



# Oregon State University

## GILL COLISEUM WOMEN'S BASKETBALL LOCKER ROOM RENOVATION

PROJECT NUMBER: 2148-19

### INVITATION TO BID #2020-000492

#### ADDENDUM NO. 3

ISSUE DATE: August 21, 2019

**CONTRACT ADMINISTRATOR:**

Shoshana Shabazz, Purchasing Analyst

Construction Contracts Administration

Email: [ConstructionContracts@oregonstate.edu](mailto:ConstructionContracts@oregonstate.edu)

This Addendum is hereby issued to inform you of the following revisions and or clarifications to the above-referenced ITB and/or the Contract Documents for the Project, to the extent they have been modified herein. Any conflict or inconsistency between this Addendum and the Solicitation Document or any previous addenda will be resolved in favor of this Addendum. Bids shall conform to this Addendum. Unless specifically changed by this Addendum, all other requirements, terms and conditions of the Solicitation Document and or Contract Documents, and any previous addenda, remain unchanged and can be modified only in writing by OSU. The following changes are hereby made:

**MODIFICATIONS:**

Item 1 **DELETE** the Bid Form in its entirety. **Replace** with the Bid Form attached to this addendum.

**TECHNICAL SPECIFICATIONS:**

Item 2 **DELETE** Section 01 23 00 - Alternates in its entirety. **Replace** with Section 01 23 00 - Alternates attached to this addendum.

Item 3 **DELETE** Section 03 35 43 - Polished Concrete Finishing in its entirety. **Replace** with Section 03 35 43 - Polished Concrete Finishing attached to this addendum.

Item 4 **DELETE** Section 09 30 00 - Tiling in its entirety. **Replace** with Section 09 30 00 - Tiling attached to this addendum.

- Item 5                    **DELETE** Section 10 28 00 - Toilet Accessories in its entirety. **Replace** with Section 10 28 00 - Toilet Accessories attached to this addendum.
- Item 6                    **DELETE Section** 10 51 00 - Solid Surface Lockers in its entirety. **Replace** with Section 10 51 00 - Solid Surface Lockers attached to this addendum.
- Item 7                    **DELETE** Section 21 00 00 - Fire Suppression Piping Systems in its entirety. **Replace** with Section 21 00 00 - Fire Suppression Piping Systems attached to this addendum.
- Item 8                    **DELETE** Section 22 00 00 - General Plumbing Requirements in its entirety. **Replace** with Section 22 00 00 - General Plumbing Requirements attached to this addendum.
- Item 9                    **DELETE** Section 22 05 00 - Common Work Results for Plumbing in its entirety. **Replace** with Section 22 05 00 - Common Work Results for Plumbing attached to this addendum.
- Item 10                   **DELETE** Section 22 05 23 - General Duty Valves for Plumbing Piping in its entirety. **Replace** with Section 22 05 23 - General Duty Valves for Plumbing Piping attached to this addendum.
- Item 11                   **DELETE** Section 22 05 29 – Hangers and Supports for Plumbing Piping and Equipment in its entirety. **Replace** with Section 22 05 29 – Hangers and Supports for Plumbing Piping and Equipment attached to this addendum.
- Item 12                   **DELETE** Section 22 07 00 - Plumbing Insulation in its entirety. **Replace** with Section 22 07 00 - Plumbing Insulation attached to this addendum.
- Item 13                   **DELETE** Section 22 11 16 - Domestic Water Piping in its entirety. **Replace** with Section 22 11 16 - Domestic Water Piping attached to this addendum.
- Item 14                   **DELETE** Section 22 11 19 - Domestic Water Piping Specialties in its entirety. **Replace** with Section 22 11 19 - Domestic Water Piping Specialties attached to this addendum.
- Item 15                   **DELETE** Section 22 13 16 - Sanitary Waste and Vent Piping in its entirety. **Replace** with Section 22 13 16 - Sanitary Waste and Vent Piping attached to this addendum.
- Item 16                   **DELETE** Section 22 13 19 - Sanitary Waste Piping Specialties in its entirety. **Replace** with Section 22 13 19 - Sanitary Waste Piping Specialties attached to this addendum.
- Item 17                   **DELETE** Section 22 40 00 - Plumbing Fixtures in its entirety. **Replace** with Section 22 40 00 - Plumbing Fixtures attached to this addendum.
- Item 18                   **DELETE** Section 23 00 00 - General HVAC Requirements in its entirety. **Replace** with Section 23 00 00 - General HVAC Requirements attached to this addendum.

