gedney.
6. Picoma Industries.
7. Republic Conduit.
8. Robroy Industries.
9. Southwire Company.
10. Thomas & Betts Corporation.
11. Western Tube and Conduit Corporation.
12. Wheatland Tube Company.

**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.

GRC: Comply with ANSI C80.1 and UL 6.

ARC: Comply with ANSI C80.5 and UL 6A.

IMC: Comply with ANSI C80.6 and UL 1242.

EMT: Comply with ANSI C80.3 and UL 797.

FMC: Comply with UL 1; zinc-coated steel.

LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.

Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.

13. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886 and NFPA 70.
14. Fittings for EMT:
  - a. Material: Steel.
  - b. Type: Setscrew.
15. 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.
16. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch, with overlapping sleeves protecting threaded joints.

Joint Compound for IMC, GRC, or ARC: 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, AND FITTINGS

Subject to compliance with requirements, provide products by the following:

17. AFC Cable Systems, Inc.
18. Anamet Electrical, Inc.
19. Arenco Corporation.
20. CANTEX Inc.
21. CertainTeed Corporation.
22. Condux International, Inc.
23. Electri-Flex Company.

24. Kraloy.

25. Lamson & Sessions; Carlon Electrical Products.

26. Niedax-Kleinhuis USA, Inc.

27. RACO; Hubbell.

28. Thomas & Betts Corporation.

**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.

ENT: Comply with NEMA TC 13 and UL 1653.

RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.

LFNC: Comply with UL 1660.

Rigid HDPE: Comply with UL 651A.

Continuous HDPE: Comply with UL 651B.

Coil able HDPE: Preassembled with conductors or cables, and complying with ASTM D 3485.

RTRC: Comply with UL 1684A and NEMA TC 14.

Fittings for RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.

Fittings for LFNC: Comply with UL 514B.

Solvent cements and adhesive primers shall have a VOC content of 510 and 550 g/L or less, respectively, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

Solvent cements and adhesive primers 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."

## 2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

Manufacturers: Subject to compliance with requirements, provide products by the following:

29. Cooper B-Line, Inc.

30. Hoffman

31. Mono-Systems, Inc.

32. Square D.

Or equal

Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1 unless otherwise indicated, and sized according to NFPA 70.

33. Metal wire ways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wire ways as required for complete system.

Wire way Covers: Hinged type unless otherwise indicated.

Finish: Manufacturer's finish.

## 2.4 BOXES, ENCLOSURES, AND CABINETS

Manufacturers: Subject to compliance with requirements, provide products by the following:

34. Adalet

35. Cooper Technologies Company; Cooper Crouse-Hinds

36. EGS/Appleton Electric

37. Erickson Electrical Equipment Company

38. FSR Inc.

39. Hoffman.
40. Hubbell Incorporated.
41. Kraloy.
42. Milbank Manufacturing Co.
43. Mono-Systems, Inc.
44. O-Z/Gedney.
45. RACO; Hubbell.
46. Robroy Industries.
47. Spring City Electrical Manufacturing Company.
48. Stahlin Non-Metallic Enclosures.
49. Thomas & Betts Corporation.
50. Wiremold / Legrand.

General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.

Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasket cover.

Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.

Floor Boxes:

51. Material: Cast metal or PVC
52. Type: Fully adjustable.
53. Shape: Rectangular.
54. 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.

Paddle Fan Outlet Boxes: Nonadjustable, designed for attachment of paddle fan weighing 70 lb.

55. 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.

Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

Box extensions used to accommodate new building finishes shall be of same material as recessed box.

Device Box Dimensions: 4 inches square by 2-1/8 inches deep.

Gangable boxes are allowed.

Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 with continuous-hinge cover with flush latch unless otherwise indicated.

56. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
57. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

Cabinets:

58. NEMA 250, Type 1 galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
59. Hinged door in front cover with flush latch and concealed hinge.
60. Key latch to match panelboards.
61. Metal barriers to separate wiring of different systems and voltage.
62. Accessory feet where required for freestanding equipment.
63. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

## PART 3 - EXECUTION

### 3.1 RACEWAY APPLICATION

Outdoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed Conduit: IMC.
2. Concealed Conduit, Aboveground: EMT.
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.

Indoors: Apply raceway products as specified below unless otherwise indicated:

6. Exposed, Not Subject to Physical Damage: EMT.
7. Exposed, Not Subject to Severe Physical Damage: EMT.
8. Exposed and Subject to Severe Physical Damage: IMC. Raceway locations include the following: 6' and below where subject to severe physical damage.
  - a. Loading dock.
  - b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
  - c. Mechanical rooms.
9. Concealed in Ceilings and Interior Walls and Partitions EMT, ENT.
10. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
11. Damp or Wet Locations: IMC.
12. 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.

Minimum Raceway Size: 1/2-inch trade size.

Raceway Fittings: Compatible with raceways and suitable for use and location.

13. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
14. EMT: Use setscrew, steel fittings. Comply with NEMA FB 2.10.
15. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

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.

Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

Install surface raceways only where indicated on Drawings.

Do not install nonmetallic conduit where ambient temperature exceeds 120-degree F.

### **3.2 INSTALLATION**

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.

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.

Complete raceway installation before starting conductor installation.

Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.

Arrange stub-ups so curved portions of bends are not visible above finished slab.

Install no more than the equivalent of Four 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.

Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

Support conduit within 12 inches of enclosures to which attached.

Raceways Embedded in Slabs:

16. 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.
17. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
18. Arrange raceways to keep a minimum of 1 inch of concrete cover in all directions.
19. Do not embed thread less fittings in concrete unless specifically approved by Architect for each specific location.
20. Change from RNC to IMC before rising above floor, where subject to severe physical damage

Stub-ups to Above Recessed Ceilings:

21. Use EMT, IMC, or RMC, ENT and PVC for raceways.
22. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

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.

Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.

Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.

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.

Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

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.

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.

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.

Surface Raceways:

23. Install surface raceway with a minimum 2-inchradius control at bend points.
24. 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.

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.

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:

25. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
26. Where an underground service raceway enters a building or structure.
27. Where otherwise required by NFPA 70.

Comply with manufacturer's written instructions for solvent welding RNC and fittings.

Expansion-Joint Fittings:

28. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30-degree F and that has straight-run length that exceeds 25 feet. Install in each run of aboveground RMC [and EMT] conduit that is located where environmental temperature change may exceed 100-degree F and that has straight-run length that exceeds 100 feet.
29. 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-degree F] <Insert temperature> temperature change.
  - b. Outdoor Locations Exposed to Direct Sunlight: [155-degree F] <Insert temperature> temperature change.
  - c. Indoor Spaces Connected with Outdoors without Physical Separation: [125-degree F] <Insert temperature> temperature change.
  - d. Attics: [135-degree F] <Insert temperature> temperature change.
  - e. <Insert location and corresponding temperature change>.
30. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per degree 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 degree F of temperature change for metal conduits.
31. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
32. 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.

Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches of flexible conduit for [recessed and semi recessed luminaires] equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

33. Use LFMC in damp or wet locations subject to severe physical damage.
34. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.

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] [top] [bottom] of box unless otherwise indicated.

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 rain tight connection between box and cover plate or supported equipment and box.

Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

Locate boxes so that cover or plate will not span different building finishes.

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.

Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

Set metal floor boxes level and flush with finished floor surface.

Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

### **3.3 INSTALLATION OF UNDERGROUND CONDUIT**

Direct-Buried Conduit:

35. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Section 312000 "Earth Moving" for pipe less than 6 inches in nominal diameter.
36. Install backfill as specified in Section 312000 "Earth Moving."
37. 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 Section 312000 "Earth Moving."
38. 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.

39. 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.
40. 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.
41. Underground Warning Tape: Comply with requirements in Section 260553 "Identification for Electrical Systems."

### **3.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES**

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.

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.

Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch above finished grade.

Install handholes with bottom below frost line, <Insert depth of frost line below grade at Project site below grade.

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.

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**

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**

Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

### **3.7 PROTECTION**

Protect coatings, finishes, and cabinets from damage and deterioration.

42. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
43. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 260533

## **SECTION 260544 – SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING**

### **PART 1 - GENERAL**

#### **1.1 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.

#### **1.2 ACTION SUBMITTALS**

**A. Product Data:** For each type of product.

**B. LEED Submittals:**

1. Product Data for Credit EQ 4.1: For sealants, documentation including printed statement of VOC content.
2. Laboratory Test Reports for Credit EQ 4: For 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."

### **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.

**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. 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: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Advance Products & Systems, Inc.
  - b. CALPICO, Inc.
  - c. Metraflex Company (The).
  - d. Pipeline Seal and Insulator, Inc.
  - e. Proco Products, Inc.
2. Sealing Elements: EPDM 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 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.

D. Packaging: Premixed and factory packaged.

## 2.4 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 <Insert value> 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.

**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.



## **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.
- B. Samples: For each type of label and sign to illustrate size, colors, lettering style, mounting provisions, and graphic features of identification products.
- C. Identification Schedule: An index of nomenclature of electrical equipment and system components used in identification signs and labels.

#### **1.3 QUALITY ASSURANCE**

- A. Comply with ANSI A13.1 and IEEE C2.
- 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.

## 1.4 COORDINATION

- A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.
- B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- C. Coordinate installation of identifying devices with location of access panels and doors.
- D. Install identifying devices before installing acoustical ceilings and similar concealment.

## 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.
- C. Colors for Raceways Carrying Circuits at More Than 600 V:
  1. Black letters on an orange field.
  2. Legend: "DANGER CONCEALED HIGH VOLTAGE WIRING."
- D. 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.
- E. Tape and Stencil for Raceways Carrying Circuits More Than 600 V: 4-inch wide black stripes on 10-inch centers diagonally over orange background that extends full length of raceway or duct and is 12 inches wide. Stop stripes at legends.

### 2.2 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.
- 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.

### **2.3 CONDUCTOR IDENTIFICATION MATERIALS**

- A. 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.

### **2.4 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. 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."

### **2.5 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.

## **2.6 EQUIPMENT IDENTIFICATION LABELS**

- A. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background. Minimum letter height shall be 3/8 inch.

## **2.7 CABLE TIES**

- A. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, Type 6/6 nylon.
1. Minimum Width: 3/16 inch.
  2. Tensile Strength at 73-degree F, According to ASTM D 638: 12,000 psi.
  3. Temperature Range: Minus 40 to plus 185-degree F.
  4. Color: Black except where used for color-coding.
- B. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self-extinguishing, one piece, self-locking, Type 6/6 nylon.
1. Minimum Width: 3/16 inch.
  2. Tensile Strength at 73-degree F, According to ASTM D 638: 12,000 psi.
  3. Temperature Range: Minus 40 to plus 185-degree F.
  4. Color: Black.
- C. Plenum-Rated Cable Ties: Self-extinguishing, UV stabilized, one piece, self-locking.
1. Minimum Width: 3/16 inch.
  2. Tensile Strength at 73-degree F, According to ASTM D 638: 7000 psi.
  3. UL 94 Flame Rating: 94V-0.
  4. Temperature Range: Minus 50 to plus 284-degree F.
  5. Color: Black.

## **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. Verify identity of each item before installing identification products.
- B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- C. Apply identification devices to surfaces that require finish after completing finish work.
- D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.
- E. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.

### 3.2 IDENTIFICATION SCHEDULE

- A. 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.
- B. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, use color-coding conductor tape to identify the phase.
  1. Color-Coding for Phase and Voltage Level
  2. Identification, 600 V or Less: Use colors listed below for 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.
  - C. Power-Circuit Conductor Identification, more than 600 V: For conductors in, pull and junction boxes, use write-on tags.
  - D. Install instructional sign including the color code for grounded and ungrounded conductors using adhesive-film-type labels.
  - E. Conductors to Be Extended in the Future: Attach write-on tags to conductors and list source.
  - F. 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.
  - G. 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.
  - H. 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.
- I. 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.
- J. 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.
- K. 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: Engraved, laminated acrylic or melamine label. 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.
    - c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
    - d. 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: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be engraved, laminated acrylic or melamine label.
    - b. Enclosures and electrical cabinets.

- c. Access doors and panels for concealed electrical items.
- d. Switchboards.
- e. Transformers: Label that includes tag designation shown on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
- f. Substations.
- g. Emergency system boxes and enclosures.
- h. Enclosed switches.
- i. Enclosed circuit breakers.
- j. Enclosed controllers.
- k. Variable-speed controllers.
- l. Push-button stations.
- m. Power transfer equipment.
- n. Contactors.
- o. Remote-controlled switches, dimmer modules, and control devices.
- p. Power-generating units.

**END OF SECTION 260553**

## **SECTION 260573 - SHORT CIRCUIT, OVERCURRENT PROTECTIVE DEVICE COORDINATION & ARC-FLASH STUDY**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. This Section includes computer-based, fault-current, overcurrent protective device coordination, and arc-flash studies. Fault-current study shall determine the minimum interrupting capacity of circuit protective devices. Protective devices shall be set based on results of the protective device coordination study. The arc-flash study shall determine the arc-flash hazard distance and the incident energy to which personnel could be exposed during work on or near electrical equipment.
  - 1. Coordination of series-rated devices is permitted where indicated on Drawings.

#### **1.2 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.

#### **1.3 ACTION SUBMITTALS**

- A. Product Data: For computer software program to be used for studies.
- B. The Electrical Contractor (EC) shall perform a survey and collect all necessary data. The Contractor shall be solely responsible to furnish all electrical data such as feeder sizes and lengths, breaker types and ratings to the Vendor actually performing the short circuit,

coordination and arc-flash study. The Electrical Contractor shall be responsible to collect accurate information. The Vendor performing the studies and the EC shall be present during the actual setting of relays and other demonstration.

- C. No switchgears, switchboards, paralleling gears shop drawings will be approved until the Short Circuit, Coordination and Arc-Flash Study report has been approved by the Architect.
- D. Other Action Submittals: The following submittals shall be made after the approval process for system protective devices has been completed. Submittals shall be in paper and 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 Architect.
    - 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.
    - b. Revised single-line diagram, reflecting field investigation results and results of short-circuit study.
  - 3. Coordination-study input data, including completed computer program input data sheets.
  - 4. Study and Equipment Evaluation Reports.
  - 5. Coordination-Study Report.
  - 6. Arc-flash study input data, including completed computer program input data sheets.
  - 7. Arc-flash study report; signed, dated, and sealed by a qualified Architect.
    - 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.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For fault current and coordination-study specialist and software developer

- B.** Qualification Data: For Arc-Flash Study Specialist.
- C.** Product Certificates: For arc-flash hazard analysis software, certifying compliance with IEEE 1584 and NFPA 70E. For short-circuit study software, certifying compliance with IEEE 399.
- D.** Product Certificates: For coordination-study and fault-current-study computer software programs, certifying compliance with IEEE 399.

## **1.5 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.

## **1.6 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 not acceptable.
- B.** Coordination-Study Specialist Qualifications: An entity experienced in the application of computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.
  - 1.** Architect, licensed in the state where Project is located, shall be responsible for the study. All elements of the study shall be performed under the direct supervision and control of Architect.
- C.** Comply with IEEE 242 for short-circuit currents and coordination time intervals.
- D.** Comply with IEEE 399 for general study procedures.
- E.** Arc-Flash Study/Short Circuit and Coordination 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 Architect who holds IEEE Computer Society's Certified Software Development Professional certification.

Arc-Flash Study/Short Circuit and Coordination Study Specialist Qualifications:  
Architect 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 Architect.

2. Field Adjusting Agency Qualifications: An independent agency, with the experience and capability to adjust overcurrent devices and to conduct the testing indicated, that is a member company of the International Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

## PART 2 - PRODUCTS

### 2.1 COMPUTER SOFTWARE DEVELOPERS

- A. Available Computer Software Developers: Subject to compliance with requirements, companies offering computer software programs that may be used in the Work include, but are not limited to, the following:
  1. ETAP
  2. EDSA Micro Corporation.
  3. SKM Systems Analysis, Inc.

- B. Approved Vendors
  1. EDG2
  2. Gill Engineering

### 2.2 COMPUTER SOFTWARE PROGRAM REQUIREMENTS

- A. Comply with IEEE 399.
- B. Analytical features of fault-current-study computer software program shall include "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.
- C. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output. Computer software program shall report device settings and ratings of all overcurrent protective devices and shall demonstrate selective coordination by computer-generated, time-current coordination plots.
  1. Optional Features:

- a. Arcing faults.
- b. Simultaneous faults.
- c. Explicit negative sequence.
- d. Mutual coupling in zero sequence.

## 2.3 SHORT-CIRCUIT 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. 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.** Study Input Data: As described in "Power System Data" Article in the Evaluations.

**G.** Short-Circuit 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.
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.

**H.** Incident Energy and Flash Protection Boundary Calculations:

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.

#### 2.4 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 for compliance with electrical distribution system coordination requirements and other conditions affecting performance. Devices to be coordinated are indicated on Drawings.
  - 1. Proceed with coordination study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to coordination study may not be used in study.
  - 2. 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 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 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.
  - 3. <Insert description>.
- F. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Include studies 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 and single line-to-ground fault at each of the following:
1. Electric utility's supply termination point.
  2. Switchgear.
  3. Unit substation primary and secondary terminals.
  4. Low-voltage switchgear.
  5. Motor-control centers.
  6. Standby generators and automatic transfer switches.
  7. Branch circuit panelboards.
  8. <Insert significant locations in the system>.

### **3.3 ARC-FLASH HAZARD ANALYSIS**

- 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. Call discrepancies to the attention of Architect.
  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 Architects.
- B.** Comply with NFPA 70E and its Annex D for hazard analysis study.
- C.** Use the short-circuit study output and the field-verified settings of the overcurrent devices.
- D.** 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.
- E. Calculate the arc-flash protection boundary and incident energy at locations in the electrical distribution system where personnel could perform work on energized parts.
- F. Include medium- and low-voltage equipment locations, except 240-V ac and 208-V ac systems fed from transformers less than 125 kVA.
- G. 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.
- H. 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).
- I. 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.
- J. 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.

### 3.4 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.

### **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.
- B. Train Owner's operating and maintenance personnel in the use of short circuit and coordination study results.

### **3.7 POWER SYSTEM DATA**

- A. Gather and tabulate the following input data to support short circuit and coordination study:
  1. Product Data for overcurrent protective devices specified in other electrical 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. 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 Architect in charge of performing the study, and shall be by the Architect or its representative who holds NETA ETT Level III certification or NICET Electrical Power Testing Level III certification.
  3. Impedance of utility service entrance.
  4. Electrical Distribution System Diagram: In hard-copy and electronic-copy formats, showing the following:
    - a. Circuit-breaker and fuse-current ratings and types.
    - b. Relays and associated power and current transformer ratings and ratios.

- c. Transformer kilovolt amperes, primary and secondary voltages, connection type, impedance, and X/R ratios.
  - d. Generator kilovolt amperes, size, voltage, and source impedance. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
  - e. Cables: Indicate conduit material, sizes of conductors, conductor material, insulation, and length.
  - f. Busway ampacity and impedance.
  - g. Motor horsepower and code letter designation according to NEMA MG 1.
5. Data sheets to supplement electrical distribution system diagram, cross-referenced with tag numbers on diagram, showing the following:
- a. Special load considerations, including starting inrush currents and frequent starting and stopping.
  - b. Transformer characteristics, including primary protective device, magnetic inrush current, and overload capability.
  - c. Motor full-load current, locked rotor current, service factor, starting time, type of start, and thermal-damage curve.
  - d. Generator thermal-damage curve.
  - e. Ratings, types, and settings of utility company's overcurrent protective devices.
  - f. Special overcurrent protective device settings or types stipulated by utility company.
  - g. Time-current-characteristic curves of devices indicated to be coordinated
  - h. Manufacturer, frame size, interrupting rating in amperes rms symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers.
  - i. Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays.
  - j. Panelboards, switchboards, motor-control center ampacity, and interrupting rating in amperes rms symmetrical.

### 3.8 FAULT-CURRENT STUDY

- A. Calculate the maximum available short-circuit current in amperes rms symmetrical at circuit-breaker positions of the electrical power distribution system. The calculation shall be for a current immediately after initiation and for a three-phase bolted short circuit at each of the following:
  - 1. Switchgear and switchboard bus.
  - 2. Medium-voltage controller.
  - 3. Motor-control center.
  - 4. Distribution panelboard.
  - 5. Branch circuit panelboard.
  - 6. <Insert significant locations in system.>
- B. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Include studies of system-switching configurations and alternate operations that could result in maximum fault conditions.
- C. Calculate momentary and interrupting duties on the basis of maximum available fault current.
- D. Calculations to verify interrupting ratings of overcurrent protective devices shall comply with IEEE 141, IEEE 241, and IEEE 242.
  - 1. Transformers:
    - a. ANSI C57.12.10.
    - b. ANSI C57.12.22.
    - c. ANSI C57.12.40.
    - d. IEEE C57.12.00.
    - e. IEEE C57.96.
  - 2. Medium-Voltage Circuit Breakers: IEEE C37.010.
  - 3. Low-Voltage Circuit Breakers: IEEE 1015 and IEEE C37.20.1.
  - 4. Low-Voltage Fuses: IEEE C37.46.

**E. Study Report:**

1. Show calculated X/R ratios and equipment interrupting rating (1/2-cycle) fault currents on electrical distribution system diagram.
2. Show interrupting (5-cycle) and time-delayed currents (6 cycles and above) on medium, and high, voltage breakers as needed to set relays and assess the sensitivity of overcurrent relays.

**F. Equipment Evaluation Report:**

1. For 600-V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
2. For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in the standards to 1/2-cycle symmetrical fault current.
3. 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.

**3.9 COORDINATION STUDY**

- A. Perform coordination study using approved computer software program. Prepare a written report using results of fault-current study. Comply with IEEE 399.
  1. Calculate the maximum and minimum 1/2-cycle short-circuit currents.
  2. Calculate the maximum and minimum interrupting duty (5 cycles to 2 seconds) short-circuit currents.
  3. Calculate the maximum and minimum ground-fault currents.
- B. Comply with IEEE 141, IEEE 241, and IEEE 242 recommendations for fault currents and time intervals.
- C. Transformer Primary Overcurrent Protective Devices:
  1. Device shall not operate in response to the following:
    - a. Inrush current when first energized.

- b. Self-cooled, full-load current or forced-air-cooled, full-load current, whichever is specified for that transformer.
    - c. Permissible transformer overloads according to IEEE C57.96 if required by unusual loading or emergency conditions.
- 2. Device settings shall protect transformers according to IEEE C57.12.00, for fault currents.
- D. Motors served by voltages more than 600 V shall be protected according to IEEE 620.
- E. Conductor Protection: Protect cables against damage from fault currents according to ICEA P-32-382, ICEA P-45-482, and conductor melting curves in IEEE 242. Demonstrate that equipment withstands the maximum short-circuit current for a time equivalent to the tripping time of the primary relay protection or total clearing time of the fuse. To determine temperatures that damage insulation, use curves from cable manufacturers or from listed standards indicating conductor size and short-circuit current.
- F. Coordination-Study Report: Prepare a written report indicating the following results of coordination study:
  1. Tabular Format of Settings Selected for Overcurrent Protective Devices:
    - a. Device tag.
    - b. Relay-current transformer ratios; and tap, time-dial, and instantaneous-pickup values.
    - c. Circuit-breaker sensor rating; and long-time, short-time, and instantaneous settings.
    - d. Fuse-current rating and type.
    - e. Ground-fault relay-pickup and time-delay settings.
  2. Coordination Curves: Prepared to determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between devices installed in series, including power utility company's upstream devices. Prepare separate sets of curves for the switching schemes and for emergency periods where the power source is local generation. Show the following information:
    - a. Device tag.
    - b. Voltage and current ratio for curves.

- c. Three-phase and single-phase damage points for each transformer.
- d. No damage, melting, and clearing curves for fuses.
- e. Cable damage curves.
- f. Transformer inrush points.
- g. Maximum fault-current cutoff point.

G. Completed data sheets for setting of overcurrent protective 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. Time switches.
2. Photoelectric switches.
3. Standalone daylight-harvesting switching controls.
4. Indoor occupancy sensors.
5. Lighting contactors.

- B. Related Requirements:

1. Section 262726 "Wiring Devices" for wall-box dimmers, wall-switch occupancy sensors, and manual light switches.

### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Show installation details for occupancy and light-level sensors.
  1. Interconnection diagrams showing field-installed wiring.
  2. Include diagrams for power, signal, and control wiring.

### 1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For each type of lighting control device to include in emergency, operation, and maintenance manuals.

## PART 2 - PRODUCTS

### 2.1 TIME SWITCHES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- 1.** Cooper Industries, Inc.
  - 2.** Intermatic, Inc.
  - 3.** Invensys Controls.
  - 4.** Leviton Manufacturing Co., Inc.
  - 5.** NSi Industries LLC; TORK Products.
  - 6.** Tyco Electronics; ALR Brand.
- B.** Electronic Time Switches: Solid state, programmable, with alphanumeric display; complying with UL 917.
- 1.** Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  - 2.** Programs: Two on-off set points on a 24-hour schedule, allowing different set points for each day of the week.
  - 3.** Circuitry: Allow connection of a photoelectric relay as substitute for on-off function of a program.
  - 4.** Astronomic Time: All channels.
  - 5.** Automatic daylight savings time changeover.
  - 6.** Battery Backup: Not less than seven days reserve, to maintain schedules and time clock.

## 2.2 OUTDOOR PHOTOELECTRIC SWITCHES

- A.** Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- 1.** Cooper Industries, Inc.
  - 2.** Intermatic, Inc.
  - 3.** NSi Industries LLC; TORK Products.
  - 4.** Tyco Electronics; ALR Brand.
- B.** Description: Solid state, with SPST dry contacts rated for 1800-VA tungsten or 1000-VA inductive, to operate connected relay, contactor coils, or microprocessor input; complying with UL 773A.
- 1.** Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  - 2.** Light-Level Monitoring Range: 1.5 to 10 fc, with an adjustment for turn-on and turn-off levels within that range.