- Item 19                    **DELETE** Section 23 05 00 - Basic HVAC Materials and Methods in its entirety. **Replace** with Section 23 05 00 - Basic HVAC Materials and Methods attached to this addendum.
- Item 20                    **DELETE** Section 23 05 53 - HVAC Identification in its entirety. **Replace** with Section 23 05 53 - HVAC Identification attached to this addendum.
- Item 21                    **DELETE** Section 23 05 93 - HVAC Testing, Adjusting, and Balancing in its entirety. **Replace** with Section 23 05 93 - HVAC Testing, Adjusting, and Balancing attached to this addendum.
- Item 22                    **DELETE** Section 23 07 00 - HVAC Insulation in its entirety. **Replace** with Section 23 07 00 - HVAC Insulation attached to this addendum.
- Item 23                    **DELETE** Section 23 09 00 - Instrumentation and Control Devices for HVAC Systems in its entirety. **Replace** with Section 23 09 00 - Instrumentation and Control Devices for HVAC Systems attached to this addendum.
- Item 24                    **DELETE** Section 23 31 00 - Metal Ducts in its entirety. **Replace** with Section 23 31 00 - Metal Ducts attached to this addendum.
- Item 25                    **DELETE** Section 23 33 00 - Duct Accessories in its entirety. **Replace** with Section 23 33 00 - Duct Accessories attached to this addendum.
- Item 26                    **DELETE** Section 23 37 10 - Grilles, Registers, and Diffusers in its entirety. **Replace** with Section 23 37 10 - Grilles, Registers, and Diffusers attached to this addendum.
- Item 27                    **DELETE** Section 26 05 00 - Common Work Results for Electrical in its entirety. **Replace** with Section 26 05 00 - Common Work Results for Electrical attached to this addendum.
- Item 28                    **DELETE** Section 27 05 00 - Common Work Results for Communications in its entirety. **Replace** with Section 27 05 00 - Common Work Results for Communications attached to this addendum.
- Item 29                    **DELETE** Section 28 05 00 - Common Work Results for Electronic Safety and Security in its entirety. **Replace** with Section 28 05 00 - Common Work Results for Electronic Safety and Security attached to this addendum.
- Item 30                    **ADD** Luminaire cut sheets: ALT-1\_Pinhole\_Lucifer attached to this addendum.
- Item 31                    **ADD** Luminaire cut sheets: L08\_BegaLimburgVanity\_Sconce attached to this addendum.
- Item 32                    **ADD** Luminaire cut sheets: L13\_PrudentialBionic attached to this addendum.



- Item 45                    **DELETE** Sheet A12.120 in its entirety. **Replace** with Sheet A12.120 located at <https://oregonstate.box.com/s/lqado8rvkrghy24mjzxyxr74blpb36>.
- Item 46                    **DELETE** Sheet A12.200 in its entirety. **Replace** with Sheet A12.200 located at <https://oregonstate.box.com/s/lqado8rvkrghy24mjzxyxr74blpb36>.
- Item 47                    **DELETE** Sheet AD1.100 in its entirety. **Replace** with Sheet AD1.100 located at <https://oregonstate.box.com/s/lqado8rvkrghy24mjzxyxr74blpb36>.
- Item 48                    **DELETE** Sheet ALT1 in its entirety. **Replace** with Sheet ALT1 located at <https://oregonstate.box.com/s/lqado8rvkrghy24mjzxyxr74blpb36>.
- Item 49                    **DELETE** Sheet ALT2 in its entirety. **Replace** with Sheet ALT2 located at <https://oregonstate.box.com/s/lqado8rvkrghy24mjzxyxr74blpb36>.
- Item 50                    **DELETE** Sheet ALT3 in its entirety. **Replace** with Sheet ALT3 located at <https://oregonstate.box.com/s/lqado8rvkrghy24mjzxyxr74blpb36>.
- Item 51                    **DELETE** Sheet G0.200 in its entirety. **Replace** with Sheet G0.200 located at <https://oregonstate.box.com/s/lqado8rvkrghy24mjzxyxr74blpb36>.
- Item 52                    **DELETE** Sheet G3.002 in its entirety. **Replace** with Sheet G3.002 located at <https://oregonstate.box.com/s/lqado8rvkrghy24mjzxyxr74blpb36>.
- Item 53                    **DELETE** Sheet G4.000 in its entirety. **Replace** with Sheet G4.000 located at <https://oregonstate.box.com/s/lqado8rvkrghy24mjzxyxr74blpb36>.
- Item 54                    **DELETE** Sheet G5.000 in its entirety. **Replace** with Sheet G5.000 located at <https://oregonstate.box.com/s/lqado8rvkrghy24mjzxyxr74blpb36>.
- Item 55                    **DELETE** Sheet GR1.100 in its entirety. **Replace** with Sheet GR1.100 located at <https://oregonstate.box.com/s/lqado8rvkrghy24mjzxyxr74blpb36>.