3. Time Delay: Fifteen second minimum, to prevent false operation.
4. Surge Protection: Metal-oxide varistor.
5. Mounting: Twist lock complies with NEMA C136.10, with base-and-stem mounting or stem-and-swivel mounting accessories as required to direct sensor to the north sky exposure.

## 2.3 DAYLIGHT-HARVESTING DIMMING CONTROLS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  1. [Cooper Industries, Inc.](#)
  2. [Hubbell Building Automation, Inc.](#)
  3. [Leviton Mfg. Company Inc.](#)
  4. [Lithonia Lighting; Acuity Lighting Group, Inc.](#)
  5. [Watt Stopper.](#)
- B. System Description: Sensing daylight and electrical lighting levels, the system adjusts the indoor electrical lighting levels. As daylight increases, the lights are dimmed.
  1. Lighting control set point is based on two lighting conditions:
    - a. When no daylight is present (target level).
    - b. When significant daylight is present.
  2. System programming is done with two hand-held, remote-control tools.
    - a. Initial setup tool.
    - b. Tool for occupants to adjust the target levels by increasing the set point up to 25 percent, or by minimizing the electric lighting level.
- C. Ceiling-Mounted Dimming Controls: Solid-state, light-level sensor unit, with separate controller unit, to detect changes in lighting levels that are perceived by the eye.
  1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  2. Sensor Output: 0- to 10-V dc to operate electronic dimming ballasts. Sensor is powered by controller unit.
  3. Power Pack: Sensor has 24-V dc, Class 2 power source, as defined by NFPA 70.
  4. Light-Level Sensor Set-Point Adjustment Range: 20 to 60 fc.

## 2.4 INDOOR OCCUPANCY SENSORS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. [Bryant Electric](#)
2. [Cooper Industries, Inc.](#)
3. [Hubbell Building Automation, Inc.](#)
4. [Leviton Manufacturing Co., Inc.](#)
5. [Lightolier Controls](#)
6. [Lithonia Lighting; Acuity Brands Lighting, Inc.](#)
7. [Lutron Electronics Co., Inc.](#)
8. [NSi Industries LLC; TORK Products](#)
9. [RAB Lighting](#)
10. [Sensor Switch, Inc.](#)
11. [Square D](#)
12. [Watt Stopper](#)

- B. General Requirements for Sensors: Wall- or ceiling-mounted, solid-state indoor occupancy sensors with a separate power pack.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Operation: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn them off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
3. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor is powered from the power pack.
4. Power Pack: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.
5. Mounting:
  - a. Sensor: Suitable for mounting in any position on a standard outlet box.
  - b. Relay: Externally mounted through a 1/2-inch knockout in a standard electrical enclosure.

- c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
  - 6. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.
  - 7. Bypass Switch: Override the "on" function in case of sensor failure.
  - 8. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc; turn lights off when selected lighting level is present.
- C. Dual-Technology Type: Ceiling mounted; detect occupants in coverage area using PIR and ultrasonic detection methods. The particular technology or combination of technologies that control on-off functions is selectable in the field by operating controls on unit.
- 1. Sensitivity Adjustment: Separate for each sensing technology.
  - 2. Detector Sensitivity: Detect occurrences of 6-inch- minimum movement of any portion of a human body that presents a target of not less than 36 sq. in., and detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
  - 3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96-inch- high ceiling.

## 2.6 SWITCHBOX-MOUNTED OCCUPANCY SENSORS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. [Bryant Electric](#)
2. [Cooper Industries, Inc.](#)
3. [Hubbell Building Automation, Inc.](#)
4. [Leviton Manufacturing Co., Inc.](#)
5. [Lightolier Controls](#)
6. [Lithonia Lighting; Acuity Brands Lighting, Inc.](#)
7. [Lutron Electronics Co., Inc.](#)
8. [NSi Industries LLC; TORK Products](#)
9. [RAB Lighting](#)
10. [Sensor Switch, Inc.](#)
11. [Square D](#)
12. [Watt Stopper](#)

- B.** General Requirements for Sensors: Automatic-wall-switch occupancy sensor, suitable for mounting in a single gang switchbox.
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  2. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F.
  3. Switch Rating: Not less than 800-VA fluorescent at 120 V, 1200-VA fluorescent at 277 V, and 800-W incandescent.
- C.** Wall-Switch Sensor Tag WS1:
1. Standard Range: 180-degree field of view, field adjustable from 180 to 40 degrees; with a minimum coverage area of 900 sq. ft..
  2. Sensing Technology: Dual technology - PIR and ultrasonic.
  3. Switch Type: SP, field selectable automatic "on," or manual "on" automatic "off."
  4. Voltage: Match the circuit voltage type.
  5. Concealed, field-adjustable, "off" time-delay selector at up to 30 minutes.

## 2.7 LIGHTING CONTACTORS

- A.** Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. [Allen-Bradley/Rockwell Automation](#).
  2. [ASCO Power Technologies, LP](#).
  3. [Eaton Corporation](#).
  4. [General Electric Company; GE Consumer & Industrial - Electrical Distribution; Total Lighting Control](#).
  5. [Square D](#).
- B.** Description: Electrically operated and mechanically held, combination-type lighting contactors, complying with NEMA ICS 2 and UL 508.
1. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less total harmonic distortion of normal load current).
  2. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation.
  3. Enclosure: Comply with NEMA 250.

4. Provide with control and pilot devices as indicated on Drawings, matching the NEMA type specified for the enclosure.

## PART 3 - EXECUTION

### 3.1 SENSOR INSTALLATION

- A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies.
- B. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

### 3.2 CONTACTOR INSTALLATION

- A. Mount electrically held lighting contactors with elastomeric isolator pads to eliminate structure-borne vibration, unless contactors are installed in an enclosure with factory-installed vibration isolators.

### 3.3 WIRING INSTALLATION

- A. Wiring Method: Comply with Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size is 1/2 inch.
- B. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.
- C. Size conductors according to lighting control device manufacturer's written instructions unless otherwise indicated.
- D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

### 3.4 IDENTIFICATION

- A. Identify components and power and control wiring according to Section 260553 "Identification for Electrical Systems."
  1. Identify controlled circuits in lighting contactors.
  2. Identify circuits or luminaires controlled by photoelectric and occupancy sensors at each sensor.
- B. Label time switches and contactors with a unique designation.

### 3.5 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.

- B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
  - 1. Operational Test: After installing time switches and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.
  - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Lighting control devices will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

### 3.6 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting sensors to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.
  - 1. For occupancy and motion sensors, verify operation at outer limits of detector range. Set time delay to suit Owner's operations.
  - 2. For daylighting controls, adjust set points and deadband controls to suit Owner's operations.
  - 3. Align high-bay occupancy sensors using manufacturer's laser aiming tool.

### 3.7 DEMONSTRATION

- A. Coordinate demonstration of products specified in this Section with demonstration requirements for low-voltage, programmable lighting control systems specified in Section 260943.13 "Addressable-Fixture Lighting Controls" and Section 260943.23 "Relay-Based Lighting Controls."
- B. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices.



## 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. This Section includes the following types of dry-type transformers rated 600 V and less, with capacities up to 1000 kVA:

1. Distribution transformers.

#### 1.3 SUBMITTALS

- A. Product Data: Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, and performance for each type and size of transformer indicated.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  1. Wiring Diagrams: Power, signal, and control wiring.
- C. Qualification Data: For testing agency.
- D. Source quality-control test reports.
- E. Field quality-control test reports.
- F. Operation and Maintenance Data: For transformers to include in emergency, operation, and maintenance manuals.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Manufacturer Seismic Qualification Certification: Submit certification that transformers, accessories, and components will withstand seismic forces defined in the Vibration and Seismic Controls for Electrical Systems requirements. Include the following:
  1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
    - a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

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.
- B. Qualification Data: For testing agency.
- C. Source quality-control test reports.
- D. Field quality-control test reports.

## 1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain each transformer 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. Comply with IEEE C57.12.91, "Test Code for Dry-Type Distribution and Power Transformers."

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Temporary Heating: Apply temporary heat according to manufacturer's written instructions within the enclosure of each ventilated-type unit, throughout periods during which equipment is not energized and when transformer is not in a space that is continuously under normal control of temperature and humidity.

## 1.7 COORDINATION

- B. Coordinate size and location of concrete bases with actual transformer provided. Cast anchor-bolt inserts into bases. For more information, see the contract documents for concrete, reinforcement, and formwork requirements.
- C. Coordinate installation of wall-mounting and structure-hanging supports with actual transformer provided.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Eaton Electrical Inc.; Cutler-Hammer Products.
  2. General Electric Company.
  3. Siemens Energy & Automation, Inc.

4. Square D; Schneider Electric.  **Highlight this (wont let me)**

## 2.2 GENERAL TRANSFORMER REQUIREMENTS

- A. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service.
- B. Cores: Grain-oriented, non-aging silicon steel.
- C. Coils: Continuous windings without splices except for taps.
  - 1. Internal Coil Connections: Brazed or pressure type.
  - 2. Coil Material: Copper.

## 2.3 DISTRIBUTION TRANSFORMERS

- A. Comply with NEMA ST 20, and list and label as complying with UL 1561.
- B. Provide transformers that are constructed to withstand seismic forces for seismic zone of installation.
- C. Cores: One leg per phase.
- D. Enclosure: Ventilated, NEMA 250, Type 2.
  - 1. Core and coil shall be encapsulated within resin compound, sealing out moisture and air.
- E. Transformer Enclosure Finish: Comply with NEMA 250.
  - 1. Finish Color: Gray.
- F. Taps for Transformers 7.5 to 24 kVA: One 5 percent tap above and one 5 percent tap below normal full capacity.
- G. Taps for Transformers 25 kVA and Larger: Two 2.5 percent taps above and two 2.5 percent taps below normal full capacity.
- H. Insulation Class: 220 deg C, UL-component-recognized insulation system with a maximum of 80 deg C rise above 40 deg C ambient temperature.
- I. Energy Efficiency for Transformers Rated 15 kVA and Larger:
  - 1. Complying with NEMA TP 1, Class 1 efficiency levels.
  - 2. Tested according to NEMA TP 2.
- J. K-Factor Rating: Transformers indicated to be K-factor rated shall comply with UL 1561 requirements for non-sinusoidal load current-handling capability to the degree defined by designated K-factor.

1. Unit shall not overheat when carrying full-load current with harmonic distortion corresponding to designated K-factor.
  2. Indicate value of K-factor on transformer nameplate.
- K. Wall Brackets: Manufacturer's standard brackets.
- L. Fungus Proofing: Permanent fungicidal treatment for coil and core.
- M. Low-Sound-Level Requirements: Minimum of 3 dBA less than NEMA ST 20 standard sound levels when factory tested according to IEEE C57.12.91.

## 2.4 IDENTIFICATION DEVICES

- A. Nameplates: Engraved, laminated-plastic or metal nameplate for each distribution transformer, mounted with stainless steel corrosion-resistant screws. See contract documents for Nameplates and label products requirements.

## 2.5 SOURCE QUALITY CONTROL

- B. Test and inspect transformers according to IEEE C57.12.91.
- C. Factory Sound-Level Tests: Conduct sound-level tests on equipment for this Project.

## PART 3 - EXECUTION

### 3.1 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 that all contract document requirements have been met. Maximum ground resistance shall be 5 ohms at location of transformer.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Construct concrete bases and anchor floor-mounting transformers according to manufacturer's written instructions.
- B. Install wall-mounting transformers level and plumb with wall brackets fabricated by transformer manufacturer and provide seismic bracing as per project requirements.

1. Brace wall-mounting transformers as required for the seismic zone that it is being installed.
- C. Construct concrete bases and anchor floor-mounting transformers according to manufacturer's written instructions, **seismic codes applicable to project**, and the contract document requirements for Hangers and Supports for Electrical Systems.

### 3.3 CONNECTIONS

- A. Ground equipment according to the contract document requirements for Grounding and Bonding for Electrical Systems.
- B. Connect wiring according to the contract document requirements for Low-Voltage Electrical Power Conductors and Cables.

### 3.4 FIELD QUALITY CONTROL

- A. Tests and Inspections:
  1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
- B. Perform tests and inspections and prepare test reports.
  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. Remove and replace units that do not pass tests or inspections and retest as specified above.
- D. Infrared Scanning: After Substantial Completion, perform an infrared scan of the transformer connections and terminations.
  1. Use an infrared-scanning device designed to measure temperature or detect significant deviations from normal values. Provide documentation of device calibration.
- E. Test Labeling: On completion of satisfactory testing of each unit, attach a dated and signed "Satisfactory Test" label to tested component.

### 3.5 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 10 percent and not being lower than nameplate voltage minus 3 percent at maximum load conditions. Submit recording and tap settings as test results.
- B. Output Settings Report: Prepare a written report recording output voltages and tap settings.

### **3.6 CLEANING**

- A.** Vacuum dirt and debris; do not use compressed air to assist in cleaning.

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## SECTION 262413 - SWITCHBOARDS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Service and distribution switchboards rated 600 V and less.
2. Transient voltage suppression devices.
3. Disconnecting and overcurrent protective devices.
4. Instrumentation.
5. Accessory components and features.
6. Identification.

#### 1.2 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Switchboards shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.
1. The term "withstand" means "the unit will remain in place without separation of any parts from the device and remain fully operational when subjected to the seismic forces specified."

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of switchboard, overcurrent protective device, transient voltage suppression device, ground-fault protector, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
- B. Shop Drawings: For each switchboard and related equipment.
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.
  2. Detail enclosure types for types other than NEMA 250, Type 1.
  3. Detail bus configuration, current, and voltage ratings.
  4. Detail short-circuit current rating of switchboards and overcurrent protective devices.
  5. Include descriptive documentation of optional barriers specified for electrical insulation and isolation.

6. Detail utility company's metering provisions with indication of approval by utility company.
  7. Include evidence of NRTL listing for series rating of installed devices.
  8. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
  9. Include time-current coordination curves for each type and rating of overcurrent protective device included in switchboards.
  10. Retain first subparagraph below if mimic bus is specified.
  11. Include diagram
  12. Include schematic and wiring diagrams for power, signal, and control wiring.
- C. Bidders will provide a Compliance Review of the Specifications and Addenda (if any). The Compliance Review shall be a paragraph-by-paragraph review of the Specifications with the following information, "C", "D" or "E" marked in the margin of the original Specifications and any subsequent Addenda.
1. "C": Comply with no exceptions.
  2. "D": Comply with deviations. For each and every deviation, provide a numbered footnote with reasons for the proposed deviation and how the intent of the Specification can be satisfied.
  3. "E": Exception, do not comply. For each and every exception, provide a numbered footnote with reasons and possible alternatives.

Unless a deviation or exception is specifically noted in the Compliance Review, it is assumed that the Bidder is in complete compliance with the plans and Specifications. Deviations or exceptions taken in cover letters, subsidiary documents, by omission or by contradiction do not release the Bidder from being in complete compliance, unless the exception or deviation has been specifically noted in the Compliance Review. The Bidder may submit the latest state-of-the-art components in lieu of specified items. All deviations from the Specifications must be approved by the Architect.

## 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Seismic Qualification Certificates: Submit certification that switchboards, overcurrent protective devices, accessories, and components will withstand seismic forces defined in Section 260548.16 "Seismic Controls for Electrical Systems." Include the following:
  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.

## 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For switchboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017800 "Closeout Submittals," include the following:
1. Routine maintenance requirements for switchboards and all installed components.
  2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
  3. Time-current coordination curves for each type and rating of overcurrent protective device included in switchboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.

## 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. Potential Transformer Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two 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. Fuses and Fusible Devices for Fused Circuit Breakers: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
  4. 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.
  5. Fuses for Fused Power-Circuit Devices: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

6. Indicating Lights: Equal to 10 percent of quantity installed for each size and type, but no fewer than one of each size and type.

## 1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers qualified as defined in NEMA PB 2.1 and trained in electrical safety as required by NFPA 70E.
- B. Testing Agency Qualifications:
  1. Testing Agency's Field Supervisor: Testing will be performed by the electrical subcontractor
- C. Source Limitations: Obtain switchboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.
- D. Product Selection for Restricted Space: Drawings indicate maximum dimensions for switchboards including clearances between switchboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- E. 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.
- F. Comply with NEMA PB 2.
- G. Comply with NFPA 70.
- H. Comply with UL 891.

## 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver switchboards in sections or lengths that can be moved past obstructions in delivery path.
- B. Remove loose packing and flammable materials from inside switchboards and connect factory-installed space heaters to temporary electrical service to prevent condensation.
- C. Handle and prepare switchboards for installation according to NECA 400 or NEMA PB 2.1.

## 1.9 PROJECT CONDITIONS

- A. Installation Pathway: Remove and replace access fencing, doors, lift-out panels, and structures to provide pathway for moving switchboards into place.
- B. Environmental Limitations:
  1. Do not deliver or install switchboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above switchboards 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 104-degree F.
  - b. Altitude: Not exceeding 6600 feet.
- C. Service Conditions: NEMA PB 2, usual service conditions, as follows:
  1. Ambient temperatures within limits specified.
  2. Altitude not exceeding 6600 feet.
- D. 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 Owner 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 and Owner's written permission.
  4. Comply with NFPA 70E.

## 1.10 COORDINATION

- A. Coordinate layout and installation of switchboards 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. 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.

## 1.11 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.
  1. Warranty Period: Five years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURED UNITS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings comparable by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.

- B. Front- and Rear-Accessible Switchboards:

1. Main Devices: Fixed, individually mounted.

2. Branch Devices: Panel and fixed, individually mounted. Sections front and rear aligned.

- C. Indoor Enclosures: Steel, NEMA 250, Type 1.

- D. Enclosure Finish for Indoor Units: Factory-applied finish in manufacturer's standard gray finish over a rust-inhibiting primer on treated metal surface.

- E. Barriers: Between adjacent switchboard sections.

- F. Utility Metering Compartment: Fabricated, barrier compartment and section complying with utility company's requirements; hinged sealed door; buses provisioned for mounting utility company's current transformers and potential transformers or potential taps as required by utility company. If separate vertical section is required for utility metering, match and align with basic switchboard. Provide service entrance label and necessary applicable service entrance features.

- G. Customer Metering Compartment: A separate customer metering compartment and section with front hinged door, for indicated metering, and current transformers for each meter. Current transformer secondary wiring shall be terminated on shorting-type terminal blocks. Include potential transformers having primary and secondary fuses with disconnecting means and secondary wiring terminated on terminal blocks.

- H. Bus Transition and Incoming Pull Sections: Matched and aligned with basic switchboard.

- I. Hinged Front Panels: Allow access to switches, metering, accessory, and blank compartments.

- J. Pull Box on Top of Switchboard:

1. Adequate ventilation to maintain temperature in pull box within same limits as switchboard.

2. Set back from front to clear circuit-breaker removal mechanism.

3. Removable covers shall form top, front, and sides. Top covers at rear shall be easily removable for drilling and cutting.
  4. Bottom shall be insulating, fire-resistive material with separate holes for cable drops into switchboard.
  5. Cable supports shall be arranged to facilitate cabling and adequate to support cables indicated, including those for future installation.
- K. Three phase, four wire unless otherwise indicated.
1. Phase- and Neutral-Bus Material: Aluminum, with Aluminum feeder switch and fuse connections.
  2. Load Terminals: Insulated, rigidly braced, runback bus extensions, of same material as through buses, equipped with compression connectors for outgoing circuit conductors. Provide load terminals for future switch and fuse positions at full-ampere rating of switch and fuse position.
  3. Ground Bus: Aluminum, equipped with compression connectors for feeder and branch-circuit ground conductors. For busway feeders, extend insulated equipment grounding cable to busway ground connection and support cable at intervals in vertical run.
  4. Main Phase Buses and Equipment Ground Buses: Uniform capacity for entire length of switchboard's main and distribution sections. Provide for future extensions from both ends.
  5. Neutral Buses: 100 percent of the ampacity of phase buses unless otherwise indicated, equipped with compression connectors for outgoing circuit neutral cables. Brace bus extensions for busway feeder neutral bus.
  6. Isolation Barrier Access Provisions: Permit checking of bus-bolt tightness.
- L. Future Devices: Equip compartments with mounting brackets, supports, bus connections, and appurtenances at full rating of switch compartment.
- M. Fungus Proofing: Permanent fungicidal treatment for overcurrent protective devices and other components including instruments and instrument transformers.

## 2.2

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings by one of the following:
1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
  2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
  3. Siemens Energy & Automation, Inc.
  4. Square D; a brand of Schneider Electric.

- B.** Surge Protection Device Description: IEEE C62.41-compliant, integrally mounted, plug-in solid-state, parallel-connected, modular with field-replaceable modules type, with sine-wave tracking suppression and filtering modules, UL 1449, second edition, short-circuit current rating matching or exceeding the switchboard short-circuit rating, and with the following features and accessories:
1. Fuses, rated at 200-kA interrupting capacity.
  2. Fabrication using bolted compression lugs for internal wiring.
  3. Integral disconnect switch.
  4. Redundant suppression circuits.
  5. Redundant replaceable modules.
  6. Arrangement with wire connections to phase buses, neutral bus, and ground bus.
  7. LED indicator lights for power and protection status.
  8. Audible alarm, with silencing switch, to indicate when protection has failed.
  9. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of system operation. Contacts shall reverse position on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.
  10. Six-digit, transient-event counter set to totalize transient surges.
- C.** Peak Single-Impulse Surge Current Rating: 160 kA per mode/320 kA per phase Withstand Capabilities: 12,000 IEEE C62.41, Category C3 (10 kA), 8-by-20-mic.sec. Surges with less than 5 percent change in clamping voltage.
- D.** Protection modes and UL 1449 SVR for grounded wye circuits with 480Y/277three-phase, four-wire circuits shall be as follows:
1. Line to Neutral: 800 V for 480Y/277
  2. Line to Ground: 800 V for 480Y/277
  3. Neutral to Ground: 800 V for 480Y/277
- E.** Protection modes and UL 1449 SVR for 240-, 480-, or 600-V, three-phase, three-wire, delta circuits shall be as follows:
1. Line to Line: 2000 V for 480 V
  2. Line to Ground: 1500 V for 480 V

## 2.3 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.
  - 1. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replaceable electronic trip; and the following field-adjustable settings:
    - a. Instantaneous trip.
    - b. Long- and short-time pickup levels.
    - c. Long- and short-time adjustments.
    - d. Ground-fault pickup level, time delay, and I squared t response.
  - 2. MCCB Features and Accessories:
    - a. Standard frame sizes, trip ratings, and number of poles.
    - b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor material.
    - c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
    - d. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.

## 2.4 INSTRUMENTATION

- A. Instrument Transformers: IEEE C57.13, NEMA EI 21.1, and the following:
  - 1. Potential Transformers: IEEE C57.13; 120 V, 60 Hz, double secondary; disconnecting type with integral fuse mountings. Burden and accuracy shall be consistent with connected metering and relay devices.
  - 2. Current Transformers: IEEE C57.13; 5A, 60 Hz, secondary; double-secondary winding and secondary shorting device. Burden and accuracy shall be consistent with connected metering and relay devices.
  - 3. Control-Power Transformers: Dry type, mounted in separate compartments for units larger than 3 kVA.
  - 4. Current Transformers for Neutral and Ground-Fault Current Sensing: Connect secondary wiring to ground overcurrent relays, via shorting terminals, to provide selective tripping of main and tie circuit breaker. Coordinate with feeder circuit-breaker, ground-fault protection.

- B. Multifunction Digital-Metering Monitor: Microprocessor-based unit suitable for three- or four-wire systems and with the following features:
1. Switch-selectable digital display of the following values with maximum accuracy tolerances as indicated:
    - a. Phase Currents, Each Phase: Plus or minus 1 percent.
    - b. Phase-to-Phase Voltages, Three Phase: Plus or minus 1 percent.
    - c. Phase-to-Neutral Voltages, Three Phase: Plus or minus 1 percent.
    - d. Megawatts: Plus or minus 2 percent.
    - e. Megavars: Plus or minus 2 percent.
    - f. Power Factor: Plus or minus 2 percent.
    - g. Frequency: Plus or minus 0.5 percent.
    - h. Accumulated Energy, Megawatt Hours: Plus or minus 2 percent; accumulated values unaffected by power outages up to 72 hours.
    - i. Megawatt Demand: Plus or minus 2 percent; demand interval programmable from five to 60 minutes.
    - j. Contact devices to operate remote impulse-totalizing demand meter.
  2. Mounting: Display and control unit flush or semi flush mounted in instrument compartment door.

## 2.5 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 switchboard. Include relay and meter test plugs suitable for testing switchboard meters and switchboard class relays.
- C. Spare-Fuse Cabinet: Suitably identified, wall-mounted, lockable, compartmented steel box or cabinet. Arrange for wall mounting.

## 2.6 IDENTIFICATION

- A. Service Equipment Label: NRTL labeled for use as service equipment for switchboards with one or more service disconnecting and overcurrent protective devices.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Receive, inspect, handle, and store switchboards according to NECA 400 or NEMA PB 2.1
- B. Examine switchboards before installation. Reject switchboards that are moisture damaged or physically damaged.
- C. Examine elements and surfaces to receive switchboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Install switchboards and accessories according to NECA 400 or NEMA PB 2.1.
- B. Equipment Mounting: Install switchboards on concrete base, 4-inch nominal thickness. Comply with requirements for concrete base specified in Section 033000 "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 switchboards.
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from switchboard units and components.
- D. Comply with mounting and anchoring requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."
- E. Operating Instructions: Frame and mount the printed basic operating instructions for switchboards, including control and key interlocking sequences and emergency procedures. Fabricate frame of finished wood or metal and cover instructions with clear acrylic plastic. Mount on front of switchboards.
- F. Install filler plates in unused spaces of panel-mounted sections.
- G. Install overcurrent protective devices, transient voltage suppression devices, and instrumentation.
  - 1. Set field-adjustable switches and circuit-breaker trip ranges.

- H. Install spare-fuse cabinet.
- I. Comply with NECA 1.

### **3.3 IDENTIFICATION**

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- B. Switchboard Nameplates: Label each switchboard compartment with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- C. Device Nameplates: Label each disconnecting and overcurrent protective device and each meter and control device mounted in compartment doors with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

### **3.4 FIELD QUALITY CONTROL**

- A. Testing Agency:
- B. Perform tests and inspections.
  - 1. Manufacturer's Field Service: Testing will be performed by the electrical subcontractor.
- C. Acceptance Testing Preparation:
  - 1. Test insulation resistance for each switchboard 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 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 switchboard. Remove front and rear panels so joints and connections are accessible to portable scanner.
    - b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switchboard 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.
  - 4.** Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- E.** Switchboard will be considered defective if it does not pass tests and inspections.
- F.** Prepare test and inspection reports, including a certified report that identifies switchboards included 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.

**3.6 PROTECTION**

- A.** Temporary Heating: Apply temporary heat, to maintain temperature according to manufacturer's written instructions, until switchboard is ready to be energized and placed into service.

**3.7 DEMONSTRATION**

- A.** Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain switchboards, overcurrent protective devices, instrumentation, and accessories

**END OF SECTION 262413**

## 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.

#### 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.

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.

## **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:
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.

## **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 NECA 407.

## **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 minus 22-degree F (minus 30-degree C) to plus 104-degree F (plus 40-degree C).
  - b. Altitude: Not exceeding 6600 feet (2000 m).

- B. Service Conditions: NEMA PB 1, usual service conditions, as follows:

1. Ambient temperatures within limits specified.
2. Altitude not exceeding 6600 feet (2000 m).

## **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.

## PART 2 - PRODUCTS

### 2.1 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.
    - c. Kitchen Areas: NEMA 250, Type 4X, stainless steel.
    - d. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
  - 2. Height: 84 inches (2.13 m) 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.
  - 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: Galvanized steel.
- c. Fungus Proofing: Permanent fungicidal treatment for overcurrent protective devices and other components.

**G. Incoming Mains:**

- 1. Location: Convertible between top and bottom.
- 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, Aluminum.
  - 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. 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.

**I. Conductor Connectors: Suitable for use with conductor material and sizes.**

- 1. Material: Hard-drawn copper, 98 percent conductivity, Aluminum.
- 2. Terminations shall allow use of 75-degree 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.
  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.
- 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.
- 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.

## 2.2 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Panelboards shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
  1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

## 2.3 POWER PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Eaton,
  2. General Electric Company; GE Energy Management - Electrical Distribution,
  3. Square D; by Schneider Electric.

**4. Siemens Energy**

- B. Panelboards: NEMA PB 1, distribution type.
- C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
  - 1. For doors more than 36 inches (914 mm) high, provide two latches, keyed alike.
- D. Mains: Circuit breaker.
- E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.
- F. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger than 125A: Bolt-on circuit breakers.
- G. Branch Overcurrent Protective Devices: Fused switches.

**2.4 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Eaton.
  - 2. General Electric Company; GE Energy Management - Electrical Distribution.
  - 3. Siemens Energy.
  - 4. Square D; by Schneider Electric.
- B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- C. Mains: Circuit breaker or lugs only.
- D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- E. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

**2.5 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Eaton.
  - 2. General Electric Company; GE Energy Management - Electrical Distribution.

3. Siemens Energy.      4. Square D; by Schneider Electric.
- Highlight this (wont let me)
- B. 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 801A and larger.
  2. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6-mA trip).
  3. GFEP Circuit Breakers: Class B ground-fault protection (30-mA trip).
  4. Arc-Fault Circuit Interrupter Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.
  5. Subfeed Circuit Breakers: Vertically mounted.
  6. MCCB Features and Accessories:
    - 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 [55] [75] percent of rated voltage.

## 2.6 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 transparent card holder.
  - 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.

## 2.7 ACCESSORY COMPONENTS AND FEATURES

- A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

## 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.
- 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.

**D. Equipment Mounting:**

1. 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.
- F. Mount top of trim 90 inches (2286 mm) 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. Mount surface-mounted panelboards to steel slotted supports 5/8 inch (16 mm) in depth. Orient steel slotted supports vertically.
- J. 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.
- K. 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.
- L. Install filler plates in unused spaces.
- M. Arrange conductors in gutters into groups and bundle and wrap with wire ties [after completing load balancing].
- N. Mount spare fuse cabinet in accessible location.

**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."
- 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: Testing will be performed by the electrical subcontractor
- B. Perform tests and inspections. Retain "Manufacturer's Field Service" Subparagraph below to require a factory-authorized service representative to assist Contractor with inspections, tests, and adjustments.
  - 1. Manufacturer's Field Service: Testing will be performed by the electrical subcontractor
- 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
  - 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. 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.

### **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.



## 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 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.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Receive, store, and handle modular meter center according to NECA 400.

## 1.8 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.

## 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] [typewritten card] with occupant's name.

### **3.3 FIELD QUALITY CONTROL**

**A.** Perform tests and inspections.

1. Manufacturer's Field Service: Testing will be performed by the electrical subcontractor.



## SECTION 262726 - WIRING DEVICES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
1. Receptacles, receptacles with integral GFCI, and associated device plates.
  2. Twist-locking receptacles.
  3. Snap switches and wall-box dimmers.
  4. Solid-state fan speed controls.
  5. Wall-switch and exterior occupancy sensors.
  6. Communications outlets.
  7. Floor service outlets, poke-through assemblies, service poles, and multi-outlet assemblies.

#### 1.2 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.

#### 1.3 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
1. Receptacles for Owner-Furnished Equipment: Match plug configurations.
  2. Cord and Plug Sets: Match equipment requirements.

#### 1.4 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.

## 1.5 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

## 1.6 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.

# 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; Division of Cooper Industries, Inc. (Cooper).
2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
3. Leviton Mfg. Company Inc. (Leviton).
4. Pass & Seymour/Legrand (Pass & Seymour).

- B. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

## 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.

## 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. 125V, 15 A is acceptable on 15 A branch circuit within apartment.
  - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Cooper.

- b. Hubbell.
- c. Leviton.
- d. Pass & Seymour.

#### **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:**

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

- a. Cooper
- b. Hubbell.
- c. Pass & Seymour.
- d. Leviton.

#### **2.5 TWIST-LOCKING RECEPTACLES**

**A. Single Convenience Receptacles:** Comply with NEMA WD 1, NEMA WD 6 Configuration as indicated and UL 498.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Cooper.
  - b. Hubbell.
  - c. Leviton.
  - d. Pass & Seymour.

#### **2.6 TOGGLE SWITCHES**

**A.** Comply with NEMA WD 1, UL 20, and FS W-S-896.

1. Switches, 120/277 V, 20 A. 120V, 15 A is acceptable for apartment lighting circuits
2. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Cooper.
  - b. Hubbell.
  - c. Leviton.
  - d. Pass & Seymour.

## 2.7 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.
- 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.

## 2.8 WALL PLATES

- A. Single and combination types shall match corresponding wiring devices.
  1. Plate-Securing Screws: Metal with head color to match plate finish.
  2. Material for Public Spaces: Plastic color as selected by the architect.
  3. Material for Apartments: Plastic color as selected by the architect.
  4. Material for Unfinished Spaces: Galvanized steel.
  5. 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.

## 2.9 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 Plate: Round, with satin finish.
- D. Power Receptacle: NEMA WD 6 Configuration 5-20R, gray finish, unless otherwise indicated.
- E. Voice and Data Communication Outlet: Two modular, keyed, color-coded, RJ-45 jacks for UTP cable complying with requirements in Section 271500 "Communications Horizontal Cabling."

## 2.10 FINISHES

- A. Device Color:
  - 1. Wiring Devices: As selected by Architect unless otherwise indicated or required by NFPA 70 or device listing.

# 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. Pigtailing 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.
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.

- 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."

### **3.4 FIELD QUALITY CONTROL**

- A. Perform the following tests and inspections:
  - 1. Test Instruments: Use instruments that comply with UL 1436.
  - 2. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.
- 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. Wiring device will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.



## SECTION 262743 - ELECTRIC-VEHICLE SERVICE EQUIPMENT - AC LEVEL 1 AND LEVEL 2

### 1.1 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 EVSE that provides AC Level 1 and Level 2 EV charging.

### 1.3 DEFINITIONS

- A. EV: Electric vehicle.
- B. EV Cable: The off-board cable containing the conductor(s) to connect the EV power controller to the EV that provides both power and communications during energy transfer.
- C. EV Charger or EV Charging Equipment: See "EVSE."
- D. EV Connector: A conductive device that, when electrically coupled to an EV inlet, establishes an electrical connection to the EV for the purpose of power transfer and information exchange. This device is part of the EV coupler.
- E. EV Coupler: A mating EV inlet and connector set.
- F. EV Inlet: The device in the vehicle into which the EV connector is inserted, and a conductive connection is made for the transfer of power and communication. This device is part of the EV coupler.
- G. EVSE: Electric-Vehicle Supply Equipment. It includes the EV charging equipment and conductors, including the ungrounded, grounded, and equipment grounding conductors and EV cables, attachment plugs, and all other fittings, devices, power outlets, or apparatus installed specifically for transferring energy between the premise wiring and the EV.

### 1.4 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 EV charging equipment.
  - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

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B. Shop Drawings: For EVSE.

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 mounting assemblies for EV charging equipment.
4. Include diagrams for power, signal, and control wiring.
5. .

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Area plans and 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. Structural members to which equipment will be attached.
  2. Electrical service.
  3. Communications service, including wireless communications equipment.
- B. Qualification Data: For factory-authorized service representative.
- C. Field quality-control reports.
- D. Sample Warranty: For manufacturer's warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For EVSE to include in operation and maintenance manuals.
- B. Software and Firmware Operational Documentation:
1. Software operating manuals.
  2. Program Software Backup: On USB, CD, Cloud, or approved media, complete with configuration files.
  3. Device address and password list.
  4. Printout of software application and graphic screens.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materialsthat match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

## 1.8 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

## 1.9 FIELD CONDITIONS

- A. Wireless Survey: Complete wireless survey to determine if wireless provider signals meet or exceed manufacturer's recommended minimum values.
- B. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
  1. Ambient Temperature: Not exceeding minus 22 to plus 122 deg F (minus 30 to plus 50 deg C).
  2. Altitude: Not exceeding 6600 feet (2000 m).

## 1.10 WARRANTY

- A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace components of EVSE that fail(s) in materials or workmanship within specified warranty period.
  1. Warranty Period: One year(s) from date of Substantial Completion.

# PART 2 - PRODUCTS

## 2.1 MANUFACTURERS

- A. Sema Connect
- B. Source Limitations: Obtain EVSE from single manufacturer.

## 2.2 PERFORMANCE REQUIREMENTS

- A. Ambient Temperature: 41 to 104 deg F (5 to 40 deg C).
- B. Relative Humidity: Zero to 95 percent.
- C. Altitude: Sea level to 1000 feet (300 m).
- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
- E. Surge Withstand: 6 kV at 3000 A.

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F. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

G. EV Charging Levels:

1. Dual vehicles, AC Level 2 at up to 7.2 kW total.

## 2.3 EVSE DESCRIPTION

A. Comply with NFPA 70.

B. Comply with:

1. SAE J1772 for SAE combo chargers.

C. Comply with ADA-ABA Accessibility Guidelines.

D. Metering: Revenue grade meter.

E. Control Power: 20 A, 110/120-V ac, 60 Hz, single phase per charger.

F. Input Power:

1. 40 A, 208/240-V ac, 60 Hz, single-phase services per charger.

G. Integral GFCI.

H. Auto-GFCI fault retry.

I. EVSE Mounting: Floor mount.

J. Enclosures:

1. Rated for environmental conditions at installed location.

- a. Other Wet or Damp Indoor Locations: NEMA 250, Type 3R.  
b. Aluminum.

K. EV Cable and Connectors:

1. SAE J1772 connector.
2. Double connectors.
3. 18-foot (6-m) cable with cable management system.
4. Field-replaceable connector and cable assembly.

L. Status Indicators:

1. LEDs to indicate power, charging, charging complete, system status, faults, and service.

M. Display Screen:

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**Electric-Vehicle Service Equipment - AC Level 1 and Level 2**

1. Daylight viewable, UV-protected display with human-machine interface capability.
  2. Displays power, charging, charging complete, remote control, system status, faults, and service.
- N. Networking:
1. WAN Communications: Cellular GSM/GPRS.
  2. Capable of remote configuration and reporting.
- O. Payment System:
1. RFID [Contactless credit card] reader.
  2. PCI compliant.
  3. Capable of remote control and authorization.

## 2.4 GENERAL FINISH REQUIREMENTS

- A. Protect mechanical finishes on exposed surfaces from damage by utilizing cushioning materials or foam or 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 roughing-in for EVSE electrical conduit to verify actual locations of conduit connections before equipment installation.
- C. Examine [walls] [walls and floors] [pavement] for suitable conditions where EVSE will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Comply with NECA 1 and NECA 413.
- B. Concrete Base Mounting:

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**Electric-Vehicle Service Equipment - AC Level 1 and Level 2**

1. Install EVSE on 6-inch (150-mm) nominal-thickness concrete base. Comply with requirements for concrete base specified in Section 033000 "Cast-in-Place Concrete."
  - a. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
  - b. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
  - c. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - d. Install anchor bolts to elevations required for proper attachment to supported equipment.
  - e. Secure EVSE to concrete base according to manufacturer's written instructions.
- C. Wiring Method: Install cables in raceways and cable trays. Conceal raceway and cables except in unfinished spaces.
  1. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."
- D. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- E. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.
- F. Disconnect: Install disconnect in a readily accessible location according to Section 262816 "Enclosed Switches and Circuit Breakers."
- G. Circuit Breakers: Comply with Section 262816 "Enclosed Switches and Circuit Breakers."
- H. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking from enclosures and components.
- I. Secure covers to enclosure.

### 3.3 CONNECTIONS

- A. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Comply with grounding requirements in Section 260526 "Grounding and Bonding for Electrical Systems."
- C. Comply with requirements for installation of conduit in Section 260533 "Raceways and Boxes for Electrical Systems." Drawings indicate general arrangement of conduit, fittings, and specialties.

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**Electric-Vehicle Service Equipment - AC Level 1 and Level 2**

- D. 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.
- E. Verify that all electrical connections have been made according to the manufacturer's instructions. Remove all burrs, shavings, and detritus from inside the enclosure.
- F. After confirming all connections, install covers and tighten fasteners to according to manufacturer's instructions.

#### 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. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections with the assistance of a factory-authorized service representative.
- C. Tests and Inspections:
  - 1. For each unit of EVSE, perform the following tests and inspections:
    - a. Unit self-test.
    - b. Operation test with load bank.
    - c. Operation test with EV.
    - d. Network communications test.
- D. EVSE will be considered defective if it does not pass tests and inspections.
- E. 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.

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**Electric-Vehicle Service Equipment - AC Level 1 and Level 2**

### 3.7 SOFTWARE SERVICE AGREEMENT

- A. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for [two] <Insert number> years.
- B. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within [two] <Insert number> years from date of Substantial Completion. Upgrading software shall include operating system and new or revised licenses for using software.
  - 1. Upgrade Notice: At least 30 days to allow Owner to schedule and access the system and to upgrade computer equipment if necessary.

### 3.8 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain EV charging equipment.

END OF SECTION 262743

**262743**

**Electric-Vehicle Service Equipment - AC Level 1 and Level 2**

## SECTION 262813 - FUSES

### PART 1 - GENERAL

#### SUMMARY

A. Section Includes:

1. Cartridge fuses rated 600-V ac and less for use in control circuits enclosed switches.
2. Spare-fuse cabinets.

### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material, dimensions, descriptions of individual components, 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. Coordination charts and tables and related data.
5. Fuse sizes for elevator feeders and elevator disconnect switches.

### 1.3 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017800 "Closeout Submittals," include the following:

1. Ambient temperature adjustment information.
2. Current-limitation curves for fuses with current-limiting characteristics.
3. Coordination charts and tables and related data.

#### **1.4 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 two of each size and type.

#### **1.6 QUALITY ASSURANCE**

- A. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with NEMA FU 1 for cartridge fuses.
- D. Comply with NFPA 70.
- E. Comply with UL 248-11 for plug fuses.

#### **1.7 PROJECT CONDITIONS**

- A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F or more than, apply manufacturer's ambient temperature adjustment factors to fuse ratings.

#### **1.8 COORDINATION**

- A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

### **PART 2 - PRODUCTS**

#### **2.1 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  1. Cooper Bussmann, Inc.
  2. Edison Fuse, Inc.
  3. Ferraz Shawmut, Inc.
  4. Littelfuse, Inc.

#### **2 2.2 CARTRIDGE FUSES**

- A. Characteristics: NEMA FU 1, nonrenewable cartridge fuses with voltage ratings consistent

with circuit voltages.

### 3 2.3 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. Motor Branch Circuits: Class RK1, time delay.
  - 2. Other Branch Circuits: Class RK1, time delay.
  - 3. Control Circuits: Class CC, fast acting.

### 3.3 INSTALLATION

- A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.
- B. Install plug-fuse adapters in Edison-base fuseholders and sockets. Ensure that adapters are

irremovable once installed.

- C. Install spare-fuse cabinet(s).

### **3.4 IDENTIFICATION**

- A. Install labels complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems" and indicating fuse replacement information on inside door of each fused switch and adjacent to each fuse block, socket, and holder.

□ □ □ □ □

## **SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS**

### **PART 1 - GENERAL**

#### **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.

#### **SUMMARY**

- B.** Section Includes:

1. Fusible switches.
2. Nonfusible switches.
3. Molded-case circuit breakers (MCCBs).
4. Molded-case switches.
5. Enclosures.

#### **DEFINITIONS**

- C.** NC: Normally closed.

- D.** NO: Normally open.

- E.** SPDT: Single pole, double throw.

#### **PERFORMANCE REQUIREMENTS**

- F.** Seismic Performance: Enclosed switches and circuit breakers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

#### **SUBMITTALS**

- G.** 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 device
  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.
- H. 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.

## **INFORMATIONAL SUBMITTALS**

- I. Qualification Data:** For qualified testing agency.
- J. 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.
- K. 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.

## CLOSEOUT SUBMITTALS

**L.** Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to the requirements for 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.

## MAINTENANCE MATERIAL SUBMITTALS

**M.** 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.

## QUALITY ASSURANCE

**N.** 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.

**O.** Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.

**P.** 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.

**Q.** 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.

**R.** Comply with NFPA 70.

## PROJECT CONDITIONS

**S.** Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:

1. Ambient Temperature: Not less than minus 22-degree F (minus 30-degree C) and not exceeding 104-degree F (40-degree C).
2. Altitude: Not exceeding 6600 feet (2010 m).

## COORDINATION

T. 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 FUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.

B. Type HD, Heavy Duty, Single Throw, 600Vac, 1200A and Smaller, Type GD for 250Vac 600A or less: UL 98 and NEMA KS1, horsepower rated, with clips or bolt pads to accommodate specified or indicated fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Type HD, Heavy Duty, Double Throw, 600Vac, 1200 A and Smaller, Type GD for 250Vac 600A or less: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified or indicated fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

D. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit (as indicated on contract drawings): 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. Auxiliary Contact Kit: Two NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
5. Hookstick Handle: Allows use of a hookstick to operate the handle.
6. Lugs: Mechanical type, suitable for number, size, and conductor material.
7. Service-Rated Switches: Labeled for use as service equipment.

## 2.2 NONFUSIBLE SWITCHES

**A. Manufacturers:** Subject to compliance with requirements, provide products by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.

**B. Type HD, Heavy Duty, Single Throw, 600Vac, 1200A and Smaller, Type GD for 250Vac, 600A or less:** UL98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

**C. Type HD, Heavy Duty, Double Throw, 600Vac, 1200A and Smaller, Type GD for 250Vac, 600A or less:** UL98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

**D. Accessories:**

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit (as indicated on contract drawings): Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Auxiliary Contact Kit: Two NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
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 CIRCUIT BREAKERS

**A.** Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.

**B.** Disconnecting and over current protection devices must be coordinated with the contract drawings, electrical power monitoring requirements, sequence of operation pertaining to a specific panelboard, and all code requirements.

**C.** Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with series-connected rating or interrupting capacity to meet available fault currents. See other Contract documents for

1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 801A or larger. Note that if branch circuit monitoring is required, then electronic trip circuit breakers will be required in lieu of thermal magnetic circuit breakers. The following Molded-Case Circuit-Breaker (MCCB) Features and Accessories shall be provided:

- a. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
- b. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator. Provide as indicated on the contract drawings or as required by NFPA 70.
- c. Standard frame sizes, trip ratings, and number of poles.
- d. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials. See contract drawings for feeder sizes
- e. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits. HVAC for mechanical equipment, etc...
- f. Communication Capability: Circuit-breaker-mounted communication module with functions and features compatible with power monitoring and control system requirements for the Electrical Power Monitoring and Control for this project. Provide the electrical power monitoring requirements of this project.

- g. Shunt Trip: 120V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage. Provide as required per the contract drawings and related sequence of operation.
  - h. 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. Provided as required by the electrical power monitoring requirements for this project.
  - i. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position. Provide as required per the contract drawings and related sequence of operation.
  - j. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or off position.
  - k. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.
- D. Current-Limiting Circuit Breakers:** Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
- E. GFCI Circuit Breakers:** Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
- F. Ground-Fault Equipment Protection (GFEP) Circuit Breakers:** Class B ground-fault protection (30-mA trip).
- G. Arc-Fault Circuit Interrupter (AFCI) Circuit Breakers:** Comply with UL 1699; 120/240-V, single-pole configuration.

## 2.4 MOLDED-CASE SWITCHES

- A. Manufacturers:** Subject to compliance with requirements, provide products by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.

- B. General Requirements:** MCCB with fixed, high-set instantaneous trip only, and short-circuit withstand rating equal to equivalent breaker frame size interrupting rating.

- C. Features and Accessories:**

1. Standard frame sizes and number of poles.
2. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials. See contract drawings for feeder sizes.
3. 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. Provided as required by the electrical power monitoring requirements for this project.
4. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position. Provide as required per the contract drawings and related sequence of operation.

## 2.5 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.
  3. Kitchen or Wash-Down Areas: NEMA 250, Type 4X, stainless steel.
  4. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.
  5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.
  6. Hazardous Areas Indicated on Drawings: NEMA 250, Type 9.

## 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 for the seismic zone the equipment is being installed and the Seismic Controls for Electrical Systems requirements of this project.

**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 complying with the contract document of Identification for Electrical Systems.
- 2.** Label each enclosure with a nameplate complying with requirements for identification in the contract documents and in the Identification for Electrical Systems project requirements.

### **3.4 FIELD QUALITY CONTROL**

**A.** Testing Agency: Testing will be performed by the electrical subcontractor

**B.** Acceptance Testing Preparation:

- 1.** Test insulation resistance for each enclosed switch and circuit breaker, component, connecting supply, feeder, and control circuit.
- 2.** Test continuity of each circuit.

**C.** Tests and Inspections:

- 1.** Perform each visual and mechanical inspection 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 required per the contract documents and the Overcurrent Protective Device Coordination Study.



## SECTION 263213 - ENGINE GENERATORS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes packaged engine-generator sets for emergency power supply with the following features:
  1. Natural Gas engine.
  2. Unit-mounted cooling system.
  3. Unit-mounted control and monitoring.
- B. Related Sections include the following:
  1. Section 263600 "Transfer Switches" for transfer switches including sensors and relays to initiate automatic-starting and -stopping signals for engine-generator sets.

#### 1.2 DEFINITIONS

- A. Operational Bandwidth: The total variation from the lowest to highest value of a parameter over the range of conditions indicated, expressed as a percentage of the nominal value of the parameter.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of packaged engine generator indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. In addition, include the following:
  1. Thermal damage curve for generator.
  2. Time-current characteristic curves for generator protective device.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  1. Dimensioned outline plan and elevation drawings of engine-generator set and other components specified.
  2. Design Calculations: Signed and sealed by a qualified Architect. Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
  3. Vibration Isolation Base Details: Signed and sealed by a qualified Architect. Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include base weights.

4. Wiring Diagrams: Power, signal, and control wiring.

#### **1.4 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For installer and testing agency.
- B. Source quality-control test reports.
  - 1. Certified summary of prototype-unit test report.
  - 2. Report of sound generation.
  - 3. Certified Torsional Vibration Compatibility: Comply with NFPA 110.
- C. Field quality-control test reports.
- D. Warranty: Special warranty specified in this Section.

#### **1.5 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For packaged engine generators to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017800 "Closeout Submittals," include the following:
  - 1. List of tools and replacement items recommended to be stored at Project for ready access. Include part and drawing numbers, current unit prices, and source of supply.

#### **1.6 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. Fuses: One for every 10 of each type and rating, but no fewer than one of each.
  - 2. Indicator Lamps: Two for every six of each type used, but no fewer than two of each.
  - 3. Filters: One set each of lubricating oil, fuel, and combustion-air filters.

#### **1.7 QUALITY ASSURANCE**

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
  - 1. Maintenance Proximity: Not more than four hours' normal travel time from Installer's place of business to Project site.
- B. Manufacturer Qualifications: A qualified manufacturer. Maintain, within 200 miles of Project site, a service center capable of providing training, parts, and emergency maintenance repairs.
- C. Testing Agency Qualifications: Testing will be performed by the manufacturer's representative.