**QUESTIONS:**

- Item 56      **Question:** Are there elevations drawn that show the overall size of the vinyl graphics?  
A015-2 Vinyl Applied Wall Graphic  
A025-1 Full Height Vinyl Applied Wall Graphic
- Answer:** Yes, refer to A11.101 in Addendum No. 3.
- Item 57      **Question:** Are there elevations draw that show the overall size of the alternate/optional video wall?
- Answer:** Yes, refer to ALT2 in Addendum No. 3.
- Item 58      **Question:** Are the items designated with the ‘preferred fabricator’ (Moss, Inc) open to bid?  
A013-2 Suspended Ceiling Beaver Logo  
A015-1 Pin-Mounted Beaver Logo  
A022-1 Fabric Wall Graphic  
A022-2 Fabric Wall Graphic  
A022-3 Fabric Wall Graphic
- Answer:** Moss Inc is Basis of Design. Contractor may propose alternate manufacturer/fabricator. Manufacturer/fabricator to provide system installation details for review and approval. Refer to GR1.100 in Addendum No. 3.
- Item 59      **Question (Follow up to Item 51):** If so, are there drawings that elaborate on these details?
- Answer:** See Answer to Item 51.
- Item 60      **Question:** Sheets A1.100 sheet note 01 states “Custom Premium Lockers. Alternate A: 10 51 23 – Plastic Laminate Clad Lockers; Alternate B: 10 51 00 – Solid Surface Lockers”. These alternates A and B for the Custom Premium Lockers are also referenced on sheets A12.100, A12.110, and A12.120.  
There is no Alternate A and B listed on the Bid Form or in the 01 23 00 – Alternates specification section, only Alternates 1, 2 and 3. Please clarify how this note corresponds to the alternates.
- Answer:** The intent is to have the player lockers to be either Plam or solid surface, to have the contractor get bids for both and then to have OSU decide based on durability and pricing information which option they would like. Sheet notes have been revised to reflect this intent and are included in Addendum No. 3.

- Item 61                    **Question:** Addendum 1 consists of the Stantec A/V Specification and narrative. After thorough review of the bid documents and this addendum, it is unclear if this A/V specification was provided for Electrical scope reference or to be included in the overall project scope. Is the engineering, provision and installation of the audio-visual system intended to be bid as part of the project scope of work?
- Answer:** The AV Narrative is a basis of design and should be bid as a part of the project scope of work (engineering, provision and installation). With the exception, that OSU will purchase the WAPs.
- Item 62                    **Question:** The ALT-1 drawing (ALT1) reflected ceiling plan references an ALT-1 Lighting Schedule for light fixture types. An ALT-1 luminaire schedule is not included in the bid documents. Please provide.
- Answer:** Refer to updated ALT-1 in Addendum No. 3
- Item 63                    **Question:** 3. The locker material shown is to be determined two alternates (A: Plastic Laminate-clad, B: Solid Surface). Which material is to be included as the base bid?
- Answer:** Refer to updated sheet notes and section 01 23 00 in Addendum No. 3

**SUBSTITUTION REQUEST:**

The following additional manufacturers are approved subject to performance and qualification as Specified.

- Item 64                    **Section Number:** 26 51 00  
                                 **Specified Item:** Type L09-4, Lithonia CLX Series  
                                 **Approved Substitute:** Metalux SNLED
- Item 65                    **Section Number:** 26 51 00  
                                 **Specified Item:** Type L11, Lighthouse C3P Bro Series  
**Approved Substitute (as noted):** Lindsley Lighting Reed Pendant (Lumen output and voltage would need to match for no exception to be taken to proposed fixture)
- Item 66                    **Section Number:** Drawing, E7.100. Sheet Notes, Note 11  
                                 **Specified Item:** Provide Myers Illuminator Inverter  
**Approved Substitute (as noted):** Evenlite, LM1600-1P-IA-OA-C10 (Match breaker quantity)
- Item 67                    **Section Number:** Drawings, E7.100  
                                 **Specified Item:** Luminaires, TYPE L02, Metalux, 22RDI Series  
**Approved Substitute:** Day-Brite, 2EVG30L835-2-D-UNV-DIM