1. Testing Agency's Field Supervisor: Testing will be performed by the manufacturers representative.
- D. Source Limitations: Obtain packaged generator sets and auxiliary components through one source from a single manufacturer.
- E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- F. Comply with ASME B15.1.
- G. Comply with NFPA 37.
- H. Comply with NFPA 70.
- I. Comply with NFPA 99.
- J. Comply with NFPA 110 requirements for Level 1 emergency power supply system.
- K. Comply with UL 2200.
- L. Engine Exhaust Emissions: Comply with applicable state and local government requirements.
- M. Noise Emission: Comply with applicable state and local government requirements for maximum noise level at adjacent property boundaries due to sound emitted by generator set including engine, engine exhaust, engine cooling-air intake and discharge, and other components of installation.

## 1.8 PROJECT CONDITIONS

- A. Environmental Conditions: Engine-generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:
  1. Ambient Temperature: Minus 5 to plus 104 deg F.
  2. Relative Humidity: 0 to 95 percent.
  3. Altitude: Sea level to 1000 feet.

## 1.9 COORDINATION

- A. Coordinate size and location of concrete bases for package engine generators. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

## 1.10 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of packaged engine generators and associated auxiliary components that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 3 years from date of Substantial Completion.

## 1.11 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Beginning at Substantial Completion, provide 12 months' full maintenance by skilled employees of manufacturer's designated service organization. Include quarterly exercising to check for proper starting, load transfer, and running under load. Include routine preventive maintenance as recommended by manufacturer and adjusting as required for proper operation. Provide parts and supplies same as those used in the manufacture and installation of original equipment.

# PART 2 - PRODUCTS

## 2.1 MANUFACTURERS

- 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. Caterpillar; Engine Div.
  2. Onan/Cummins Power Generation; Industrial Business Group.
  3. Spectrum Detroit Natural Gas.

## 2.2 ENGINE-GENERATOR SET

- A. Factory-assembled and -tested, engine-generator set.
- B. Mounting Frame: Maintain alignment of mounted components without depending on concrete foundation; and have lifting attachments.
1. Rigging Diagram: Inscribed on metal plate permanently attached to mounting frame to indicate location and lifting capacity of each lifting attachment and generator-set center of gravity.
- C. Capacities and Characteristics:
1. Power Output Ratings: Nominal ratings as indicated.
  2. Output Connections: Three-phase, four wire.
  3. Nameplates: For each major system component to identify manufacturer's name and address, and model and serial number of component.

**D. Generator-Set Performance:**

1. Steady-State Voltage Operational Bandwidth: 3 percent of rated output voltage from no load to full load.
2. Transient Voltage Performance: Not more than 20 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within three seconds.
3. Steady-State Frequency Operational Bandwidth: 0.5 percent of rated frequency from no load to full load.
4. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.
5. Transient Frequency Performance: Less than 5 percent variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within five seconds.
6. Output Waveform: At no load, harmonic content measured line to line or line to neutral shall not exceed 5 percent total and 3 percent for single harmonics. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50 percent.
7. Sustained Short-Circuit Current: For a 3-phase, bolted short circuit at system output terminals, system shall supply a minimum of 250 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to generator system components.
8. Start Time: Comply with NFPA 110, Type 10, system requirements.

**2.3 ENGINE**

**A. Fuel:** Natural Gas.

**B. Rated Engine Speed:** 1800 rpm.

**C. Maximum Piston Speed for Four-Cycle Engines:** 2250 fpm.

**D. Lubrication System:** The following items are mounted on engine or skid:

1. Filter and Strainer: Rated to remove 90 percent of particles 5 micrometers and smaller while passing full flow.
2. Thermostatic Control Valve: Control flow in system to maintain optimum oil temperature. Unit shall be capable of full flow and is designed to be fail-safe.
3. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps, siphons, special tools, or appliances.

- E. Coolant Jacket Heater: Electric-immersion type, factory installed in coolant jacket system. Comply with NFPA 110 requirements for Level 1 equipment for heater capacity.
- F. Governor: Mechanical.
- G. Cooling System: Closed loop, liquid cooled, with radiator factory mounted on engine-generator-set mounting frame and integral engine-driven coolant pump.
  - 1. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.
  - 2. Size of Radiator: Adequate to contain expansion of total system coolant from cold start to 110 percent load condition.
  - 3. Expansion Tank: Constructed of welded steel plate and rated to withstand maximum closed-loop coolant system pressure for engine used. Equip with gage glass and petcock.
  - 4. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.
  - 5. Coolant Hose: Flexible assembly with inside surface of nonporous rubber and outer covering of aging-, ultraviolet-, and abrasion-resistant fabric.
    - a. Rating: 50-psig maximum working pressure with coolant at 180 deg F, and noncollapsible under vacuum.
    - b. End Fittings: Flanges or steel pipe nipples with clamps to suit piping and equipment connections.
- H. Muffler/Silencer: Critical type, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer's engine backpressure requirements.
  - 1. Minimum sound attenuation of 25 dB at 500 Hz.
  - 2. Sound level measured at a distance of 10 feet from exhaust discharge after installation is complete shall be 85 dBA or less.
- I. Air-Intake Filter: Heavy-duty, engine-mounted air cleaner with replaceable dry-filter element and "blocked filter" indicator.
- J. Starting System: 12-V electric, with negative ground.
  - 1. Components: Sized so they will not be damaged during a full engine-cranking cycle with ambient temperature at maximum specified in Part 1 "Project Conditions" Article.
  - 2. Cranking Motor: Heavy-duty unit that automatically engages and releases from engine flywheel without binding.

3. Cranking Cycle: As required by NFPA 110 for system level specified.
4. Battery: Adequate capacity within ambient temperature range specified in Part 1 "Project Conditions" Article to provide specified cranking cycle at least twice without recharging.
5. Battery Cable: Size as recommended by engine manufacturer for cable length indicated. Include required interconnecting conductors and connection accessories.
6. Battery Compartment: Factory fabricated of metal with acid-resistant finish and thermal insulation. Thermostatically controlled heater shall be arranged to maintain battery above 50 deg F regardless of external ambient temperature within range specified in Part 1 "Project Conditions" Article. Include accessories required to support and fasten batteries in place.
7. Battery-Charging Alternator: Factory mounted on engine with solid-state voltage regulation and 35-A minimum continuous rating.
8. Battery Charger: Current-limiting, automatic-equalizing and float-charging type. Unit shall comply with UL 1236 and include the following features:
  - a. Operation: Equalizing-charging rate of 10 A shall be initiated automatically after battery has lost charge until an adjustable equalizing voltage is achieved at battery terminals. Unit shall then be automatically switched to a lower float-charging mode and shall continue to operate in that mode until battery is discharged again.
  - b. Automatic Temperature Compensation: Adjust float and equalize voltages for variations in ambient temperature from minus 40 deg F to plus 140 deg F to prevent overcharging at high temperatures and undercharging at low temperatures.
  - c. Automatic Voltage Regulation: Maintain constant output voltage regardless of input voltage variations up to plus or minus 10 percent.
  - d. Ammeter and Voltmeter: Flush mounted in door. Meters shall indicate charging rates.
  - e. Safety Functions: Sense abnormally low battery voltage and close contacts providing low battery voltage indication on control and monitoring panel. Sense high battery voltage and loss of ac input or dc output of battery charger. Either condition shall close contacts that provide a battery-charger malfunction indication at system control and monitoring panel.
  - f. Enclosure and Mounting: NEMA 250, Type 1, wall-mounted cabinet.

## 2.4 CONTROL AND MONITORING

- A. Automatic Starting System Sequence of Operation: When mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in one or more separate automatic transfer switches initiate starting and stopping of generator set. When mode-selector switch is switched to the on position, generator set starts. The off

position of same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms. Operation of a remote emergency-stop switch also shuts down generator set.

- B. Manual Starting System Sequence of Operation:** Switching on-off switch on the generator control panel to the on position starts generator set. The off position of same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms. Operation of a remote emergency-stop switch also shuts down generator set.
- C. Configuration:** Operating and safety indications, protective devices, basic system controls, and engine gages shall be grouped in a common control and monitoring panel mounted on the generator set. Mounting method shall isolate the control panel from generator-set vibration.
- D. Indicating and Protective Devices and Controls:** As required by NFPA 110 for Level 1 system, and the following:
  - 1.** AC voltmeter.
  - 2.** AC ammeter.
  - 3.** AC frequency meter.
  - 4.** DC voltmeter (alternator battery charging).
  - 5.** Engine-coolant temperature gage.
  - 6.** Engine lubricating-oil pressure gage.
  - 7.** Running-time meter.
  - 8.** Ammeter-voltmeter, phase-selector switch (es).
  - 9.** Generator-voltage adjusting rheostat.
  - 10.** Generator overload.
- E. Supporting Items:** Include sensors, transducers, terminals, relays, and other devices and include wiring required to support specified items. Locate sensors and other supporting items on engine or generator, unless otherwise indicated.
- F. Common Remote Audible Alarm:** Comply with NFPA 110 requirements for Level 1 systems. Include necessary contacts and terminals in control and monitoring panel.
  - 1.** Overcrank shutdown.
  - 2.** Coolant low-temperature alarm.
  - 3.** Control switch not in auto position.

4. Battery-charger malfunction alarm.
  5. Battery low-voltage alarm.
- G. Remote Alarm Annunciator: Comply with NFPA 99. An LED labeled with proper alarm conditions shall identify each alarm event and a common audible signal shall sound for each alarm condition. Silencing switch in face of panel shall silence signal without altering visual indication. Connect so that after an alarm is silenced, clearing of initiating condition will reactivate alarm until silencing switch is reset. Cabinet and faceplate are surface- or flush-mounting type to suit mounting conditions indicated.
- H. Remote Emergency-Stop Switch: Flush; wall mounted, unless otherwise indicated; and labeled. Push button shall be protected from accidental operation.

## 2.5 GENERATOR OVERCURRENT AND FAULT PROTECTION

- A. Generator Circuit Breaker: Molded-case, thermal-magnetic type; 100 percent rated; complying with NEMA AB 1 and UL 489.
1. Tripping Characteristic: Designed specifically for generator protection.
  2. Trip Rating: Matched to generator rating.
3. Shunt Trip: Connected to trip breaker when generator set is shut down by other protective devices.
4. Mounting: Adjacent to or integrated with control and monitoring panel.
- B. Emergency System" signals for ground-fault. Integrate ground-fault alarm indication with other generator-set alarm indications.

## 2.6 GENERATOR, EXCITER, AND VOLTAGE REGULATOR

- A. Comply with NEMA MG 1.
- B. Drive: Generator shaft shall be directly connected to engine shaft. Exciter shall be rotated integrally with generator rotor.
- C. Electrical Insulation: Class H or Class F.
- D. Stator-Winding Leads: Brought out to terminal box to permit future reconnection for other voltages if required.
- E. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, overspeed up to 125 percent of rating, and heat during operation at 110 percent of rated capacity.
- F. Enclosure: Driproof.

- G. Instrument Transformers: Mounted within generator enclosure.
- H. Voltage Regulator: Solid-state type, separate from exciter, providing performance as specified.
  - 1. Adjusting rheostat on control and monitoring panel shall provide plus or minus 5 percent adjustment of output-voltage operating band.
- I. Strip Heater: Thermostatically controlled unit arranged to maintain stator windings above dew point.
- J. Windings: Two-thirds pitch stator winding and fully linked amortisseur winding.
- K. Subtransient Reactance: 12 percent, maximum.

## 2.7 OUTDOOR ENGINE GENERATOR ENCLOSURE

- A. Description: Vandal-resistant, sound-attenuating, weatherproof steel housing, wind resistant up to 100 mph. Multiple panels shall be lockable and provide adequate access to components requiring maintenance. Panels shall be removable by one person without tools. Instruments and control shall be mounted within enclosure.
  - 1. Sound Attenuation Level: Level two.

## 2.8 VIBRATION ISOLATION DEVICES

- A. Restrained Spring Isolators: Freestanding, Steel, Open-Spring Isolators with Vertical-Limit Stop Restraint in Two-Part Telescoping Housing:
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Ace Mountings Co., Inc.
    - b. California Dynamics Corporation.
    - c. Isolation Technology, Inc.
    - d. Kinetics Noise Control, Inc.
    - e. Mason Industries, Inc.
    - f. Vibration Eliminator Co., Inc.
    - g. Vibration Isolation.
    - h. Vibration Mountings & Controls, Inc.

2. Two-Part Telescoping Housing: A steel top and bottom frame separated by an elastomeric material and enclosing the spring isolators. Housings are equipped with adjustable snubbers to limit vertical movement.
  - 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. Threaded top housing with adjustment bolt and cap screw to fasten and level equipment.
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.

## 2.9 FINISHES

- A. Manufacturer's standard finish over corrosion-resistant pretreatment and compatible primer.

## 2.10 SOURCE QUALITY CONTROL

- A. Prototype Testing: Factory test engine-generator set using same engine model, constructed of identical or equivalent components and equipped with identical or equivalent accessories.
  1. Tests: Comply with NFPA 110, Level 1 Energy Converters and with IEEE 115.
- B. Project-Specific Equipment Tests: Before shipment, factory test engine-generator set and other system components and accessories manufactured specifically for this Project. Perform tests at rated load and power factor. Include the following tests:
  1. Test components and accessories furnished with installed unit that are not identical to those on tested prototype to demonstrate compatibility and reliability.
  2. Full load run.
  3. Maximum power.
  4. Voltage regulation.
  5. Transient and steady-state governing.
  6. Single-step load pickup.
  7. Safety shutdown.

8. Provide 14 days' advance notice of tests and opportunity for observation of tests by Owner's representative.
9. Report factory test results within 10 days of completion of test.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas, equipment bases, and conditions, with Installer present, for compliance with requirements for installation and other conditions affecting packaged engine-generator performance.
- B. Examine roughing-in of piping systems and electrical connections. Verify actual locations of connections before packaged engine-generator installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Comply with packaged engine-generator manufacturers' written installation and alignment instructions and with NFPA 110.
- B. Install packaged engine generator to provide access, without removing connections or accessories, for periodic maintenance.
- C. Install packaged engine generator on cast-in-place concrete equipment bases.
  1. Comply with requirements for vibration isolation devices specified in this section.
- D. Install Schedule 40, black steel piping with welded joints and connect to engine muffler. Install thimble at wall. Piping shall be same diameter as muffler outlet. Flexible connectors and steel piping materials and installation requirements are specified in Section 232116 Hydronic Piping Specialties."
  1. Install condensate drain piping to muffler drain outlet full size of drain connection with a shutoff valve, stainless-steel flexible connector, and Schedule 40, black steel pipe with welded joints. Flexible connectors and piping materials and installation requirements are specified in Section 232116 Hydronic Piping Specialties."
- E. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted.

### 3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping and specialties.
- B. Connect fuel, cooling-system, and exhaust-system piping adjacent to packaged engine generator to allow service and maintenance.

- C. Connect engine exhaust pipe to engine with flexible connector.
- 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."

### **3.4 IDENTIFICATION**

- A. Identify system components according to Section 230553 "Identification for HVAC Piping and Equipment" and Section 260553 "Identification for Electrical Systems."

### **3.5 FIELD QUALITY CONTROL**

- A. Testing Agency: Testing will be performed by the manufacturer's representative
- 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. Perform tests and inspections and prepare test reports.
  - 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.
- D. Tests and Inspections:
  - 1. Perform tests recommended by manufacturer and each electrical test and visual and mechanical inspection for "AC Generators and for Emergency Systems" specified in NETA Acceptance Testing Specification. Certify compliance with test parameters.
  - 2. NFPA 110 Acceptance Tests: Perform tests required by NFPA 110 that are additional to those specified here including, but not limited to, single-step full-load pickup test.
  - 3. Battery Tests: Equalize charging of battery cells according to manufacturer's written instructions. Record individual cell voltages.
    - a. Measure charging voltage and voltages between available battery terminals for full-charging and float-charging conditions. Check electrolyte level and specific gravity under both conditions.
    - b. Test for contact integrity of all connectors. Perform an integrity load test and a capacity load test for the battery.
    - c. Verify acceptance of charge for each element of the battery after discharge.
    - d. Verify that measurements are within manufacturer's specifications.

4. Battery-Charger Tests: Verify specified rates of charge for both equalizing and float-charging conditions.
  5. System Integrity Tests: Methodically verify proper installation, connection, and integrity of each element of engine-generator system before and during system operation. Check for air, exhaust, and fluid leaks.
  6. Exhaust-System Back-Pressure Test: Use a manometer with a scale exceeding 40-inch wg. Connect to exhaust line close to engine exhaust manifold. Verify that back pressure at full-rated load is within manufacturer's written allowable limits for the engine.
  7. Exhaust Emissions Test: Comply with applicable government test criteria.
- E. Coordinate tests with tests for transfer switches and run them concurrently.
- F. Test instruments shall have been calibrated within the last 12 months, traceable to standards of NIST, and adequate for making positive observation of test results. Make calibration records available for examination on request.
- G. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
- H. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
- I. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- J. Remove and replace malfunctioning units and retest as specified above.
- K. Retest: Correct deficiencies identified by tests and observations and retest until specified requirements are met.
- L. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation resistances, time delays, and other values and observations. Attach a label or tag to each tested component indicating satisfactory completion of tests.
- M. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each power wiring termination and each bus connection. Remove all access panels so terminations and connections are accessible to portable scanner.
  1. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan 11 months after date of Substantial Completion.
  2. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

3. Record of Infrared Scanning: Prepare a certified report that identifies terminations and connections checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

### **3.6 DEMONSTRATION**

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain packaged engine generators. Refer to Section 017900 "Demonstration and Training."

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## SECTION 263600 - TRANSFER SWITCHES

### PART 1 - GENERAL

#### 1.1 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 automatic transfer switches rated 600 V and less,

#### 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 transfer switches.
2. Include rated capacities, operating characteristics, electrical characteristics, and accessories.

- B. Shop Drawings:

1. Include plans, elevations, sections, details showing minimum clearances, conductor entry provisions, gutter space, and installed features and devices.
2. Include material lists for each switch specified.
3. Single-Line Diagram: Show connections between transfer switch, power sources, and load; and show interlocking provisions for each combined transfer switch and bypass/isolation switch.
4. Riser Diagram: Show interconnection wiring between transfer switches, bypass/isolation switches, annunciators, and control panels.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.

- B. Seismic Qualification Certificates: For transfer switches, 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.

## **1.5 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For each type of product 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. Features and operating sequences, both automatic and manual.
    - b. List of all factory settings of relays; provide relay-setting and calibration instructions, including software, where applicable.

## **1.6 QUALITY ASSURANCE**

- A. Testing Agency Qualifications:
  1. Testing will be performed by the electrical subcontractor

## **1.7 WARRANTY**

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of transfer switch or transfer switch components that fail in materials or workmanship within specified warranty period.
  1. Warranty Period: 12 months from date of Substantial Completion.

## **PART 2 - PRODUCTS**

### **2.1 PERFORMANCE REQUIREMENTS**

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NEMA ICS 1.
- C. Comply with NFPA 99.
- D. Comply with NFPA 110.
- E. Comply with UL 1008 unless requirements of these Specifications are stricter.
- F. Indicated Current Ratings: Apply as defined in UL 1008 for continuous loading and total system transfer, including tungsten filament lamp loads not exceeding 30 percent of switch ampere rating, unless otherwise indicated.

- G. Tested Fault-Current Closing and Short-Circuit Ratings: Adequate for duty imposed by protective devices at installation locations in Project under the fault conditions indicated, based on testing according to UL 1008.
  - 1. Where transfer switch includes internal fault-current protection, rating of switch and trip unit combination shall exceed indicated fault-current value at installation location.
  - 2. Short-time withstand capability for three cycles.
- H. Repetitive Accuracy of Solid-State Controls: All settings shall be plus or minus 2 percent or better over an operating temperature range of minus 20 to plus 70-degree C.
- I. Resistance to Damage by Voltage Transients: Components shall meet or exceed voltage-surge withstand capability requirements when tested according to IEEE C62.62. Components shall meet or exceed voltage-impulse withstand test of NEMA ICS 1.
- J. Electrical Operation: Accomplish by a nonfused, momentarily energized solenoid or electric-motor-operated mechanism. Switches for emergency or standby purposes shall be mechanically and electrically interlocked in both directions to prevent simultaneous connection to both power sources unless closed transition.
- K. Neutral Switching: Where four-pole switches are indicated, provide neutral pole switched simultaneously with phase poles.
- L. Neutral Terminal: Solid and fully rated unless otherwise indicated.
- M. Battery Charger: For generator starting batteries.
  - 1. Float type, rated 2 A.
  - 2. Ammeter to display charging current.
  - 3. Fused ac inputs and dc outputs.
- N. Annunciation, Control, and Programming Interface Components: Devices at transfer switches for communicating with remote programming devices, annunciators, or annunciator and control panels shall have communication capability matched with remote device.
- O. Factory Wiring: Train and bundle factory wiring and label, consistent with Shop Drawings, by color-code or by numbered or lettered wire and cable with printed markers at terminations. Color-coding and wire and cable markers are specified in Section 260553 "Identification for Electrical Systems."
  - 1. Designated Terminals: Pressure type, suitable for types and sizes of field wiring indicated.
  - 2. Power-Terminal Arrangement and Field-Wiring Space: Suitable for top, side, or bottom entrance of feeder conductors as indicated.

3. Control Wiring: Equipped with lugs suitable for connection to terminal strips.
  - P. Enclosures: General-purpose NEMA 250, Type 1, complying with NEMA ICS 6 and UL 508, unless otherwise indicated.
- ## 2.2 CONTACTOR-TYPE AUTOMATIC TRANSFER SWITCHES
- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    1. Emerson.
    2. GE Zenith Controls.
    3. Russelectric, Inc.
  - B. Comply with Level 1 equipment according to NFPA 110.
  - C. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.
    1. Limitation: Switches using molded-case switches or circuit breakers or insulated-case circuit-breaker components are unacceptable.
    2. Switch Action: Double throw; mechanically held in both directions.
    3. Contacts: Silver composition or silver alloy for load-current switching. Contactor-style automatic transfer-switch units, rated 600 A and higher, shall have separate arcing contacts.
    4. Conductor Connectors: Suitable for use with conductor material and sizes.
    5. Material: Aluminum.
    6. Main and Neutral Lugs: Mechanical type.
    7. Ground Lugs and Bus-Configured Terminators: Mechanical type.
    8. Ground bar.
    9. Connectors shall be marked for conductor size and type according to UL 1008.
  - D. Automatic Open-Transition Transfer Switches: Interlocked to prevent the load from being closed on both sources at the same time.
    1. Sources shall be mechanically and electrically interlocked to prevent closing both sources on the load at the same time.

- E. Manual Switch Operation: Under load, with door closed and with either or both sources energized. Transfer time is same as for electrical operation. Control circuit automatically disconnects from electrical operator during manual operation.
- F. Signal-Before-Transfer Contacts: A set of normally open/normally closed dry contacts operates in advance of retransfer to normal source. Interval shall be adjustable from 1 to 30 seconds.
- G. Automatic Transfer-Switch Controller Features:
  - 1. Controller operates through a period of loss of control power.
  - 2. Undervoltage Sensing for Each Phase of Normal and Alternate Source: Sense low phase-to-ground voltage on each phase. Pickup voltage shall be adjustable from 85 to 100 percent of nominal, and dropout voltage shall be adjustable from 75 to 98 percent of pickup value. Factory set for pickup at 90 percent and dropout at 85 percent.
  - 3. Voltage/Frequency Lockout Relay: Prevent premature transfer to generator. Pickup voltage shall be adjustable from 85 to 100 percent of nominal. Factory set for pickup at 90 percent. Pickup frequency shall be adjustable from 90 to 100 percent of nominal. Factory set for pickup at 95 percent.
  - 4. Time Delay for Retransfer to Normal Source: Adjustable from zero to 30 minutes, and factory set for 10 minutes. Override shall automatically defeat delay on loss of voltage or sustained undervoltage of emergency source, provided normal supply has been restored.
  - 5. Test Switch: Simulate normal-source failure.
  - 6. Switch-Position Pilot Lights: Indicate source to which load is connected.
  - 7. Source-Available Indicating Lights: Supervise sources via transfer-switch normal- and emergency-source sensing circuits.
    - a. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."
    - b. Emergency Power Supervision: Red light with nameplate engraved "Emergency Source Available."
  - 8. Unassigned Auxiliary Contacts: Two normally open, single-pole, double-throw contacts for each switch position, rated 10 A at 240-V ac.
  - 9. Transfer Override Switch: Overrides automatic retransfer control so transfer switch will remain connected to emergency power source regardless of condition of normal source. Pilot light indicates override status.
  - 10. Engine Starting Contacts: One isolated and normally closed, and one isolated and normally open; rated 10 A at 32-V dc minimum.

11. Engine Shutdown Contacts: Instantaneous; shall initiate shutdown sequence at remote engine-generator controls after retransfer of load to normal source.
12. Engine-Generator Exerciser: Solid-state, programmable-time switch starts engine generator and transfers load to it from normal source for a preset time, then retransfers and shuts down engine after a preset cool-down period. Initiates exercise cycle at preset intervals adjustable from 7 to 30 days. Running periods shall be adjustable from 10 to 30 minutes. Factory settings shall be for 7-day exercise cycle, 20-minute running period, and 5-minute cool-down period. Exerciser features include the following:
  - a. Exerciser Transfer Selector Switch: Permits selection of exercise with and without load transfer.
  - b. Push-button programming control with digital display of settings.
  - c. Integral battery operation of time switch when normal control power is unavailable.

### 2.3 SOURCE QUALITY CONTROL

- A. Factory Tests: Test and inspect components, assembled switches, and associated equipment according to UL 1008. Ensure proper operation. Check transfer time and voltage, frequency, and time-delay settings for compliance with specified requirements. Perform dielectric strength test complying with NEMA ICS 1.
- B. Prepare test and inspection reports.
  1. For each of the tests required by UL 1008, performed on representative devices, for emergency systems. Include results of test for the following conditions:
    - a. Overvoltage.
    - b. Undervoltage.
    - c. Loss of supply voltage.
    - d. Reduction of supply voltage.
    - e. Alternative supply voltage or frequency is at minimum acceptable values.
    - f. Temperature rise.
    - g. Dielectric voltage-withstand; before and after short-circuit test.
    - h. Overload.
    - i. Contact opening.
    - j. Endurance.

- k. Short circuit.
- l. Short-time current capability.
- m. Receptacles withstand capability.
- n. Insulating base and supports damage.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Floor-Mounting Switch: Anchor to floor by bolting.
  - 1. Install transfer switches on cast-in-place concrete equipment base(s).
  - 2. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases.
  - 3. Provide workspace and clearances required by NFPA 70.
- B. Identify components according to Section 260553 "Identification for Electrical Systems."
- C. Set field-adjustable intervals and delays, relays, and engine exerciser clock.
- D. Comply with NECA 1.

### 3.2 CONNECTIONS

- A. Wiring to Remote Components: Match type and number of cables and conductors to generator sets, control, and communication requirements of transfer switches as recommended by manufacturer. Increase raceway sizes at no additional cost to Owner if necessary to accommodate required wiring.
- B. Wiring Method: Install cables in raceways and cable trays except within electrical enclosures. Conceal raceway and cables except in unfinished spaces.
  - 1. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."
- C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.
- 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."
- F. Route and brace conductors according to manufacturer's written instructions. Do not obscure manufacturer's markings and labels.

- G. Brace and support equipment according to Section 260548.16 "Seismic Controls for Electrical Systems."
- H. Final connections to equipment shall be made with liquid tight, flexible metallic conduit no more than 18 inches (457 mm) in length.

### 3.3 FIELD QUALITY CONTROL

- A. Testing Agency:
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
  1. After installing equipment, test for compliance with requirements according to NETA ATS.
  2. Visual and Mechanical Inspection:
    - a. Compare equipment nameplate data with Drawings and Specifications.
    - b. Inspect physical and mechanical condition.
    - c. Inspect anchorage, alignment, grounding, and required clearances.
    - d. Verify that the unit is clean.
    - e. Verify appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.
    - f. Verify that manual transfer warnings are attached and visible.
    - g. Verify tightness of all control connections.
    - h. Inspect bolted electrical connections for high resistance using one of the following methods, or both:
      - 1) Use of low-resistance ohmmeter.
      - 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method according to manufacturer's published data.
    - i. Perform manual transfer operation.
    - j. Verify positive mechanical interlocking between normal and alternate sources.
    - k. Perform visual and mechanical inspection of surge arresters.

- I. Inspect control power transformers.
  - 1) Inspect for physical damage, cracked insulation, broken leads, tightness of connections, defective wiring, and overall general condition.
  - 2) Verify that primary and secondary fuse or circuit-breaker ratings match Drawings.
  - 3) Verify correct functioning of draw out disconnecting contacts, grounding contacts, and interlocks.
3. Electrical Tests:
  - a. Perform insulation-resistance tests on all control wiring with respect to ground.
  - b. Perform a contact/pole-resistance test. Compare measured values with manufacturer's acceptable values.
  - c. Verify settings and operation of control devices.
  - d. Calibrate and set all relays and timers.
  - e. Verify phase rotation, phasing, and synchronized operation.
  - f. Perform automatic transfer tests.
  - g. Verify correct operation and timing of the following functions:
    - 1) Normal source voltage-sensing and frequency-sensing relays.
    - 2) Engine start sequence.
    - 3) Time delay on transfer.
    - 4) Alternative source voltage-sensing and frequency-sensing relays.
    - 5) Automatic transfer operation.
    - 6) Interlocks and limit switch function.
    - 7) Time delay and retransfer on normal power restoration.
    - 8) Engine cool-down and shutdown feature.
4. Measure insulation resistance phase-to-phase and phase-to-ground with insulation-resistance tester. Include external annunciation and control circuits. Use test voltages and procedure recommended by manufacturer. Comply with manufacturer's specified minimum resistance.
  - a. Check for electrical continuity of circuits and for short circuits.

- b. Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.
  - c. Verify that manual transfer warnings are properly placed.
  - d. Perform manual transfer operation.
- 5. After energizing circuits, perform each electrical test for transfer switches stated in NETA ATS and demonstrate interlocking sequence and operational function for each switch at least three times.
  - a. Simulate power failures of normal source to automatic transfer switches and retransfer from emergency source with normal source available.
  - b. Simulate loss of phase-to-ground voltage for each phase of normal source.
  - c. Verify time-delay settings.
  - d. Verify pickup and dropout voltages by data readout or inspection of control settings.
  - e. Test bypass/isolation unit functional modes and related automatic transfer-switch operations.
  - f. Perform contact-resistance test across main contacts and correct values exceeding 500 microhms and values for one pole deviating by more than 50 percent from other poles.
  - g. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.
- 6. Ground-Fault Tests: Coordinate with testing of ground-fault protective devices for power delivery from both sources.
  - a. Verify grounding connections and locations and ratings of sensors.
- D. Coordinate tests with tests of generator and run them concurrently.
- E. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation and contact resistances and time delays. Attach a label or tag to each tested component indicating satisfactory completion of tests.
- F. Transfer switches will be considered defective if they do not pass tests and inspections.
- G. Remove and replace malfunctioning units and retest as specified above.
- H. Prepare test and inspection reports.

- I. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switch. Remove all access panels so joints and connections are accessible to portable scanner.
  - 1. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
  - 2. Record of Infrared Scanning: Prepare a certified report that identifies switches checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

### **3.4 DEMONSTRATION**

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain transfer switches and related equipment.
- B. Training shall include testing ground-fault protective devices and instructions to determine when the ground-fault system shall be retested. Include instructions on where ground-fault sensors are located and how to avoid negating the ground-fault protection scheme during testing and circuit modifications.
- C. Coordinate this training with that for generator equipment.



## **SECTION 264113 - LIGHTNING PROTECTION FOR STRUCTURES**

### **PART 1 - PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. Section includes lightning protection for all structures on the site.

#### **1.2 ACTION SUBMITTALS**

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For air terminals and mounting accessories.
  - 1. Layout of the lightning protection system, along with details of the components to be used in the installation.
  - 2. Include indications for use of raceway, data on how concealment requirements will be met, and calculations required by NFPA 780 for bonding of grounded and isolated metal bodies.

#### **1.3 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For qualified Installer and manufacturer. Include data on listing or certification by UL.
- B. Certification, signed by Contractor, that roof adhesive is approved by manufacturer of roofing material.
- C. Field quality-control reports.
- D. Comply with recommendations in NFPA 780, Annex D, "Inspection and Maintenance of Lightning Protection Systems," for maintenance of the lightning protection system.
- E. Other Informational Submittals: Plans showing dimensioned as-built locations of grounding features, including the following:
  - 1. Ground rods.
  - 2. Ground loop conductor.

#### **1.4 QUALITY ASSURANCE**

- A. Installer Qualifications: Certified by UL or LPI as a Master Installer/Designer, trained and approved for installation of units required for this Project.
- B. System Certificate:
  - 1. UL Master Label.

- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 780, "Definitions" Article.

## 1.5 COORDINATION

- A. Coordinate installation of lightning protection with installation of other building systems and components, including electrical wiring, supporting structures and building materials, metal bodies requiring bonding to lightning protection components, and building finishes.
- B. Coordinate installation of air terminals attached to roof systems with roofing manufacturer and Installer.
- C. Flashings of through-roof assemblies shall comply with roofing manufacturers' specifications.

## PART 2 - PRODUCTS

### 2.1 LIGHTNING PROTECTION SYSTEM COMPONENTS

- A. Comply with UL 96 and NFPA 780.
- B. Roof-Mounted Air Terminals: NFPA 780, Class I, copper unless otherwise indicated.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. East Coast Lightning Equipment Inc.
    - b. ERICO International Corporation.
    - c. Harger.
    - d. Heary Bros. Lightning Protection Co. Inc.
    - e. Independent Protection Co.
    - f. Preferred Lightning Protection.
    - g. Robbins Lightning, Inc.
    - h. Thompson Lightning Protection, Inc.
  - 2. Air Terminals More than 24 Inches Long: With brace attached to the terminal at not less than half the height of the terminal.
  - 3. Single-Membrane, Roof-Mounted Air Terminals: Designed specifically for single-membrane roof system materials. Comply with requirements in roofing Sections.
- C. Main and Bonding Conductors: Copper or aluminum.
- D. Ground Loop Conductor: The same size and type as the main conductor except tinned.

- E. Ground Rods: Copper-clad steel; 3/4 inch in diameter by 10 feet long.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Install lightning protection components and systems according to UL 96A and NFPA 780.
- B. Install conductors with direct paths from air terminals to ground connections. Avoid sharp bends.
- C. Conceal the following conductors:
  1. System conductors.
  2. Down conductors.
  3. Interior conductors.
  4. Conductors within normal view of exterior locations at grade within 200 feet of building.
- D. Cable Connections: Use crimped or bolted connections for all conductor splices and connections between conductors and other components. Use exothermic-welded connections in underground portions of the system.
- E. Cable Connections: Use exothermic-welded connections for all conductor splices and connections between conductors and other components.
  1. Exception: In single-ply membrane roofing, exothermic-welded connections may be used only below the roof level.
- F. Air Terminals on Single-Ply Membrane Roofing: Comply with roofing membrane and adhesive manufacturer's written instructions.
- G. Bond extremities of vertical metal bodies exceeding 60 feet in length to lightning protection components.
- H. Ground Loop: Install ground-level, potential equalization conductor and extend around the perimeter of structure.
  1. Bury ground ring not less than 24 inches from building foundation.
  2. Bond ground terminals to the ground loop.
  3. Bond grounded building systems to the ground loop conductor within 12 feet of grade level.
- I. Bond lightning protection components with intermediate-level interconnection loop conductors to grounded metal bodies of building at 60-foot intervals.

### **3.2 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."

### **3.3 CORROSION PROTECTION**

- A.** Do not combine materials that can form an electrolytic couple that will accelerate corrosion in the presence of moisture unless moisture is permanently excluded from junction of such materials.
- B.** Use conductors with protective coatings where conditions cause deterioration or corrosion of conductors.

### **3.4 FIELD QUALITY CONTROL**

- A.** Notify Architect at least 48 hours in advance of inspection before concealing lightning protection components.
- B.** UL Inspection: Meet requirements to obtain a UL Master Label for system.
- C.** LPI System Inspection: Meet requirements to obtain an LPI System Certificate.

**END OF SECTION 264113**

## SECTION 28 15 10 - MULTI-FAMILY DATA-ON-CREDENTIAL ACCESS CONTROL DEVICES

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. System operation and credential encoding system.
- B. Online door controller system.
- C. Mobile configuration application.
- D. Electromechanical resident room locks.
- E. Electromechanical common area locks.
- F. Credential enrollment station.
- G. Cloud based access control system application software.
- H. Access credentials.

#### 1.2 RELATED REQUIREMENTS:

- A. Section 01 78 00 - Closeout Submittals.
- B. Section 06 10 53 - Miscellaneous Rough Carpentry.
- C. Section 06 20 00 - Finish Carpentry.
- D. Section 08 06 71 - Door Hardware Schedule.
- E. Section 08 11 13 - Hollow Metal Doors and Frames.
- F. Section 08 14 16 - Flush Wood Doors.
- G. Section 08 43 16 - Storefronts.
- H. Section 08 71 00 - Door Hardware”
- I. Section 11 12 00 - Parking Control Equipment.
- J. Section 14 21 00 - Electric Traction Elevators.
- K. Division 26 Section “Electrical”.

#### 1.3 CODES AND REFERENCES:

- A. Comply with the version year adopted by the Authority Having Jurisdiction.
  - 1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.

2. ICC/IBC - International Building Code.
3. NFPA 80 - Fire Doors and Windows.
4. NFPA 101 - Life Safety Code.
5. NFPA 105 - Installation of Smoke Door Assemblies.
6. FCC Part 15 Subpart C.
7. State Building Codes, Local Amendments.

#### 1.4 REFERENCE STANDARDS:

- A. All hardware specified herein shall comply with the following industry standards:
  1. ANSI/BHMA Certified Product Standards - A156 Series
  2. UL10C – Positive Pressure Fire Tests of Door Assemblies.

#### 1.5 SUBMITTALS

- A. Refer to Section 01 33 00 for general submittal procedures.
- B. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.
- C. System Operational Descriptions: Complete system operational narratives for the integrated access controlled openings defining the owner's prescribed requirements for the opening functionality. Narratives include, but are not limited to, the following situations: normal secured/unsecured state of door; authorized access; authorized egress; unauthorized access; unauthorized egress; fire alarm and loss of power conditions, and interfaces with other building control systems.
- D. Shop Drawings: Details of electrified access control hardware indicating the following:
  1. Wiring Diagrams: Upon receipt of approved schedules, submit detailed system wiring diagrams for power, signaling, monitoring, communication, and control of the access control system electrified hardware. Differentiate between manufacturer-installed and field-installed wiring. Include the following:
    - a. Elevation diagram of each unique access controlled opening showing location and interconnection of major system components with respect to their placement in the respective door openings.
    - b. Complete (risers, point-to-point) access control system block wiring diagrams.
  2. Electrical Coordination: Coordinate with related Division 26 Electrical Sections the voltages and wiring details required at electrically controlled and operated hardware openings.

- E. Proof of Certification: Provide copy of manufacturer(s) official certification or accreditation document indicating proof of status as a qualified and authorized provider of the primary access control components.
- F. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware and site management installation in quantity as required in Division 01, Closeout Submittals. The manual to include the name, address, and contact information of the manufacturers providing the hardware and their nearest service representatives. The final copies delivered after completion of the installation test to include "as built" modifications made during installation, checkout, and acceptance.
- G. Warranties and Maintenance: Special warranties and maintenance agreements specified in this Section.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Inventory components upon receipt and provide secure lock-up and shelving. Do not store electronic locks, software or accessories at Project site without prior authorization.
- B. Tag each lockset or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.
- C. Deliver, as applicable, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service.

#### 1.7 COORDINATION

- A. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing electrified door hardware and access control system components.
- B. System Survey: Prior to ordering the system, review the construction documents to determine the correct number and locations of stand-alone locks and wired devices if possible.
  - 1. Data-on-Credential applications that require physical credentials are supported by online updaters.
- C. Electrical Connections: Coordinate the layout and installation of scheduled electrified door and related access control equipment with required connections to source power junction boxes, low voltage power supplies and Power over Ethernet switches as applicable.

#### 1.8 WARRANTY

- A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

- B. Warranty Period: Written warranty, executed by manufacturer(s), agreeing to repair or replace components of standard and electrified door hardware that fails in materials or workmanship within specified warranty period after final acceptance by the Owner. Failures include, but are not limited to, the following:
  - 1. Structural failures including excessive deflection, cracking, or breakage.
  - 2. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
  - 3. Electrical component defects and failures within the systems operation.
- C. Standard Warranty Period: One year from date of Substantial Completion, unless otherwise indicated.
- D. Special Warranty Periods:
  - 1. nexTouch NTB600 Series Cylindrical Lock: 3 year electrical, 3 year mechanical, 1 year finish.
  - 2. nexTouch NTM600 Series Mortise Lock: 3 year electrical, 3 year mechanical, 1 year finish.
  - 3. nexTouch NTT600 Series Electrified Trim for Rim Exit Device: 3 year electrical, 3 year mechanical, 1 year finish.
  - 4. YRL YRD600 Series Deadbolt Lock: 1 year electrical, 3 year mechanical, 1 year finish.
  - 5. YRL YRC600 Series Interconnected Lock: 1 year electrical, 3 year mechanical, 1 year finish.
  - 6. Yale NTX-600-KIT Updater/Controller: 1 year electrical.
    - a. NTX600-CTRL: 1 year electrical.
    - b. HID R10BLE, R40BLE, SE SEOS BLE Readers: limited lifetime electrical.

## 1.9 MAINTENANCE SERVICE

- A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed by certified integrator for continued adjustment, maintenance, and removal and replacement of system components.

## 1.10 SCOPE OF WORK

- A. Access Control Site Management System: Furnish and install at the indicated locations the specified integrated access control door hardware and access control system firmware and software for a completely operational access control. System includes, but is not necessarily limited, to the following:
  - 1. Electrified integrated access control locks, network switches, updaters, door position switches, remote credential updaters, keypads, access credentials, system application software and mobile configuration device application, special tools, operating manuals, and required cabling and accessories as detailed below and listed in the Access Control Hardware Sets at the end of Part 3.

- a. Provide manufacturer approved integrated access control locks, exit hardware, and remote mounted credential updaters and keypads that are functionally compatible with the specified access control equipment interfaces.
- B. Owner to provide the following:
  - 1. Internet accessible devices that support current browser software.
  - 2. Compatible mobile devices that run an Android OS and offer NFC (Near Field Communication) capabilities, thus capable of accepting the mobile configuration application.
    - a. For offline lock and online updater configuration: Mobile device to run an Android OS and offer NFC (Near Field Communication) capabilities, thus capable of accepting the mobile configuration application.
    - b. For mobile access to offline lock and online updaters: Bluetooth Low Energy (BLE) capable IOS or Android mobile device with internet connection to download the Yale Accentra Access mobile application
  - 3. Power Sourcing, Network Switches, Power over Ethernet: Quantity as required to accommodate installed access control devices.
  - 4. Network Control Connections: LAN/Ethernet communication ports (jacks) and network interface cards as needed, CAT5e (CAT6) cabling from network router/switch to networked updater, outlet and cover plates and/or patch cables required for network connection.
  - 5. Power Supplies, including battery or uninterrupted backup power supply (UPS) and separately fused surge protection, required for the electrified door hardware, access control equipment, and PoE switches or wireless routers driving the integrated credential reader locking devices.
  - 6. Installation, final configuration and commissioning of electrified door and access control system hardware, power supplies and related accessories.
  - 7. System application and cloud services and mobile application including installation, programming, and end user training of the access control system and mobile access applications demonstrating operating, repair, and maintenance procedures.
- C. Electrical contractor, Division 26, to provide the following:
  - 1. Source power wiring (120VAC) as required for the integrated locking and access control hardware, equipment, accessories and power supplies. This includes quad outlets as required on a dedicated circuit and the related conduit, stub-in, junction boxes and connectors required for the source power delivery and connections.

2. Provide required conduit, stub-in, junction and back boxes for both the electrified locking hardware and access control equipment at each of the access controlled or monitored openings per plan drawings and specs. Supply and install conduit between each of the aforementioned devices and between the electrical junction boxes, power supplies and access control equipment located on or above the door opening.
    - a. At wall mounted updaters, provide conduit on the secured side of the door, 36" from the finish floor and 6" from the edge of the frame, to the related power supplies and access control equipment.
    - b. At electrical hardware power transfers provide conduit on the secured side of the opening from the power transfer, thru-wire hinge, or serviceable panel location on the frame jamb to the related power supplies and access control equipment.
  3. Electrical Contractor to provide all 120VAC cabling connections and terminations from the electrical junction boxes to these electrical devices.
- D. Access Control System Integrator to provide the following:
1. Low voltage wiring (12/24VDC) and communication cabling (RS-485) to support controllers, relays, and electrified locking devices and door operators to updaters and power supplies. Work includes related connectors, final terminations, and hook-ups required for a complete and functional access controlled opening in accordance with applicable codes and specified system operational narratives.
    - a. Provide size appropriate spacers for updaters mounted against metal surfaces.
- E. Elevator Contractor to provide the following:
1. Interface or landing of interface cable onto the elevator call button will be performed by a certified elevator contractor.
  2. Coordinate with certified integrator provisions for a credential reader with output allowing the elevator call button to be activated. A validated credential reader and updater will be required for activation.
- F. Final connections to fire alarm system, if required, by electrical and fire alarm system contractors.
1. Provide permits, submittals and approvals required by the authority having jurisdiction, prior to commencing with work.

## PART 2 PRODUCTS

### 2.1 ACCESS CONTROL EQUIPMENT AND SYSTEM FEATURES

- A. System: System is cloud based and supports all major browsers.
1. Client Requirements:

- a. Internet Browser: Firefox, Chrome, Internet Explorer, Edge or similar.
  - b. Internet access.
2. System Features:
- a. 5,000 unique user credentials.
  - b. Unlimited credential updaters (with door control).
  - c. User-definable schedules and revalidation periods.
  - d. Unlimited user-definable access for authorized users to system services.
  - e. Unlimited provisioning of mobile credentials for system users.
  - f. Remote and schedule unlock for online door controllers.
  - g. Remote reboot and remote firmware upgrade of online controllers.
  - h. Access permissions with start and end dates and times for credential holders.
  - i. User definable emergency one-time-PIN code issuance for offline locks.
  - j. Unlimited cloud accessible audit history.
  - k. Visibility of online status of online openings.
  - l. System export capabilities to .CSV file format.
- B. Mobile Configuration Application: Provide a configuration application which is compatible with Android 5.0 or later and offers NFC (Near Field Communication capabilities).
- 1. Configures time, date and system association for both offline locks and online updaters.
  - 2. Assigns unique identities to all devices within the system.
  - 3. Communicates lock information- lock type and firmware version to the cloud service.
  - 4. Displays locally retrieved audit trail from offline locks.
  - 5. Controls local lock settings and master code.
  - 6. Resets offline locks to factory default.
  - 7. Offline lock firmware upgrade over the air via NFC or BLE.
- C. Mobile Access Application: For residents and staff who desire to use a mobile device to access offline locks and/or online updaters- must have internet connectivity to receive the mobile credential and the device must be either Android 5.0 or IOS 13.

1. Stores SEOS credential in secure element of the mobile device.
  2. Revalidates mobile credential when an internet connection is established.
  3. Communicates access privileges to both offline locks and online openings.
  4. Provides positive visual, and optional audible, and vibratory feedback about the status of credential transaction in real time.
  5. Communicates transaction information to the cloud when an internet connection is established.
- D. Offline System Operation: This facility will operate with offline lock access control of common area and resident doors. Updates are provided to the physical credential by presentation to the online updater after updates in the cloud system which may be operating as either a door controller or as an enrollment station. Updates are provided to the mobile credential “over the air” via an active internet connection.
- E. The facility will operate with the control of online updaters if physical credential access is required. If only mobile access is required, the facility may optionally operate without the control of online updaters.
- F. Manufacturers:
1. Yale Locks and Hardware (YA) – Data-on-Credential compatible with the Yale Multi-Family Access Management Software System.

## 2.2 SYSTEM COMPONENTS AND TECHNOLOGY

- A. The system shall provide the ability for online operators to operate as online doors for the purposes of both access control and encoding/updating credentials. Provide the necessary network and lock components to create an online lock control system at the perimeter of the building. Utilize standard Ethernet and Power over Ethernet (PoE) as the communication backbone between the system server and the wired (on-line) doors and updaters.
- B. Functionality:
1. Online updaters must function as an offline locking system by continuing to grant access to authorized users if online communication is interrupted but continuous power is still applied.
  2. Must provide real-time control of online updaters and access privileges of individual users from a central or remote location.
  3. Must allow resident and staff credentials to be changed, extended, or revoked from cloud system. Resident credentials are automatically revoked upon move-out or expiration of a lease and allowable access timeframe.
  4. Credential holders shall be able to obtain a one-time PIN code from the systems software with proper authorization by the site administrator for emergency access to offline locks.

5. Must be possible to display access audit trails, low battery events, and system access in the cloud system. Additionally, audit trails from offline locks must be visible from the mobile configuration application via local lock retrieval.
  6. Must be possible to issue multiple mobile and physical credentials per user.
- C. Lock Communication: Provide locks with RFID and BLE read/write capabilities to provide the communication link between the system server and the lockset over data-on-credential transport mechanism.
- D. Credential Updaters/Controller combination: Provide Yale R10/40 OSDP SE BLE Updaters compatible with: ISO 14443A. Provide system capable of supporting an unlimited number of online updaters acting as single door controllers and/or credential enrollment stations. Controller directly connects into the LAN/WAN network, using DHCP, DNS and TCP/IP addressing. Controller can be powered by PoE switches (specified in the electrical section), or by a 24VDC power supply. Controller shall offer a manual configuration lock option to prevent unauthorized configuration of the online updater.

## 2.3 DATA-ON-CREDENTIAL ACCESS CONTROL LOCKS

### 2.4 DATA-ON-CREDENTIAL ACCESS CONTROL SECTIONAL MORTISE LOCKS: ANSI/BHMA A156.13, SERIES 1000, GRADE 1 MORTISE LOCKSET WITH INTEGRATED KEYPAD FOR ACCESS AND PROGRAMMING. VOICE GUIDED PROGRAMMING AND MASTER PIN CODE SECURITY FOR SETTING. OPTIONAL KEY OVERRIDE FEATURE TO ACCEPT STANDARD, INTERCHANGEABLE CORE, SECURITY AND PATENTED CYLINDERS.

A. Fully-encrypted AES 128 NFC and BLE wireless communication between lock and Yale Seos® credentials.

B. Seos® credential reader included within the lock.

C. Motorized locking and unlocking.

D. Programming Language: English (default), Spanish or French.

E. Firmware upgradable over the air via configuration application.

F. User Interface:

a. Capacitive Touchscreen.

G. Deadbolt: Available with or without (as specified in sets).

H. Audit Trail:

a. 200 locally retrievable audit events.

b. Unlimited audits in the cloud management system.

I. Unlocking Modes:

- a. Key override (momentary).
- b. One time PIN code (4-8 digits).
- c. Yale SEOS card, fob or mobile credential.