- Item 68                    **Section Number:** Drawings, E7.100  
                              **Specified Item:** Luminaires, TYPE L09-4, Lithonia, CLX Series  
  
                              **Approved Substitute:** Day-Brite, FSS430L835-UNV-DIM
- Item 69                    **Section Number:** Drawings, E7.100  
                              **Specified Item:** Luminaires, TYPE L14, Finelite, SEEM2 Series  
  
                              **Approved Substitute:** Ledalite, 3908LBEQS1167DE
- Item 70                    **Section Number:** Drawings, E7.100  
                              **Specified Item:** Luminaires, TYPE X01, Sure-Lites, CX Series  
  
                              **Approved Substitute:** Evenlite, SOVACR1C BARCUC
- Item 71                    **Section Number:** Drawings, E7.100  
                              **Specified Item:** Luminaires, TYPE X02, Sure-Lites, CX Series  
  
                              **Approved Substitute:** Evenlite, SOVACR2M BARCUC

END OF ADDENDUM NO. 3





## BID FORM

ITB NUMBER & NAME: 2020-000492, Gill Coliseum Women's Basketball Locker Room Renovation

BID DUE DATE AND TIME: \_\_\_\_\_  
(fill in)

FROM: \_\_\_\_\_  
(Name of Contractor)

TO: Oregon State University ("Owner")  
Construction Contracts Administration  
644 SW 13th Street  
Corvallis, Oregon 97333

1. The Undersigned hereby proposes to furnish all material and labor and perform all work hereinafter indicated for the above project in strict accordance with the Contract Documents for the Base Bid as follows:

\_\_\_\_\_ Dollars (\$\_\_\_\_\_)

and the Undersigned agrees to be bound by the documents either contained in or incorporated by reference in the Invitation to Bid and ADDENDA numbered \_\_\_\_ through\_\_\_\_, inclusive. (fill in blanks)

The Undersigned proposes to add to or deduct from the Base Bid indicated above the items of work relating to the following Alternate(s) as designated in the Specifications:

ALTERNATE 1: Team Room Wet Area. (circle one) ADD / DEDUCT : \$\_\_\_\_\_

ALTERNATE 2: Pre-Game Digital Wall. (circle one) ADD / DEDUCT : \$\_\_\_\_\_

ALTERNATE 3: Premium Lounge and Teaching Room. (circle one) ADD / DEDUCT : \$\_\_\_\_\_

ALTERNATE 4: Lockers. (circle one) ADD / DEDUCT : \$\_\_\_\_\_

2. The work shall be completed within the time stipulated and specified in Division 1, Section 01 11 00, of the Specifications.

3. The Undersigned certifies that: (1) This Bid has been arrived at independently and is being submitted without collusion with and without any agreement, understanding, or planned common course of action with any other vendor of materials, supplies, equipment or services described in the invitation to bid designed to limit independent bidding or competition; and (2) The contents of the Bid have not been communicated by the Undersigned or its employees or agents to any person not an employee or agent of the Undersigned or its surety on any Bid security furnished with the Bid and will not be communicated to such person prior to the official opening of the Bid.

4. The Undersigned agrees, if awarded a contract, to comply with the provisions of ORS 279C.800 through 279C.870 pertaining to the payment of the prevailing wages.

5. Contractor's CCB license number is \_\_\_\_\_. As a condition to submitting a Bid, Contractor must be licensed with the Oregon Construction Contractors Board in accordance with ORS 701.021 to 701.128, and disclose the license number. Failure to be licensed and disclose the number will render the Bid unresponsive and it will be rejected, unless contrary to federal law.

6. The Bidder hereby certifies that all subcontractors who perform construction work as described in ORS 701.005(5) are licensed with the Construction Contractors Board in accordance with ORS 701.021 to 701.128 at the time the Bid is submitted.

7. Contractor's Project Manager for this project is: \_\_\_\_\_,

Email: \_\_\_\_\_ Cell Phone: \_\_\_\_\_.

8. The Undersigned agrees, if awarded the Contract, to deliver to Owner, a satisfactory Performance Bond and Payment Bond, each in an amount equal to one hundred (100) percent of the Contract sum, using forms provided by the Owner. The surety requested to issue the Performance Bond and Payment Bond will be:

\_\_\_\_\_  
*(name of surety company - not insurance agency)*

The Undersigned hereby authorizes said surety company to disclose any information to the Owner concerning the Undersigned's ability to supply a Performance Bond and Payment Bond each in the amount of the Contract.

By signature below, Contractor agrees to be bound by this Bid.