J. Locking Modes:

- a. Automatic relocking with available variable timing.
- b. One touch keypad locking.
- c. Yale SEOS card, fob or mobile credential (with one touch locking off).
- d. PIN Code keypad locking (prior to commissioning).
- e. Locking button on interior escutcheon.

K. Electronic lock access options:

- a. Up to 25 4-8 digit PIN codes (prior to commissioning).
- b. One time PIN code (after commissioning).
- c. Yale Seos® credentials (after commissioning).

L. Power Source:

- a. 4 AA alkaline batteries (standard).
- b. External 9 VDC regulated power supply (alternative).
- c. 9 VDC transistor battery backup terminal at the keypad (emergency).

M. Manufacturers:

- N. Data-on-Credential Access Control Exit Device Trim: ANSI/BHMA A156.3, Grade 1 exit trim with integrated keypad for access and programming. Voice guided programming and master PIN code security for settings. Optional key override feature to accept standard, interchangeable core, security and patented cylinders.
1. Fully-encrypted AES 128 NFC and BLE wireless communication between lock and Yale Seos® credentials.
  2. Seos® credential reader included within the lock.
  3. Motorized locking and unlocking.
  4. Automatic door handing learning procedure.
  5. Programming Language: English (default), Spanish, or French.

6. Firmware upgradable over the air via configuration application.

7. User Interface:

a. Capacitive Touchscreen.

8. Audit Trail:

a. 200 locally retrievable events.

b. Unlimited audits in the cloud management system.

9. Unlocking Modes:

a. Key override.

b. One time PIN code (4-8 digits).

c. Yale SEOS card, fob or mobile credential.

10. Locking Modes:

1) Automatic relocking with available variable timing.

2) One touch keypad locking.

3) Yale SEOS card, fob or mobile credential (with one touch locking off).

4) PIN Code keypad locking (prior to commissioning)

5) Locking button on interior escutcheon.

11. Optional Modes:

1) Privacy mode.

2) Wrong Try Shutdown.

3) Passage Mode.

12. Lock access options:

a. Up to 25 4-8 digit PIN codes (prior to commissioning).

b. One time PIN code (after commissioning).

c. Yale Seos® credentials (after commissioning).

13. Power Source:

a. 4 AA alkaline batteries (standard).

b. External 9 VDC regulated power supply (alternative).

- c. 9 VDC transistor battery backup terminal at the keypad (emergency).
- 14. Rim exit device compatibility:
  - a. Yale: 1800, 2100, 2150, 6100, 6150, 7100, 7150.
- 15. Manufacturers:
  - a. Yale Commercial (YA) – nexTouch NTT600-ACC Series.

## 2.5 ONLINE CREDENTIAL UPDATER/DOOR CONTROLLERS

- A. Contactless smart credential updaters to securely read information from and write access control data to 13.56 MHz contactless RFID smart credentials. The contactless smart credential updater is designed for use in the Yale Accentra Access Control system by providing:
  - 1. Secure access control data exchange between the credential and the updater utilizing key diversification and mutual authentication routines.
  - 2. Contactless smart credential updater to be designed for low current operation to enable migration from most legacy proximity applications without the need to replace existing electrified door hardware, wiring and/or power supplies.
  - 3. Updater product construction suitable for both indoor and outdoor applications.
  - 4. Updater available with either pig tail or terminal block wiring options.
  - 5. Updater available in either mini-mullion or wall switch form factor.
  - 6. Manufacturers (13.56 MHz iCLASS):
    - 1) Yale (YA) - NXT 610BLE/640BLE KIT (as specified).

## 2.6 CREDENTIALS

- A. Provide secure RFID credentials that meet NIST requirements for encryption and HIPAA requirements for patient information security as required by the access control system specified herein. Credential technology shall provide protection against surreptitious tracking of the credential by means of random Credential Serial Number (CSN) generation. Credentials shall additionally provide a second layer of anti-cloning encryption to eliminate credential duplication. Physical credentials are to be capable of resisting tearing, bending, scratching, and moisture.
- B. Contactless Smart Card Credentials: Card credentials incorporating an access control identification technology that utilizes 13.56 MHz radio frequency (RF) circuits in microchip form. The microchips are encoded and securely transmit the encoded information when activated.
  - 1. Technology features:
    - a. Available in 8K-Bytes.

- b. AES-128 bits cryptographic algorithms for data protection.
  - c. Hardware chip integrating co-processor with high performance for cryptographic calculations with symmetric keys.
2. Security features:
    - a. Programmable with one or several Secure Identity Objects® (SIOs®) for each application.
  3. Card credential technology contactless features:
    - a. Tri-technology: 13.56MHz credential supports Yale Accentra offlin iCLASS SEOS and PACS online iCLASS SEOS technologies with 8K memory and 125kHz 26 bit proximity.
  4. Interoperability:
    - a. Fully supported by iCLASS SE® and multiCLASS SE® readers that can process SIO-enabled data formats. PACS online only supported by iCLASS SE readers with firmware Revision E or later.
- C. Quantity: Include three per resident room. Coordinate additional credential quantities with the facility manager.
1. Manufacturers (13.56 MHz iCLASS SEOS):
    - a. Yale - NTX600-YALPRX-8K.
- D. Key Fobs: Fobs incorporating an access control identification technology that utilizes 13.56 MHz radio frequency (RF) circuits in microchip form. The microchips are encoded and securely transmit the encoded information when activated.
1. Technology features:
    - a. Available in 8K-Bytes.
    - b. AES-128 bits cryptographic algorithms for data protection.
    - c. Hardware chip integrating co-processor with high performance for cryptographic calculations with symmetric keys.
  2. Security features:
    - a. Programmable with one or several Secure Identity Objects® (SIOs) for each application.
  3. Fob technology features:
    - a. MHz FOB supports Yale Accentra offline iCLASS SEOS and PACS online iCLASS SEOS technologies with 8K.
  4. Memory interoperability:

- a. Fully supported by iCLASS SE® and multiCLASS SE® readers that can process SIO-enabled data formats. PACS only supported by iCLASS SE readers with firmware Revision E or later.
- 5. Quantity: Include three per resident room. Coordinate additional fob credential quantities with the facility manager.
- 6. Manufacturers (13.56 MHz iCLASS Seos offline and online):
  - a. Yale – NTX600-YALFOB-8K.

## 2.7 FABRICATION

- A. Fasteners: Provide system components manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to manufacturers recognized installation standards for application intended.

## 2.8 FINISHES

- A. Standard: Designations used in the Hardware Sets and elsewhere indicate hardware finishes complying with ANSI/BHMA A156.18, including coordination with traditional U.S. finishes indicated by certain manufacturers for their products.
- B. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware.

# PART 3 EXECUTION

## 3.1 EXAMINATION

- A. Examine conditions for compliance with requirements for installation tolerances, labeled fire door assembly construction, and other conditions affecting performance.
- B. Notify architect of any discrepancies or conflicts between the door schedule, door types, drawings and scheduled hardware. Proceed only after such discrepancies or conflicts have been resolved in writing.

## 3.2 PREPARATION

- A. Hollow Metal Doors and Frames: Comply with ANSI/DHI A115 series.
- B. Wood Doors: Comply with ANSI/DHI A115-W series.

## 3.3 INSTALLATION

- A. Install each item to comply with manufacturer's written instructions and according to specifications.
  - 1. Installers are to be trained and certified by the manufacturer on the proper installation and adjustment of products including but limited to: front desk equipment and software, remote controllers, electromechanical exit devices, and unit room locks.

- B. Storage: Provide a secure lock up for materials delivered to the project but not yet installed. Control the handling and installation of items so that the completion of the work will not be delayed by material losses before and after installation.

### 3.4 FIELD QUALITY CONTROL

- A. Field Inspection (Punch Report): Reference Division 01 Sections “Closeout Procedures”. Produce project punch report for each installed door opening indicating compliance with approved submittals and verification hardware is properly installed, operating and adjusted. Include list of items to be completed and corrected, indicating the reasons or deficiencies causing the Work to be incomplete or rejected.

### 3.5 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating unit and each door lock to ensure proper operation. Replace units that cannot be adjusted to operate as intended.

### 3.6 CLEANING AND PROTECTION

- A. Protect all components stored on construction site in a covered and dry place. Protect installed components during the construction phase. Install components at the latest possible time frame.
- B. Clean components as necessary to restore proper finish. Provide final protection and maintain conditions that ensure components are without damage or deterioration at time of owner occupancy.

### 3.7 DEMONSTRATION

- A. Instruct Owner's managerial personnel on the correct use of the online updater, configuration application for the purpose of lock updates for time after battery changes, and cloud service components.
- B. Instruct Owner's managerial personnel on the location and navigation of the cloud service and configuration application user manuals in the cloud service.
- C. Instruct Owner's maintenance personnel to adjust, operate, and maintain electromechanical door hardware.

### 3.8 DOOR HARDWARE SCHEDULE

- A. Refer to Section 080671, Door Hardware Schedule, for hardware sets.
- B. Manufacturer's Abbreviations:

END OF SECTION

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## SECTION 31 31 16 - TERMITICIDE CONTROL

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Chemical soil treatment.
- B. Termite-resistant vapor barrier sheet.

#### 1.2 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Vapor barrier placement under concrete slab-on-grade.
- B. Section 06 05 73 - Wood Treatment: Field-applied termiticide for wood.

#### 1.3 REFERENCE STANDARDS

- A. ASTM E1643 - Standard Practice for Selection, Design, Installation and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs 2018a.
- B. ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs 2017.
- C. Title 7, United States Code, 136 through 136y - Federal Insecticide, Fungicide and Rodenticide Act 2006.

#### 1.4 SUBMITTALS

- A. See Section 01 33 00 for general submittal procedures.
- B. Product Data: Indicate toxicants to be used, composition by percentage, dilution schedule, intended application rate.
- C. Product Data: Submit manufacturers' data on manufactured products showing compliance with specified requirements.
- D. Test Reports: Indicate regulatory agency approval reports when required.
- E. Test Reports: Submit termite-resistant sheet manufacturer's summary of independent laboratory and field testing for effectiveness in subterranean termite exclusion.
- F. Manufacturer's Certificate: Certify that toxicants meet or exceed specified requirements.
- G. Certificate of compliance from authority having jurisdiction indicating approval of toxicants.
- H. Manufacturer's Instructions: Indicate caution requirement.
- I. Record and document moisture content of soil before application.
- J. Installer Qualifications: Company specializing in performing work of the type specified and with minimum three (3) years of documented experience.

- K. Maintenance Data: Indicate re-treatment schedule and [\_\_\_\_].
- L. Warranty: Submit warranty and ensure that forms have been completed in Owner's name.

## 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing this type of work and:
  - 1. Having minimum of three (3) years documented experience.
  - 2. Approved by manufacturer of treatment materials.
  - 3. Licensed in the State in which the Project is located.

## 1.6 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Provide five year installer's warranty against damage to building caused by termites.
  - 1. Include coverage for repairs to building and to contents damaged due to building damage. Repair damage and, if required, re-treat.
  - 2. Inspect annually and report in writing to Owner. Provide inspection service for [\_\_\_\_\_] years from Date of Substantial Completion.
- C. Termite-Resistant Vapor Barrier Sheet: Provide five year manufacturer's limited warranty.

# PART 2 PRODUCTS

## 2.1 CHEMICAL SOIL TREATMENT

- A. Toxicant Chemical: EPA Title 7, United States Code, 136 through 136y approved; synthetically color dyed to permit visual identification of treated soil.
- B. Diluent: Recommended by toxicant manufacturer.
- C. Mixes: Mix toxicant to manufacturer's instructions.

## 2.2 TERMITE BARRIER SHEET

- A. Termite-Resistant Vapor Barrier Sheet: Plastic sheet, complying with ASTM E1745, Class C; stated by manufacturer as suitable for installation in contact with soil or granular fill under concrete slabs, and for exclusion of subterranean termites.
- B. Accessory Products: Vapor retarder manufacturer's recommended tape, adhesive, prefabricated boots, etc., for sealing seams and penetrations in vapor retarder.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify that soil surfaces are unfrozen, sufficiently dry to absorb toxicant, and ready to receive treatment.
- B. Verify final grading is complete.

### 3.2 APPLICATION - CHEMICAL TREATMENT

- A. Comply with requirements of U.S. EPA and applicable state and local codes.
- B. Spray apply toxicant in accordance with manufacturer's instructions.
- C. Apply toxicant at following locations:
  - 1. Under Slabs-on-Grade.
  - 2. In Crawl Spaces.
  - 3. At Both Sides of Foundation Surface.
  - 4. Soil Within 10 feet of Building Perimeter For a Depth of [ ] feet.
- D. Under slabs, apply toxicant immediately prior to installation of vapor barrier.
- E. At foundation walls, apply toxicant immediately prior to finish grading work outside foundations.
- F. Apply extra treatment to structure penetration surfaces such as pipe or ducts, and soil penetrations such as grounding rods or posts.
- G. Re-treat disturbed treated soil with same toxicant as original treatment.
- H. If inspection or testing identifies the presence of termites, re-treat soil and re-test.

### 3.3 INSTALLATION - BARRIER SHEET

- A. Comply with ASTM E1643.
- B. Lap joints minimum 6 inches. Seal joints, seams and penetrations watertight with manufacturer's recommended products and follow manufacturer's written instructions.

### 3.4 PROTECTION

- A. Do not permit soil grading over treated work.
- B. Protect sheet materials from damage after completed installation. Repair damage with manufacturer's recommended products and according to the manufacturer's written instructions.

END OF SECTION

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## SECTION 31 66 13 – SHORT AGGREGATE PIER FOUNDATION 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 work of this section.

#### 1.2 SUMMARY

- A. Work Includes: Provide all labor, specialty geotechnical design, materials, equipment, apparatus, tools, transportation, protection and services necessary for, and reasonably incidental to design and install the short aggregate pier foundation system. The aggregate piers shall be constructed by compacting aggregate in an excavation hole using special high-energy impact densification equipment. The aggregate piers shall be in a columnar-type configuration and shall be used to produce an intermediate foundation system for the support of the foundation loads as indicated on the drawings and as specified herein.

1. Provide detailed geotechnical calculations and shop drawings prepared by a professional engineer (hereby referred to as the specialty engineer) registered in the state of the proposed project to design the short aggregate pier foundation system. Support the loads indicated on the drawings to within the settlement limits indicated in this specification. Verify the settlement limits are satisfied by load testing a pier.
2. Special attention is directed to the submittal requirements for final certification of the short aggregate piers foundation system by the Specialty Engineer.

#### 1.3 DEFINITIONS

- A. Short Aggregate Pier Foundation System: A columnar configuration of aggregate that is produced by compacting aggregate in an excavated cavity using special high energy impact compaction equipment to form a settlement control and foundation support system for column and strip footing.

#### 1.4 REFERENCES

A. Design Standards

1. “Control of Settlement and Uplift of Structures Using Short Aggregate Piers,” by Evert C. Lawton, Nathaniel S. Fox, and Richard L. Handy
2. Settlement of Structures Supported on Marginal or Inadequate Soils Stiffened with Short Aggregate Piers,” by Evert C. Lawton and Nathaniel S. Fox

B. Modulus Load Testing

1. ASTM D-1143 – Pile Load Test Procedures
2. ASTM D-1194 – Spread Footing Load Test
3. ASTM D-3687 – Uplift Load Test

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C. Materials and Inspection

1. ASTM D-1241 – Aggregate Quality
2. ASTM STP 399 – Dynamic Penetrometer Testing
3. ASTM D-422 – Gradation of Soils

1.5 SUBMITTALS

- A. The Aggregate Pier installer shall submit detailed geotechnical design calculations, construction drawings, and shop drawings. All plans and calculations shall be signed and sealed by a Professional Engineer in the State of the proposed project. The calculations shall include a detailed explanation of the design properties for settlement calculation and the load testing procedure.
- B. The Aggregate Pier installer shall coordinate with the Support of Excavation installer for the placement of the piers relative to the sheeting and shoring components.
- C. The Aggregate Pier Installer shall submit a notarized manufacturer's certification, indicating that the aggregate and other materials used conform to the requirements of this specification.
- D. Insurance: Certificate verifying the Specialty Engineer's professional liability insurance coverage shall be submitted to the Architect/Engineer within 10 days of bid acceptance.
- E. Observation Reports: Written field reports presenting the Specialty Engineer's field observations shall be submitted to the Architect/Engineer within 7 days of each field visit.
- F. Final Certification: Upon completion of the construction, the Specialty Engineer shall submit to the Architect/Engineer a written certification that the Short Aggregate Pier Foundation System has been constructed in conformance with the specified performance requirements and the construction documents,
- G. Daily Aggregate Pier Progress Reports – The testing agency retained by the owner shall submit progress reports to the General Contractor, Architect, and the Structural Engineer not later than two (2) days after pier installation. The reports shall indicate the pier location, length, average lift thickness, and final elevations of the base and top of pier. The report shall also indicate the type and size of the densification equipment used. The Aggregate Pier Installer shall immediately report any unusual conditions encountered during installation to the General Contractor, the aggregate pier designer, and the Testing Agency.

1.6 QUALITY ASSURANCE

- A. Aggregate Pier Installer Qualifications: Installers of aggregate pier foundation systems shall be licensed by Geopier Foundation Co., Inc. and shall have successfully completed not less than three (3) projects with similar soil conditions, depths and type of work contained in this project. Submit satisfactory proof of compliance to Architect.
  1. Pre-qualified Aggregate Pier Installer: GeoStructures, Inc. Leesburg, VA (703) 771-9844 Attn: Mike Cowell

- B. Specialty Engineer Qualifications: The Contractor shall engage the services of a Professional Engineer who shall be responsible for the design, preparation of short aggregate pier foundation system drawings, quality control, periodic field observation, and final certification of the complete short aggregate pier foundation system. The Specialty Engineer shall have the following minimum qualifications:
1. Registered in the state of the proposed project.
  2. Specialization in geotechnical design of Short Aggregate Pier Foundation Systems with a minimum of 3 years experience on projects of a similar size and scope.
  3. General liability insurance coverage in the aggregate amount of \$1,000,000.00 to protect the engineer from claims, which may arise in the performance of the engineering and construction services.
- C. Survey Work:
1. General Contractor shall perform surveys, and layouts for pier work. Conduct layout work for each pier to lines and levels required before installation.
  2. General Contractor shall furnish building base line, grade information, and building corners.
- D. Analyze the site conditions and subsurface investigation data prepared by the geotechnical consultant, and make supplemental investigations as deemed necessary by the Specialty Engineer for the proper design of the short aggregate pier foundation system.
- E. Performance Requirements:
1. Aggregate piers shall be designed in accordance with generally accepted engineering practice and the method described in “Control of Settlement and Uplift of Structures Using Short Aggregate Piers.”
  2. The design shall meet the following criteria:
    - a. Allowable Bearing Pressure for Aggregate Pier Improved Soil as defined in drawings
    - b. Minimum Aggregate Pier Area Coverage (Spread Footings) 30%
    - c. Estimated Total Immediate plus Long Term Settlement for Footings  $\leq 1''$
    - d. Estimated Immediate plus Long Term Differential Settlement for Adjacent Footings  $\leq \frac{1}{2}''$
  3. The design shall be verified by a single pier load test. Test pier location to be specified by the aggregate pier specialty engineer and shall be same diameter and length as the production piers.

## 1.7 JOB CONDITIONS

- A. Site Examination: Contractor shall examine the site to ascertain the state thereof and to understand the complexities of the work. Compare the site with the drawings, the condition of the premises, the actual elevations, existing obstructions, areas of work, and other conditions that would affect the completion of the work.
- B. A Geotechnical Investigation and Report has been prepared for the site and is available for use by the Bidder. The report is not a warranty of the subsurface conditions, and is to be used by the Bidder at his risk. Assume responsibility for the deductions made, or the conclusions drawn from such information.

## PART 2 - PRODUCTS

### 2.1 AGGREGATE PIER MATERIALS

- A. Aggregate above Water Table: Type I Gradation B in accordance with ASTM D-1241-68, or other graded aggregate selected by the Aggregate Pier Installer and successfully used in the load test.
- B. Aggregate below Water Table: Type I Gradation B, except particles passing the No. 40 sieve shall be eliminated. Alternatively, No. 57 stone, or other stone selected by the Aggregate Pier installer and successfully used in the load test may be used.

### 2.2 DENSIFICATION EQUIPMENT

- A. Provide densification equipment of type generally used in Aggregate Pier installation and approved by the pier specialty engineer.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Installer must examine areas and conditions under which aggregate piers are to be installed and notify General Contractor in writing of conditions detrimental to proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the installer.

### 3.2 INSTALLING AGGREGATE PIERS

- A. Coordinate pier installation with sheeting and shoring contractor to ensure that installation does not reduce the capacity or otherwise jeopardize the soldier pile's lateral restraint.
- B. Aggregate used for piers constructed above the water table shall be compacted to a densification and strength that provides resistance to the dynamic penetration test ASTM STP 399 of a minimum average of 15 blows per 1.75 inch vertical movement.
  - 1. Perform dynamic penetration tests on each pier until the pattern of performed exceeds 15 blows. Once the pattern of test establishes the 15 blows per pier reduce the tests to questionable or differing conditions.
- C. The Aggregate Piers Installer shall have a full time Quality control representative on site to verify and report all installation procedures.
- D. Rejected Aggregate Piers: Piers improperly located or installed beyond the maximum allowable tolerances shall be abandoned and replaced with new piers, unless the Engineer approves other remedial measures proposed by the installer. All material and labor required to replace rejected aggregate piers shall be provided at no additional cost to the Owner, unless the cause of rejection is due to an obstruction.

- E. Tolerances: The center of each pier shall be within six (6) inches of the plan locations indicated. The final measurement for the top of aggregate piers shall be the lowest point on the aggregate in the last compacted lift.
- F. Footing Bottom
  - 1. All excavations for footing bottoms supported by aggregate pier foundations shall be prepared in the following manner: Over excavation below the bottom of footing shall be limited to 3 inches. This includes limiting the teeth from excavators from over excavation beyond 3 inches below the footing elevation.
  - 2. Compaction of surface soil and top of aggregate piers shall be prepared using a standard, hand-operated impact compactor. Compaction shall be performed over the entire footing bottom to compact any loose surface soil and loose surface pier aggregate.
  - 3. Excavation and surface compaction of all footings shall be the responsibility of the General Contractor.

### 3.3 FIELD QUALITY CONTROL

- A. The Owner will engage the services of an approved independent, testing agency to perform field inspection of pier installation, and to monitor the load test. The testing agency will issue copies of all reports as specified herein.
- B. The contractor shall be responsible for scheduling with the testing laboratory, and shall provide free access to work and cooperate with the Testing Agency.
- C. Pier Installation: The testing agency and the quality control personnel for the Aggregate Piers Installer shall be present during pier installation and the load test. The Aggregate Pier Installer shall provide all dial indicators and other measuring devices. The inspector shall make detailed records of the installation of each pile and the results of load tests.
- D. Aggregate Pier Load Testing: Provide 1 single test pier. Additional tests shall be performed, if deemed necessary by the Aggregate Pier Designer. Use test piers of same diameter as required for Project and install with same equipment as used in installation of production piers. Install test pier as indicated on drawings for production piers. Load single test piers to twice the required design load as indicated on the drawings. The Testing Agency shall monitor the installation of load test aggregate piers to document procedures and criteria used for constructing the load test pier.
- E. Bottom Stabilization Verification Test: After completion of the bottom pier bulb, or at anytime during the process of constructing the pier, the energy source may be turned off, and a bottom stabilization verification test may be performed. These tests shall be performed when a new soil formation is encountered, and at the beginning of a project to provide quantitative information on pier stabilization. A reference bar is placed over the cavity, and a mark is made on the tamper shaft that has been placed on top of the compacted aggregate. The energy to the tamper is restarted. If the measured vertical movement exceeds 150% of the value achieved during the load test, added energy is applied to redensify the bulb. The procedure for measuring is then repeated. If there is still movement greater than 150% of that achieved during the load test and greater than  $\frac{1}{2}$  inch, a lift of loose aggregate may be placed on top of the compacted aggregate, and the verification test may be performed on this next lift after it is tested. Movement must be limited to below 150% of the values achieved for the load test before completion of

2/3 of the pier depth unless unusually powerful modified hydraulic hammers are being used with tamper heads smaller than 26 inches in diameter.

- F. The Specialty Engineer responsible for the design of the short aggregate pier foundation system shall provide final certification in writing regarding their findings.

### 3.4 PAYMENT FOR WORK

- A. Basis for Bids: Bids will be based on providing a complete short aggregate pier foundation system.
- B. Delays: Contractor is not entitled to additional compensation for delays, including those as a result of weather, site conditions, lay-out, equipment breakdowns, etc., except as provided under obstructions.

END OF SECTION 31 66 13

## SECTION 32 14 00 - UNIT PAVING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Precast unit pavers
  - 2. Pedestal support systems and pavers

#### 1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at the project site prior to construction at the request of the Landscape Architect.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For materials other than water and aggregates.
- B. Product Data: For the following:
  - 1. Pavers.
  - 2. Pedestal support systems.
  - 3. See materials schedule for more information.
- C. Sustainable Design Submittals:
  - 1. Product Certificates for LEED v2009 Credit MR 5: For products and materials required to comply with requirements for regional materials, certificates indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating distance to Project, cost for each regional material, and fraction by weight that is considered regional.
  - 2. Product Certificates for LEED v2009 Credit SS 7.1: For products and materials required to comply with requirements for urban heat island non-roof, provide certificates indicating solar reflectance index value.
- D. Sieve Analyses: For aggregate setting-bed materials, according to ASTM C136.
- E. Samples for Initial Selection: For each type of unit paver indicated and the following:
  - 1. Exposed edge restraints involving color selection.
  - 2. See materials schedule for more information.
- F. Samples for Verification: For full-size units of each type of unit paver indicated. Include Samples of the following:

1. See materials schedule for more information.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Adhesion and Compatibility Test Reports: From latex-additive manufacturer for mortar and grout containing latex additives.
- B. Material Certificates: For unit pavers. Include statements of material properties indicating compliance with requirements, including compliance with standards. Provide for each type and size of unit.
- C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for unit pavers, indicating compliance with requirements.
  1. For solid interlocking paving units, include test data for freezing and thawing according to ASTM C67.

#### 1.5 QUALITY ASSURANCE

- A. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
  1. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion. If mockup is not retained, remove and properly dispose of mock-up.
  2. Install a 4 ft x 4 ft mockup for review and approval by owner and landscape architect prior to construction. Mockup shall show typical conditions as well as at least one of edge conditions found in the project.
  3. See materials schedule for more information.
  4. Refer to Section 01 43 89 for general mockup requirements.

#### 1.6 PRECONSTRUCTION TESTING

- A. Preconstruction Adhesion and Compatibility Testing: Submit to latex-additive manufacturer, for testing as indicated below, Samples of flooring materials that will contact or affect mortar and grout that contain latex additives.
- B. Use manufacturer's standard test methods to determine whether mortar and grout materials will obtain optimal adhesion with, and will be nonstaining to, installed brick and other materials constituting brick flooring installation.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store pavers on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied.
- B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

- C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
- D. Store liquids in tightly closed containers protected from freezing.
- E. Store asphalt cement and other bituminous materials in tightly closed containers.

## 1.8 FIELD CONDITIONS

- A. Cold-Weather Protection: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen subgrade or setting beds. Remove and replace unit paver work damaged by frost or freezing.

# PART 2 - PRODUCTS

## 2.1 MANUFACTURERS

- A. Source Limitations: Obtain each type of unit paver, joint material, and setting material from single source with resources to provide materials and products of consistent quality in appearance and physical properties.

## 2.2 CURBS AND EDGE RESTRAINTS

- A. See materials schedule for product information.
- B. Drainage Geotextile: Nonwoven needle-punched geotextile fabric, manufactured for subsurface drainage applications, made from polyolefins or polyesters; with elongation greater than 50.

## 2.3 CONCRETE PAVERS

- A. Manufacturer: See Materials Schedule.
- B. Interlocking Concrete Paver Units: Reference Hardscape Schedule for product information.
- C. Average Compressive Strength (ASTM C 140): 9,400 psi with no individual unit under 8500 psi (50 Mpa).
- D. Average Water Absorption (ASTM C 140): 5% with no unit greater than 7%.
  - 1. Solar Reflectance (SR) value for unit paver surface materials: Minimum 0.33 initial SR; or minimum 0.28 for three-year aged SR.

## 2.4 PEDESTALS AND SHIMS

- A. Provide manufacturer's adjustable paver pedestals and shims. Products shall be included in paver manufacturer's warranty.
- B. Manufacturer: See Materials Schedule.

## 2.5 WIND UPLIFT SYSTEM

- A. Provide pavers and pedestals with a wind uplift protection system providing a minimum of 350 psf resistance. Basis of Design is Nitterhouse Masonry Wind Uplift System or approved equal.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine surfaces indicated to receive unit paving, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Where unit paving is to be installed over waterproofing, examine waterproofing installation, with waterproofing Installer present, for protection from paving operations, including areas where waterproofing system is turned up or flashed against vertical surfaces.
- C. Proceed with installation only after unsatisfactory conditions have been corrected and waterproofing protection is in place.

### 3.2 PREPARATION

- A. Remove substances from concrete substrates that could impair mortar bond, including curing and sealing compounds, form oil, and laitance.
- B. Sweep concrete substrates to remove dirt, dust, debris, and loose particles.
- C. Proof-roll prepared subgrade according to requirements in Section 312000 "Earth Moving" to identify soft pockets and areas of excess yielding. Proceed with unit paver installation only after deficient subgrades have been corrected and are ready to receive subbase and base course for unit pavers.

### 3.3 INSTALLATION, GENERAL

- A. Do not use unit pavers with chips, cracks, voids, discolorations, or other defects that might be visible or cause staining in finished work.
- B. Mix pavers from several pallets or cubes, as they are placed, to produce uniform blend of colors and textures.
- C. Cut unit pavers with motor-driven masonry saw equipment to provide clean, sharp, unchipped edges. Cut units to provide pattern indicated and to fit adjoining work neatly. Use full units without cutting where possible. Hammer cutting is not acceptable.
  1. For concrete pavers, a block splitter may be used.
- D. Handle protective-coated brick pavers to prevent coated surfaces from contacting backs or edges of other units. If, despite these precautions, coating does contact bonding surfaces of brick, remove coating from bonding surfaces before setting brick.
- E. Joint Pattern: As indicated.

- F. Pavers over Waterproofing: Exercise care in placing pavers and setting materials over waterproofing so protection materials are not displaced and waterproofing is not punctured or otherwise damaged. Carefully replace protection materials that become displaced and arrange for repair of damaged waterproofing before covering with paving.
  - 1. Provide joint filler at waterproofing that is turned up on vertical surfaces unless otherwise indicated; where unfilled joints are indicated, provide temporary filler or protection until paver installation is complete.
- G. Tolerances: Do not exceed 1/32-inch (0.8-mm) unit-to-unit offset from flush (lippage) or 1/8 inch in 10 feet (3 mm in 3 m) from level, or indicated slope, for finished surface of paving.
- H. Tolerances: Do not exceed[ 1/16-inch (1.6-mm) unit-to-unit offset from flush (lippage) nor 1/8 inch in 24 inches (3 mm in 600 mm) and] 1/4 inch in 10 feet (6 mm in 3 m) from level, or indicated slope, for finished surface of paving.
- I. Expansion and Control Joints: Provide for sealant-filled joints at locations and of widths indicated. Provide compressible foam filler as backing for sealant-filled joints unless otherwise indicated; where unfilled joints are indicated, provide temporary filler until paver installation is complete. Install joint filler before setting pavers. Sealant materials and installation are specified in Section 079200 "Joint Sealants."
- J. Expansion and Control Joints: Provide cork joint filler at locations and of widths indicated. Install joint filler before setting pavers. Make top of joint filler flush with top of pavers.
- K. Provide edge restraints as indicated. Install edge restraints before placing unit pavers.
  - 1. Install edge restraints to comply with manufacturer's written instructions. Install stakes at intervals required to hold edge restraints in place during and after unit paver installation.
  - 2. For metal edge restraints with top edge exposed, drive stakes at least 1 inch (25 mm) below top edge.
  - 3. Install job-built concrete edge restraints to comply with requirements in Section 033000 "Cast-in-Place Concrete."
  - 4. Where pavers set in mortar bed are indicated as edge restraints for pavers set in aggregate setting bed, install pavers set in mortar and allow mortar to cure before placing aggregate setting bed and remainder of pavers. Cut off mortar bed at a steep angle so it will not interfere with aggregate setting bed.
  - 5. Where pavers embedded in concrete are indicated as edge restraints for pavers set in aggregate setting bed, install pavers embedded in concrete and allow concrete to cure before placing aggregate setting bed and remainder of pavers. Hold top of concrete below aggregate setting bed.
- L. Install wind-uplift system on roof pavers at corners and areas indicated to prevent dislodging of pavers due to high wind.

### 3.4 REPAIRING, POINTING, AND CLEANING

- A. Remove and replace unit pavers that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Provide new units to match adjoining units and install in same manner as original units, with same joint treatment and with no evidence of replacement.
- B. Pointing: During tooling of joints, enlarge voids or holes and completely fill with grout. Point joints at sealant joints to provide a neat, uniform appearance, properly prepared for sealant application.
- C. Cleaning: Remove excess grout from exposed paver surfaces; wash and scrub clean.
  1. Remove temporary protective coating as recommended by coating manufacturer and as acceptable to paver and grout manufacturers.
  2. Do not allow protective coating to enter floor drains. Trap, collect, and remove coating material.

END OF SECTION

## SECTION 32 93 00 - PLANTS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Plants.
2. Tree stabilization.
3. Tree-watering devices.
4. Landscape edgings.
5. Tree grates.

B. Related Requirements:

1. Section 329200 "Turf and Grasses" for turf (lawn) and meadow planting, hydroseeding, and erosion-control materials.
2. Section 329600 "Transplanting" for transplanting non-nursery-grown trees.

#### 1.2 ALLOWANCES

A. Allowances for plants are specified in Section 012100 "Allowances."

1. Perform planting work under quantity allowances and only as authorized. Authorized work includes work required by Drawings and the Specifications and only work authorized in writing by Architect.
2. Notify Architect weekly of extent of work performed that is attributable to quantity allowances.
3. Perform work that exceeds quantity allowances only as authorized by Change Orders.

B. Furnish trees as part of tree allowance.

#### 1.3 UNIT PRICES

- A. Work of this Section is affected by unit prices specified in Section 012200 "Unit Prices."
- B. Unit prices apply to authorized work covered by quantity allowances.
- C. Unit prices apply to additions to and deletions from the Work as authorized by Change Orders.

#### 1.4 DEFINITIONS

- A. Backfill: The earth used to replace or the act of replacing earth in an excavation.

- B. Balled and Burlapped Stock: Plants dug with firm, natural balls of earth in which they were grown, with a ball size not less than diameter and depth recommended by ANSI Z60.1 for type and size of plant required; wrapped with burlap, tied, rigidly supported, and drum laced with twine with the root flare visible at the surface of the ball as recommended by ANSI Z60.1.
- C. Balled and Potted Stock: Plants dug with firm, natural balls of earth in which they are grown and placed, unbroken, in a container. Ball size is not less than diameter and depth recommended by ANSI Z60.1 for type and size of plant required.
- D. Bare-Root Stock: Plants with a well-branched, fibrous-root system developed by transplanting or root pruning, with soil or growing medium removed, and with not less than the minimum root spread according to ANSI Z60.1 for type and size of plant required.
- E. Container-Grown Stock: Healthy, vigorous, well-rooted plants grown in a container, with a well-established root system reaching sides of container and maintaining a firm ball when removed from container. Container shall be rigid enough to hold ball shape and protect root mass during shipping and be sized according to ANSI Z60.1 for type and size of plant required.
- F. Fabric Bag-Grown Stock: Healthy, vigorous, well-rooted plants established and grown in-ground in a porous fabric bag with well-established root system reaching sides of fabric bag. Fabric bag size is not less than diameter, depth, and volume required by ANSI Z60.1 for type and size of plant.
- G. Finish Grade: Elevation of finished surface of planting soil.
- H. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. Pesticides include insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. They also include substances or mixtures intended for use as a plant regulator, defoliant, or desiccant. Some sources classify herbicides separately from pesticides.
- I. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. Pests include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.
- J. Planting Area: Areas to be planted.
- K. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth. See Section 329113 "Soil Preparation for drawing designations for planting soils.
- L. Plant; Plants; Plant Material: These terms refer to vegetation in general, including trees, shrubs, vines, ground covers, ornamental grasses, bulbs, corms, tubers, or herbaceous vegetation.
- M. Root Flare: Also called "trunk flare." The area at the base of the plant's stem or trunk where the stem or trunk broadens to form roots; the area of transition between the root system and the stem or trunk.
- N. Stem Girdling Roots: Roots that encircle the stems (trunks) of trees below the soil surface.

- O. Subgrade: The surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

## 1.5 COORDINATION

- A. Coordination with Turf Areas (Lawns): Plant trees, shrubs, and other plants after finish grades are established and before planting turf areas unless otherwise indicated.
  - 1. When planting trees, shrubs, and other plants after planting turf areas, protect turf areas, and promptly repair damage caused by planting operations.

## 1.6 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at the project site prior to construction at the request of the Landscape Architect.

## 1.7 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Plant Materials: Include quantities, sizes, quality, and sources for plant materials.
  - 2. Plant Photographs: Include color photographs in digital format of each required species and size of plant material as it will be furnished to Project. Take photographs from an angle depicting true size and condition of the typical plant to be furnished. Include a scale rod or other measuring device in each photograph. For species where more than 20 plants are required, include a minimum of three photographs showing the average plant, the best quality plant, and the worst quality plant to be furnished. Identify each photograph with the full scientific name of the plant, plant size, and name of the growing nursery.
- B. Samples for Verification: For each of the following:
  - 1. Organic Mulch: 11-quart (1-L) volume of each organic mulch required; in sealed plastic bags labeled with composition of materials by percentage of weight and source of mulch. Each Sample shall be typical of the lot of material to be furnished; provide an accurate representation of color, texture, and organic makeup.
  - 2. Mineral Mulch: 2 lb (1.0 kg) of each mineral mulch required, in sealed plastic bags labeled with source of mulch. Sample shall be typical of the lot of material to be delivered and installed on-site; provide an accurate indication of color, texture, and makeup of the material.
  - 3. Weed Control Barrier: 12 by 12 inches (300 by 300 mm).
  - 4. Proprietary Root-Ball-Stabilization Device: One unit.
  - 5. Edging Materials and Accessories: Manufacturer's standard size, to verify color selected.

## 1.8 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For landscape Installer. Include list of similar projects completed by Installer demonstrating Installer's capabilities and experience. Include project names, addresses, and year completed, and include names and addresses of owners' contact persons.
- B. Product Certificates: For each type of manufactured product, from manufacturer, and complying with the following:
  - 1. Manufacturer's certified analysis of standard products.
  - 2. Analysis of other materials by a recognized laboratory made according to methods established by the Association of Official Analytical Chemists, where applicable.
- C. Pesticides and Herbicides: Product label and manufacturer's application instructions specific to Project.
- D. Sample Warranty: For special warranty.

## 1.9 CLOSEOUT SUBMITTALS

- A. Maintenance Data: Recommended procedures to be established by Owner for maintenance of plants during a calendar year. Submit before expiration of required maintenance periods.

## 1.10 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful establishment of plants.
  - 1. Professional Membership: Installer shall be a member in good standing of either the Professional Landcare Network or the American Nursery and Landscape Association.
  - 2. Experience: Five years' experience in landscape installation in addition to requirements in Section 014000 "Quality Requirements."
  - 3. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
  - 4. Personnel Certifications: Installer's field supervisor shall have certification in one of the following categories from the Professional Landcare Network:
    - a. Landscape Industry Certified Technician - Exterior.
    - b. Landscape Industry Certified Interior.
    - c. Landscape Industry Certified Horticultural Technician.
  - 5. Pesticide Applicator: State licensed, commercial.
- B. Provide quality, size, genus, species, and variety of plants indicated, complying with applicable requirements in ANSI Z60.1.

1. Selection of plants purchased under allowances is made by Architect, who tags plants at their place of growth before they are prepared for transplanting.
- C. Measurements: Measure according to ANSI Z60.1. Do not prune to obtain required sizes.
  1. Trees and Shrubs: Measure with branches and trunks or canes in their normal position. Take height measurements from or near the top of the root flare for field-grown stock and container-grown stock. Measure main body of tree or shrub for height and spread; do not measure branches or roots tip to tip. Take caliper measurements 6 inches (150 mm) above the root flare for trees up to 4-inch (100-mm) caliper size, and 12 inches (300 mm) above the root flare for larger sizes.
  2. Other Plants: Measure with stems, petioles, and foliage in their normal position.
- D. Plant Material Observation: Architect may observe plant material either at place of growth or at site before planting for compliance with requirements for genus, species, variety, cultivar, size, and quality. Architect may also observe trees and shrubs further for size and condition of balls and root systems, pests, disease symptoms, injuries, and latent defects and may reject unsatisfactory or defective material at any time during progress of work. Remove rejected trees or shrubs immediately from Project site.
  1. Notify Architect of sources of planting materials seven days in advance of delivery to site.

## 1.11 DELIVERY, STORAGE, AND HANDLING

- A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of compliance with state and Federal laws if applicable.
- B. Bulk Materials:
  1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
  2. Provide erosion-control measures to prevent erosion or displacement of bulk materials; discharge of soil-bearing water runoff; and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
  3. Accompany each delivery of bulk materials with appropriate certificates.
- C. Deliver bare-root stock plants within 36 hours of digging. Immediately after digging up bare-root stock, pack root system in wet straw, hay, or other suitable material to keep root system moist until planting. Transport in covered, temperature-controlled vehicles, and keep plants cool and protected from sun and wind at all times.
- D. Do not prune trees and shrubs before delivery. Protect bark, branches, and root systems from sun scald, drying, wind burn, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape. Provide protective covering of plants during shipping and delivery. Do not drop plants during delivery and handling.
- E. Handle planting stock by root ball.

- F. Store bulbs, corms, and tubers in a dry place at 60 to 65 deg F (16 to 18 deg C) until planting.
- G. Apply antidesiccant to trees and shrubs using power spray to provide an adequate film over trunks (before wrapping), branches, stems, twigs, and foliage to protect during digging, handling, and transportation.
  - 1. If deciduous trees or shrubs are moved in full leaf, spray with antidesiccant at nursery before moving and again two weeks after planting.
- H. Wrap trees and shrubs with burlap fabric over trunks, branches, stems, twigs, and foliage to protect from wind and other damage during digging, handling, and transportation.
- I. Deliver plants after preparations for planting have been completed, and install immediately. If planting is delayed more than six hours after delivery, set plants and trees in their appropriate aspect (sun, filtered sun, or shade), protect from weather and mechanical damage, and keep roots moist.
  - 1. Heel-in bare-root stock. Soak roots that are in less than moist condition in water for two hours. Reject plants with dry roots.
  - 2. Set balled stock on ground and cover ball with soil, peat moss, sawdust, or other acceptable material.
  - 3. Do not remove container-grown stock from containers before time of planting.
  - 4. Water root systems of plants stored on-site deeply and thoroughly with a fine-mist spray. Water as often as necessary to maintain root systems in a moist, but not overly wet condition.

## 1.12 FIELD CONDITIONS

- A. Field Measurements: Verify actual grade elevations, service and utility locations, irrigation system components, and dimensions of plantings and construction contiguous with new plantings by field measurements before proceeding with planting work.
- B. Planting Restrictions: Plant during one of the following periods or as required by the City of Falls Chruch. Coordinate planting periods with maintenance periods to provide required maintenance from date of Substantial Completion.
  - 1. Spring Planting: March and May
  - 2. Fall Planting: September and November.
- C. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions and warranty requirements.

## 1.13 WARRANTY

- A. Special Warranty: Installer agrees to repair or replace plantings and accessories that fail in materials, workmanship, or growth within specified warranty period.

1. Failures include, but are not limited to, the following:
  - a. Death and unsatisfactory growth, except for defects resulting from abuse, lack of adequate maintenance, or neglect by Owner.
  - b. Structural failures including plantings falling or blowing over.
  - c. Faulty performance of tree stabilization, edgings, and tree grates.
  - d. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
2. Warranty Periods: From date of Substantial Completion.
  - a. Trees, Shrubs, Vines, and Ornamental Grasses: 12 months.
  - b. Ground Covers, Biennials, Perennials, and Other Plants: 12 months.
  - c. Annuals: Three months.
3. Include the following remedial actions as a minimum:
  - a. Immediately remove dead plants and replace unless required to plant in the succeeding planting season.
  - b. Replace plants that are more than 25 percent dead or in an unhealthy condition at end of warranty period.
  - c. A limit of one replacement of each plant is required except for losses or replacements due to failure to comply with requirements.
  - d. Provide extended warranty for period equal to original warranty period, for replaced plant material.

## PART 2 - PRODUCTS

### 2.1 PLANT MATERIAL

- A. General: Furnish nursery-grown plants true to genus, species, variety, cultivar, stem form, shearing, and other features indicated in Plant List, Plant Schedule, or Plant Legend indicated on Drawings and complying with ANSI Z60.1; and with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully branched, healthy, vigorous stock, densely foliated when in leaf and free of disease, pests, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.
1. Trees with damaged, crooked, or multiple leaders; tight vertical branches where bark is squeezed between two branches or between branch and trunk ("included bark"); crossing trunks; cut-off limbs more than 3/4 inch (19 mm) in diameter; or with stem girdling roots are unacceptable.
  2. Collected Stock: Do not use plants harvested from the wild, from native stands, from an established landscape planting, or not grown in a nursery unless otherwise indicated.

- B. Provide plants of sizes, grades, and ball or container sizes complying with ANSI Z60.1 for types and form of plants required. Plants of a larger size may be used if acceptable to Architect, with a proportionate increase in size of roots or balls.
- C. Root-Ball Depth: Furnish trees and shrubs with root balls measured from top of root ball, which begins at root flare according to ANSI Z60.1. Root flare shall be visible before planting.
- D. Labeling: Label at least one plant of each variety, size, and caliper with a securely attached, waterproof tag bearing legible designation of common name and full scientific name, including genus and species. Include nomenclature for hybrid, variety, or cultivar, if applicable for the plant.
- E. If formal arrangements or consecutive order of plants is indicated on Drawings, select stock for uniform height and spread, and number the labels to assure symmetry in planting.
- F. Annuals and Biennials: Provide healthy, disease-free plants of species and variety shown or listed, with well-established root systems reaching to sides of the container to maintain a firm ball, but not with excessive root growth encircling the container. Provide only plants that are acclimated to outdoor conditions before delivery.

## 2.2 FERTILIZERS

- A. Planting Tablets: Tightly compressed chip-type, long-lasting, slow-release, commercial-grade planting fertilizer in tablet form. Tablets shall break down with soil bacteria, converting nutrients into a form that can be absorbed by plant roots.
  - 1. Size: 5-gram tablets.
  - 2. Nutrient Composition: 20 percent nitrogen, 10 percent phosphorous, and 5 percent potassium, by weight plus micronutrients.

## 2.3 MULCHES

- A. Organic Mulch: Free from deleterious materials and suitable as a top dressing of trees and shrubs, consisting of one of the following:
  - 1. Type: Shredded hardwood.
  - 2. Size Range: 3 inches (76 mm) maximum, 1 inch (13 mm) minimum.
  - 3. Color: Natural.

## 2.4 WEED-CONTROL BARRIERS

- A. Nonwoven Geotextile Filter Fabric: Polypropylene or polyester fabric, 3 oz./sq. yd. (101g/sq. m) minimum, composed of fibers formed into a stable network so that fibers retain their relative position. Fabric shall be inert to biological degradation and resist naturally encountered chemicals, alkalis, and acids.

- B. Composite Fabric: Woven, needle-punched polypropylene substrate bonded to a nonwoven polypropylene fabric, 4.8 oz./sq. yd. (162 g/sq. m).

## 2.5 PESTICIDES

- A. General: Pesticide registered and approved by the EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.
- B. Pre-Emergent Herbicide (Selective and Nonselective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.
- C. Post-Emergent Herbicide (Selective and Nonselective): Effective for controlling weed growth that has already germinated.

## 2.6 TREE-STABILIZATION MATERIALS

### A. Trunk-Stabilization Materials:

1. Upright and Guy Stakes: Rough-sawn, sound, new hardwood, free of knots, holes, cross grain, and other defects, 2-by-2-inch nominal (38-by-38-mm actual) by length indicated, pointed at one end.
2. Guys and Tie Wires: ASTM A641/A641M, Class 1, galvanized-steel wire, two-strand, twisted, 0.106 inch (2.7 mm) in diameter.
3. Flags: Standard surveyor's plastic flagging tape, white, 6 inches (150 mm) long.
4. Proprietary Staking-and-Guying Devices: Proprietary stake or anchor and adjustable tie systems to secure each new planting by plant stem; sized as indicated and according to manufacturer's written recommendations.

### B. Root-Ball Stabilization Materials:

1. Proprietary Root-Ball Stabilization Devices: Proprietary at- or below-grade stabilization systems to secure each new planting by root ball and that do not encircle the trunk; sized according to manufacturer's written recommendations unless otherwise indicated.

## 2.7 LANDSCAPE EDGINGS

- A. See Vegetated Green Roof specification and materials schedule.

## 2.8 TREE-WATERING DEVICES

- A. Watering Pipe: PVC pipe 4 inches (100 mm) in diameter, site-cut to length as required, and with snug-fitting removable cap.

## 2.9 MISCELLANEOUS PRODUCTS

- A. Wood Pressure-Preservative Treatment: AWPA U1, Use Category UC4a; acceptable to authorities having jurisdiction, and containing no arsenic or chromium.
- B. Antidesiccant: Water-insoluble emulsion, permeable moisture retarder, film forming, for trees and shrubs. Deliver in original, sealed, and fully labeled containers and mix according to manufacturer's written instructions.
- C. Burlap: Non-synthetic, biodegradable.
- D. Planter Drainage Gravel: Washed, sound crushed stone or gravel complying with ASTM D448 for Size No. 8.
- E. Planter Filter Fabric: Nonwoven geotextile manufactured for separation applications and made of polypropylene, polyolefin, or polyester fibers or combination of them.
- F. Mycorrhizal Fungi: Dry, granular inoculant containing at least 5300 spores per lb (0.45 kg) of vesicular-arbuscular mycorrhizal fungi and 95 million spores per lb (0.45 kg) of ectomycorrhizal fungi, 33 percent hydrogel, and a maximum of 5.5 percent inert material.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas to receive plants, with Installer present, for compliance with requirements and conditions affecting installation and performance of the Work.
  - 1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
  - 2. Verify that plants and vehicles loaded with plants can travel to planting locations with adequate overhead clearance.
  - 3. Suspend planting operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
  - 4. Uniformly moisten excessively dry soil that is not workable or which is dusty.
- B. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Architect and replace with new planting soil.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities and turf areas and existing plants from damage caused by planting operations.

- B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.
- C. Lay out individual tree and shrub locations and areas for multiple plantings. Stake locations, outline areas, adjust locations when requested, and obtain Architect's acceptance of layout before excavating or planting. Make minor adjustments as required.
- D. Lay out plants at locations directed by Architect. Stake locations of individual trees and shrubs and outline areas for multiple plantings.

### 3.3 PLANTING AREA ESTABLISHMENT

- A. General: Prepare planting area for soil placement and mix planting soil according to Section 329113 "Soil Preparation."
- B. Placing Planting Soil: Blend planting soil in place
- C. Before planting, obtain Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.
- D. Application of Mycorrhizal Fungi: At time directed by Architect, broadcast dry product uniformly over prepared soil at application rate according to manufacturer's written recommendations.

### 3.4 EXCAVATION FOR TREES AND SHRUBS

- A. Planting Pits and Trenches: Excavate circular planting pits.
  - 1. Excavate planting pits with sides sloping inward at a 45-degree angle. Excavations with vertical sides are unacceptable. Trim perimeter of bottom leaving center area of bottom raised slightly to support root ball and assist in drainage away from center. Do not further disturb base. Ensure that root ball will sit on undisturbed base soil to prevent settling. Scarify sides of planting pit smeared or smoothed during excavation.
  - 2. Excavate approximately three times as wide as ball diameter for balled and burlapped stock.
  - 3. Excavate at least 12 inches (300 mm) wider than root spread and deep enough to accommodate vertical roots for bare-root stock.
  - 4. Do not excavate deeper than depth of the root ball, measured from the root flare to the bottom of the root ball.
  - 5. If area under the plant was initially dug too deep, add soil to raise it to the correct level and thoroughly tamp the added soil to prevent settling.
  - 6. Maintain angles of repose of adjacent materials to ensure stability. Do not excavate subgrades of adjacent paving, structures, hardscapes, or other new or existing improvements.
  - 7. Maintain supervision of excavations during working hours.
  - 8. Keep excavations covered or otherwise protected when unattended by Installer's personnel.

9. If drain tile is indicated on Drawings or required under planting areas, excavate to top of porous backfill over tile.
- B. Backfill Soil: Subsoil and topsoil removed from excavations may not be used as backfill soil unless otherwise indicated.
- C. Obstructions: Notify Architect if unexpected rock or obstructions detrimental to trees or shrubs are encountered in excavations.
  1. Hardpan Layer: Drill 6-inch- (150-mm-) diameter holes, 24 inches (600 mm) apart, into free-draining strata or to a depth of 10 feet (3 m), whichever is less, and backfill with free- draining material.
- D. Drainage: Notify Architect if subsoil conditions evidence unexpected water seepage or retention in tree or shrub planting pits.
- E. Fill excavations with water and allow to percolate away before positioning trees and shrubs.

### 3.5 TREE, SHRUB, AND VINE PLANTING

- A. Inspection: At time of planting, verify that root flare is visible at top of root ball according to ANSI Z60.1. If root flare is not visible, remove soil in a level manner from the root ball to where the top-most root emerges from the trunk. After soil removal to expose the root flare, verify that root ball still meets size requirements.
- B. Roots: Remove stem girdling roots and kinked roots. Remove injured roots by cutting cleanly; do not break.
- C. Balled and Burlapped Stock: Set each plant plumb and in center of planting pit or trench with root flare 2 inches (50 mm) above adjacent finish grades.
  1. Use planting soil as indicated for backfill.
  2. After placing some backfill around root ball to stabilize plant, carefully cut and remove burlap, rope, and wire baskets from tops of root balls and from sides, but do not remove from under root balls. Remove pallets, if any, before setting. Do not use planting stock if root ball is cracked or broken before or during planting operation.
  3. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
  4. Place planting tablets equally distributed around each planting pit when pit is approximately one-half filled. Place tablets beside the root ball about 1 inch (25 mm) from root tips; do not place tablets in bottom of the hole.
    - a. Quantity: Three for each caliper inch of plant.
  5. Continue backfilling process. Water again after placing and tamping final layer of soil.

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- D. Container-Grown Stock: Set each plant plumb and in center of planting pit or trench with root flare 1 inch (25 mm) above adjacent finish grades.
    - 1. Use planting soil as indicated for backfill.
    - 2. Carefully remove root ball from container without damaging root ball or plant.
    - 3. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
    - 4. Place planting tablets equally distributed around each planting pit when pit is approximately one-half filled. Place tablets beside the root ball about 1 inch (25 mm) from root tips; do not place tablets in bottom of the hole.
      - a. Quantity: Two per plant.
    - 5. Continue backfilling process. Water again after placing and tamping final layer of soil.
  - E. Slopes: When planting on slopes, set the plant so the root flare on the uphill side is flush with the surrounding soil on the slope; the edge of the root ball on the downhill side will be above the surrounding soil. Apply enough soil to cover the downhill side of the root ball.

### 3.6 MECHANIZED TREE-SPADE PLANTING

- A. Trees may be planted with an approved mechanized tree spade at the designated locations. Do not use tree spade to move trees larger than the maximum size allowed for a similar field-grown, balled-and-burlapped root-ball diameter according to ANSI Z60.1, or larger than manufacturer's maximum size recommendation for the tree spade being used, whichever is smaller.
- B. Use the same tree spade to excavate the planting hole as will be used to extract and transport the tree.
- C. When extracting the tree, center the trunk within the tree spade and move tree with a solid ball of earth.
- D. Cut exposed roots cleanly during transplanting operations.
- E. Plant trees following procedures in "Tree, Shrub, and Vine Planting" Article.
- F. Where possible, orient the tree in the same direction as in its original location.

### 3.7 TREE, SHRUB, AND VINE PRUNING

- A. Remove only dead, dying, or broken branches. Do not prune for shape.
- B. Prune, thin, and shape trees, shrubs, and vines as directed by Architect.
- C. Prune, thin, and shape trees, shrubs, and vines according to standard professional horticultural and arboricultural practices. Unless otherwise indicated by Architect, do not cut tree leaders; remove only injured, dying, or dead branches from trees and shrubs; and prune to retain natural character.

- D. Do not apply pruning paint to wounds.

### 3.8 TREE STABILIZATION

- A. Trunk Stabilization by Upright Staking and Tying: Install trunk stabilization as follows unless otherwise indicated on Drawings:
  1. Upright Staking and Tying: Stake trees of 2- through 5-inch (50- through 125-mm) caliper. Stake trees of less than 2-inch (50-mm) caliper only as required to prevent wind tip out. Use a minimum of two stakes of length required to penetrate at least 18 inches (450 mm) below bottom of backfilled excavation and to extend at least 72 inches (1830 mm) above grade. Set vertical stakes and space to avoid penetrating root balls or root masses.
  2. Support trees with two strands of tie wire, connected to the brass grommets of tree-tie webbing at contact points with tree trunk. Allow enough slack to avoid rigid restraint of tree.
  3. Proprietary Staking and Guying Device: Install staking and guying system sized and positioned as recommended by manufacturer unless otherwise indicated and according to manufacturer's written instructions.
- B. Root-Ball Stabilization: Install at- or below-grade stabilization system to secure each new planting by the root ball unless otherwise indicated on Drawings.
  1. Proprietary Root-Ball Stabilization Device: Install root-ball stabilization system sized and positioned as recommended by manufacturer unless otherwise indicated and according to manufacturer's written instructions.

### 3.9 PLACING SOIL IN PLANTERS

- A. Place a layer of drainage gravel at least 4 inches (100 mm) thick in bottom of planter. Cover bottom with filter fabric and wrap filter fabric 4 inches (100 mm) up on all sides. Duct tape along the entire top edge of the filter fabric, to secure the filter fabric against the sides during the soil- filling process.
- B. Fill planter with planting soil. Place soil in lightly compacted layers to an elevation of 1-1/2 inches (38 mm) below top of planter, allowing natural settlement.

### 3.10 GROUND COVER AND PLANT PLANTING

- A. Set out and space ground cover and plants other than trees, shrubs, and vines as indicated on Drawings in even rows with triangular spacing.
- B. Use planting soil for backfill.
- C. Dig holes large enough to allow spreading of roots.
- D. For rooted cutting plants supplied in flats, plant each in a manner that minimally disturbs the root system but to a depth not less than two nodes.

- E. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water.
- F. Water thoroughly after planting, taking care not to cover plant crowns with wet soil.
- G. Protect plants from hot sun and wind; remove protection if plants show evidence of recovery from transplanting shock.

### 3.11 PLANTING AREA MULCHING

- A. Install weed-control barriers before mulching according to manufacturer's written instructions. Completely cover area to be mulched, overlapping edges a minimum of 6 inches (150 mm) and secure seams with galvanized pins.
- B. Mulch backfilled surfaces of planting areas and other areas indicated.
  - 1. Organic Mulch in Planting Areas:
    - a. On-grade Conditions: Apply 3-inch (50-mm) average thickness of organic mulch over whole surface of planting area, and finish level with adjacent finish grades.
    - b. On-Structure Conditions: Apply 2-inch (75-mm) average thickness of organic mulch over whole surface of planting area, and finish level with adjacent finish grades.
    - c. Do not place mulch within 3 inches (75 mm) of trunks or stems.

### 3.12 EDGING INSTALLATION

- A. See Vegetated Green Roof Specification and Materials Schedule.

### 3.13 PLANT MAINTENANCE

- A. Maintain plantings by pruning, cultivating, watering, weeding, fertilizing, mulching, restoring planting saucers, adjusting and repairing tree-stabilization devices, resetting to proper grades or vertical position, and performing other operations as required to establish healthy, viable plantings.
- B. Fill in, as necessary, soil subsidence that may occur because of settling or other processes. Replace mulch materials damaged or lost in areas of subsidence.
- C. Apply treatments as required to keep plant materials, planted areas, and soils free of pests and pathogens or disease. Use integrated pest management practices when possible to minimize use of pesticides and reduce hazards. Treatments include physical controls such as hosing off foliage, mechanical controls such as traps, and biological control agents.

### 3.14 PESTICIDE APPLICATION

- A. Apply pesticides and other chemical products and biological control agents according to authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.

- B. Pre-Emergent Herbicides (Selective and Nonselective): Apply to tree, shrub, and ground-cover areas according to manufacturer's written recommendations. Do not apply to seeded areas.
- C. Post-Emergent Herbicides (Selective and Nonselective): Apply only as necessary to treat already-germinated weeds and according to manufacturer's written recommendations.

### 3.15 REPAIR AND REPLACEMENT

- A. General: Repair or replace existing or new trees and other plants that are damaged by construction operations, in a manner approved by Architect.
  - 1. Submit details of proposed pruning and repairs.
  - 2. Perform repairs of damaged trunks, branches, and roots within 24 hours, if approved.
  - 3. Replace trees and other plants that cannot be repaired and restored to full-growth status, as determined by Architect.
- B. Remove and replace trees that are more than 25 percent dead or in an unhealthy condition before the end of the corrections period or are damaged during construction operations that Architect determines are incapable of restoring to normal growth pattern.
  - 1. Provide new trees of same size as those being replaced.
  - 2. Species of Replacement Trees: Same species being replaced and/or Species selected by Architect.

### 3.16 CLEANING AND PROTECTION

- A. During planting, keep adjacent paving and construction clean and work area in an orderly condition. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.
- B. Remove surplus soil and waste material including excess subsoil, unsuitable soil, trash, and debris and legally dispose of them off Owner's property.
- C. Protect plants from damage due to landscape operations and operations of other contractors and trades. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.
- D. After installation and before Substantial Completion, remove nursery tags, nursery stakes, tie tape, labels, wire, burlap, and other debris from plant material, planting areas, and Project site.
- E. At time of Substantial Completion, verify that tree-watering devices are in good working order and leave them in place. Replace improperly functioning devices.

### 3.17 MAINTENANCE SERVICE

- A. Maintenance Service for Trees and Shrubs: Provide maintenance by skilled employees of landscape Installer. Maintain as required in "Plant Maintenance" Article. Begin maintenance immediately after plants are installed and continue until plantings are acceptably healthy and well established, but for not less than maintenance period below:
  - 1. Maintenance Period: 12 months from date of Substantial Completion.
- B. Maintenance Service for Ground Cover and Other Plants: Provide maintenance by skilled employees of landscape Installer. Maintain as required in "Plant Maintenance" Article. Begin maintenance immediately after plants are installed and continue until plantings are acceptably healthy and well established, but for not less than maintenance period below:
  - 1. Maintenance Period: 12 months from date of Substantial Completion.

END OF SECTION

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## SECTION 32 97 00 - VEGETATED ROOF ASSEMBLIES

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Continuous vegetated roof assemblies.

B. Related Requirements:

1. Section 072100 "Thermal Insulation" for roofing membrane, roof thermal insulation, aggregate or roof-paver ballast, and roofing system warranty.
2. Section 129300 "Site Furnishings" for exterior unit planters.

#### 1.2 DEFINITIONS

- A. Captured Water: Water that is retained in the drainage layer of a vegetated roof assembly after new water additions have ceased and that cannot escape the roof except through evaporation or plant transpiration.
- B. Finish Elevation: Elevation of finished growing-media surface of planting area.
- C. Planting Area: Areas to be planted.
- D. Plant; Plants; Plant Material: Vegetation in general, including trees, shrubs, vines, ground covers, ornamental grasses, bulbs, corms, tubers, or herbaceous vegetation.
- E. Growing Medium: Manufactured, lightweight soil mixture that promotes good growing conditions for specific varieties of plants.

#### 1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at the project site prior to construction at the request of the Landscape Architect.

#### 1.4 ACTION SUBMITTALS

A. Product Data: For each vegetated roof assembly.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Include material descriptions for each growing medium.

B. Sustainable Design Submittals:

1. LEED: Submit additional LEED submittals required by other Specifications Sections.

C. Shop Drawings: For each vegetated roof assembly.

1. Include plans, sections, slopes, and drain locations.
  2. Indicate dimensions, weights, and loads.
  3. Detail field assembly of components, depth of growing media, and attachments to other work.
  4. Indicate walkway pavers, geofoam fill, locations of irrigation, coordination with lighting, and accessories.
- D. Samples for Verification: For each of the following components of vegetated roof assembly:
1. Drainage / water Retention Component: 12 by 12 inches (300 by 300 mm)
  2. Filter Fabric: 12 by 12 inches (300 by 300 mm).
  3. Growing Media: 1-pint (0.5-liter) volume of each growing medium, in sealed plastic bags labeled with content and source. Each Sample shall be typical of the lots of growing media to be furnished. Provide an accurate representation of texture and composition.
  4. Access Boxes: One in each size and color required.

## 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Certificates: For each type of manufactured product.
  1. Manufacturer's certified analysis of standard products.
  2. Analysis of other materials by a recognized laboratory, according to methods established by the Association of Official Analytical Chemists, where applicable.
- C. Product Test Reports: For complete analysis of each growing medium, for tests performed by manufacturer and witnessed by a qualified testing agency or by a qualified testing agency.
- D. Field quality-control reports.
- E. Sample Warranty: For special warranties.

## 1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For vegetated roof assembly and plants, including a recommended maintenance plan with procedures for inspection and care during a calendar year. Submit before start of required warranty and maintenance periods.
- B. Continuing Maintenance Proposal: From vegetated roof assembly Installer approved by roofing-membrane manufacturer to Owner, in the form of a standard one-year maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.

## 1.7 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified vegetated roof assembly Installer, approved, authorized, or licensed by roofing-membrane manufacturer, whose work has resulted in successful establishment of vegetated roofs.
  - 1. Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when vegetated roof assembly work is in progress.

## 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of conformance with state and Federal laws if applicable.
- B. Bulk Materials:
  - 1. Do not dump or store bulk materials on or near structures, utilities, walkways and pavements, or existing roof areas or plants.
  - 2. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of debris-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
  - 3. Accompany each delivery of bulk materials with product certificates.
- C. Handle and store materials, and place equipment in a manner to avoid overloading roof structure or damaging roofing membrane.

## 1.9 FIELD CONDITIONS

- A. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions and warranty requirements.

## 1.10 WARRANTY

- A. Special Warranty for Vegetated Roof Assembly: Installer agrees to repair or replace components of vegetated roof assembly that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, ponding water or prolonged wetness of growing medium caused as a result of failure of the assembly to properly drain.
  - 2. Warranty Period: Five years from date of Substantial Completion.
- B. Special Warranty for Plant Growth: Installer agrees to repair or replace plantings and accessories that fail in materials, workmanship, or growth within specified warranty period.

1. Foliage Cover: Planted materials shall grow to achieve and maintain at least 80 percent foliage cover over planting area commencing 24 months after planting, through the duration of this warranty.
2. Failures include, but are not limited to, death and unsatisfactory growth except for defects resulting from abuse, lack of adequate maintenance, neglect by Owner, or incidents that are beyond Contractor's control.
3. Warranty Period: From date of Substantial Completion as follows:
  - a. Trees and Shrubs: Two years.
  - b. Ground Covers, Perennials, Vines, and Ornamental Grasses: Two number years.
4. Include the following remedial actions as a minimum:
  - a. Immediately remove dead plants and replace unless required to plant in the succeeding planting season.
  - b. Replace plants that are more than 25 percent dead or in an unhealthy condition at end of warranty period.
  - c. A limit of one replacement of each plant will be required except for losses or replacements due to failure to comply with requirements.
5. Provide extended warranty for period equal to original warranty period, for replaced plant material.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Source Limitations: Furnish and install a completed vegetated roof assembly from the single- source to ensure total system compatibility and integrity.
- B. Manufacturer:
  1. See materials schedule for more information.

### 2.2 VEGETATED ROOF ASSEMBLY COMPONENTS

- A. Refer to specifications provided by Architect for Substrate, waterproofing, rootstop, and insulation.
- B. Drainage / Water Retention Component
  1. Three-dimensions, molded panels of recycled polyethylene with drainage channels top and bottom sides and water retention reservoirs top side shall meet the following physical properties
  2. See materials schedule for more information.

3. Expanded lightweight aggregate for use as fill material for drainage / water retention component as required.
  4. See materials schedule for more information.
- C. Filter Fabric
1. Non-woven, polymeric, geotextile fabric
  2. See materials schedule for more information.
- D. Growing Media
1. Custom growing media mix capable of supporting vigorous growing of the specified vegetation, complying with the following specification.

## 2.3 ACCESSORIES

- A. Access Boxes: Manufacturer's standard stainless-steel boxes with removable, rigid covers for accessing drains, valves, and switches beneath the finish elevation of growing medium; secure each cover with four noncorrosive screws.
  1. Products: Subject to compliance with the requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. JDR Enterprises, Inc.; Access Box
    - b. ZinCo USA, Inc.; Inspection Chamber
  2. Size: 12 inches (305 mm) in diameter by depth of vegetated roof assembly at each location as shown on Drawings for each location.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine each area to receive vegetated roof assembly for compliance with requirements for installation tolerances and other conditions affecting performance.
  1. Verify that roof insulation over roofing membrane is in place, secure, and flush along all seams.
  2. Verify that perimeter and other flashings are in place and secure along entire lengths where they will be covered by vegetated roof assembly.
- B. Inspect growing medium.
  1. Verify that no foreign or deleterious material or liquid, such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in growing medium within a planting area.

2. If growing medium is contaminated by foreign or deleterious material or liquid, remove growing medium and contamination and replace with new growing medium.

### 3.2 INSTALLATION, GENERAL

- A. Protection Course: Cover roofing system with protection board with butted and fully taped joints before roofing system is subject to vegetated roof assembly installation work.
- B. Install vegetated roof assembly according to manufacturer's written instructions.
- C. Access Boxes: Install access box at each drain, valve, and switch and at locations shown on Drawings. Install top of boxes beneath the finish elevation of growing medium.

### 3.3 PLANTING

- A. Perform planting according to vegetated roof assembly manufacturer's written instructions.
- B. Do not place growing medium or plants during frozen, wet, or muddy conditions.
- C. Suspend spreading, grading, and planting operations during periods of excessive moisture until the moisture content in growing medium reaches acceptable levels to attain the required results.
- D. Uniformly moisten an excessively dry growing medium that is too dusty or unworkable.
- E. Preplanted Vegetative Mat: Install in full contact with growing medium and secure in position.
- F. Site Planting: Plant vegetated roofs according to requirements specified in Section 329200 "Turf and Grasses." And Section 329300 "Plants." except as otherwise indicated on Drawings and required by vegetated roof assembly manufacturer's written instructions. Perform digging carefully to prevent damaging roofing system below the vegetated roof assembly.
- G. Individual Plant Planting: Set out and space plants other than grasses and wildflowers as indicated on Drawings in even rows with triangular spacing.
  1. Dig holes large enough to allow spreading of roots.
  2. Free up or remove girdling roots.
  3. Work growing medium around roots to eliminate air pockets.
  4. Water thoroughly after planting, taking care not to cover plant crowns with wet growing medium.
  5. Protect plants from hot sun and wind; remove protection if plants show evidence of recovery from transplanting shock.

### 3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage Division 07 membrane roofing manufacturer's authorized service representative to provide inspection of vegetated roof assembly installation and prepare inspection reports.

- B. Correct deficiencies in work that do not comply with requirements.

### 3.5 PROTECTION

- A. Protect vegetated roof assemblies from damage, including growing-medium contamination, due to operations of other contractors and trades. Repair or replace damaged vegetated roof assemblies.

### 3.6 MAINTENANCE SERVICE

- A. Maintenance Service: Provide maintenance by skilled employees of vegetated roof assembly Installer approved by roofing-membrane manufacturer. Begin maintenance immediately after plants are installed and continue until plantings are acceptably healthy and well established but for not less than the specified maintenance period.

1. Assembly and Plant Maintenance: During maintenance period, maintain plantings by pruning, cultivating, watering, weeding, fertilizing, mulching, restoring planting saucers, adjusting and repairing devices, resetting plants to proper elevations or vertical position, and performing other operations as required to establish healthy, viable plantings. Spray or treat as required to keep trees and shrubs free of insects and disease.
  - a. Replace growing medium that becomes displaced or eroded because of settling or other processes.
  - b. Apply treatments as required to keep plant materials, planted areas, and growing medium free of pests and pathogens or disease. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards. Treatments include physical controls such as hosing off foliage, mechanical controls such as traps, and biological control agents.
  - c. Use only products and methods acceptable to roofing-membrane manufacturer.
2. Maintenance Period: 12 months from date of Substantial Completion.

END OF SECTION

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## SECTION 33 41 00 - SUBDRAINAGE

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Building Perimeter and Under-Slab Drainage Systems.
- B. Filter aggregate and fabric and bedding.

#### 1.2 REFERENCE STANDARDS

- A. ASTM D2487 - Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System) 2017, with Editorial Revision (2020).
- B. ASTM D2729 - Standard Specification for Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings 2021.

#### 1.3 SUBMITTALS

- A. See Section 01 33 00 - SUBMITTAL PROCEDURES , for submittal procedures.
- B. Product Data: Provide data on pipe drainage products, pipe accessories, and filter fabric.
- C. Shop Drawings: Indicate dimensions, layout of piping, high and low points of pipe inverts, gradient of slope between corners and intersections.
- D. Project Record Documents: Record location of pipe runs, connections, cleanouts and principal invert elevations.

### PART 2 PRODUCTS

#### 2.1 REGULATORY REQUIREMENTS

- A. Comply with applicable code for materials and installation of the work of this section.

#### 2.2 PIPE MATERIALS

- A. Polyvinyl Chloride Pipe: ASTM D2729; plain end, 4 inch inside diameter; with required fittings.
- B. Corrugated Plastic Tubing: Flexible type; 4 inch diameter, with required fittings.
- C. Use perforated pipe at subdrainage system; unperforated through sleeved walls.

#### 2.3 AGGREGATE AND BEDDING

- A. Filter Aggregate and Bedding Material: Granular fill as specified in Section 31 23 23.
- B. Filter Aggregate and Bedding Material: Granular Fill - Gravel : Pit run washed stone; free of shale, clay, friable material and debris; Graded in accordance with ASTM D2487 Group Symbol GW.

- C. Filter Sand: Natural river or bank sand; washed; free of silt, clay, loam, friable or soluble materials, and organic matter.

1. Grade in accordance with ASTM D2487 Group Symbol SW.

## 2.4 ACCESSORIES

- A. Pipe Couplings: Solid plastic.
- B. Joint Covers: No. 15 asphalt saturated roofing felt.

# PART 3 EXECUTION

## 3.1 EXAMINATION

- A. Verify that trench cut is ready to receive work and excavations, dimensions, and elevations are as indicated on layout drawings.

## 3.2 PREPARATION

- A. Hand trim excavations to required elevations. Correct over-excavation with fill sand.
- B. Remove large stones or other hard matter that could damage drainage piping or impede consistent backfilling or compaction.

## 3.3 INSTALLATION

- A. Install and join pipe and pipe fittings in accordance with pipe manufacturer's instructions.
- B. Place drainage pipe on clean cut subsoil.
- C. Lay pipe to slope gradients noted on drawings; with maximum variation from true slope of 1/8 inch in 10 feet.
- D. Loosely butt pipe ends. Place joint cover strip 12 inches wide, around pipe diameter centered over joint.
- E. Place pipe with perforations facing down. Mechanically join pipe ends.
- F. Install pipe couplings.
- G. Install filter aggregate at sides, over joint covers and top of pipe. Provide top cover compacted thickness of 12 inches.
- H. Place filter fabric over levelled top surface of aggregate cover prior to subsequent backfilling operations.
- I. Place aggregate in maximum 4 inch lifts, consolidating each lift.
- J. Compact to 95 percent of maximum dry density. Do not displace or damage pipe when compacting.
- K. Place impervious fill over drainage pipe aggregate cover and compact.

- L. Connect to storm sewer system with unperforated pipe , through installed sleeves.
- M. Coordinate the Work with connection to municipal sewer utility service, and trenching.

#### 3.4 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Field inspection and testing.
- B. Request inspection prior to and immediately after placing aggregate cover over pipe.

#### 3.5 PROTECTION

- A. Protect pipe and aggregate cover from damage or displacement until backfilling operation begins.

END OF SECTION