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

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

\_\_\_\_\_

FEDERAL TAX ID: \_\_\_\_\_

TELEPHONE NO: \_\_\_\_\_

SIGNATURE: \_\_\_\_\_

Authorized Signature

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

\*\*\*\*\* END OF BID \*\*\*\*\*

**SECTION 01 23 00**

**ALTERNATES**

**PART 1 - GENERAL**

**1.01 SECTION INCLUDES**

- A. The alternates described in this Section may be exercised at the option of the Owner within 60 days of the execution of the Contract.
- B. It is generally the practice of the Owner to exercise alternates in numerical order.
- C. The Owner reserves the right to accept the alternates without regard to order or sequence; but, such acceptance shall not impair the selection of a low, responsible and responsive bidder to whom the Contract may be awarded under an equitable bid procedure.

**1.02 QUALITY ASSURANCE**

- A. For each alternate which is accepted, coordinate the work of the various trades involved, and modify surrounding work as required to complete the project as intended.
- B. In the change-in-price figure for each alternate, include incidental costs which are attributable to adjustments in the work of other trades which may be required to achieve the contemplated and final conditions.
- C. Questions:
  - 1. If there is a question regarding the extent, scope, nature, or intent of the alternates, contact the Owner's Authorized Representative for clarification.
  - 2. Failure on the part of the Contractor to clarify any unclear items shall not relieve the Contractor of the responsibility for performing the selected alternates in accordance with the intent and requirements of the Project Manual and Drawings.
  - 3. The description of the alternates hereinafter is qualitative and not quantitative; the Contractor shall determine the quantities of labor and materials and the extent of same required to execute the selected alternates in accordance with the intent and requirements of the Project Manual and Drawings.
  - 4. The applicable Sections of the Specifications apply to the work under each alternate.

**1.03 LIST OF ALTERNATES**

- A. A. Alternate No. 1: Team Room Wet Area.
  - 1. Alternate: Provide price to renovate team wet area as indicated on Drawings. Sheet ALT 1 - New paint, wall tile, floor tile and lighting fixtures in Team Room wet area. No change in fixture type or count.
- B. Alternate No. 2: Pre-Game Digital Wall.
  - 1. Alternate: Provide price to renovate Pre-Game area as indicated on Drawings. Sheet ALT 2 - Infrastructure for future Digital LED wall.
- C. Alternate No. 3: Premium Lounge and Teaching Room.

1. Alternate: Provide price to renovate Teaching Room and Lounge as indicated on Drawings. Sheet ALT 3 – Premium finishes, glass swing doors and new lecture tables.

D. Alternate No. 4: Lockers

1. Alternate: Provide price to provide Plastic Laminate-Clad Lockers as specified in Section 10 51 23, in lieu of Base Bid - Solid Surface Lockers specified in Section 10 51 00.

**END OF SECTION 01 23 00**

## SECTION 03 35 43 - POLISHED CONCRETE FINISHING

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Polished concrete finishing, including staining.
2. Concrete for polished concrete, including concrete materials, mixture design, placement procedures, initial finishing, and curing as specified in Section 03 30 00 "Cast-in-Place Concrete."

#### 1.2 RELATED SECTIONS

- A. Section 09 93 00 – Staining and Transparent Finishing.

#### 1.21.3 DEFINITIONS

- A. Design Reference Sample: Sample designated by Architect in the Contract Documents that reflects acceptable surface quality and appearance of polished concrete.

#### 1.31.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with polished concrete to attend, including the following:
    - a. Contractor's superintendent.
    - b. Polished concrete finishing Subcontractor.
  2. Review cold- and hot-weather concreting procedures, curing procedures, construction joints, concrete repair procedures, concrete finishing, and protection of polished concrete.

#### 1.41.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Polishing Schedule: Submit plan showing polished concrete surfaces and schedule of polishing operations for each area of polished concrete before start of polishing operations. Include locations of all joints, including construction joints.

- C. Samples for Verification: For each type of exposed color.

#### 1-51.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Material Certificates: For each of the following, signed by manufacturers:
1. Repair materials.
  2. Stain materials.
  3. Liquid floor treatments.

#### 1-61.7 QUALITY ASSURANCE

- A. All materials used in the Polished Concrete System shall be manufactured and provided by a single manufacturer to ensure compatibility.
- B. Use adequate numbers of skilled workmen thoroughly trained and experienced in the necessary crafts and completely familiar with the specified requirements and methods needed for proper performance of the work of this section.
- C. Contractor shall have a minimum of 3 years' experience installing polished concrete system of this type which is required for this project and who is acceptable to the manufacturer.
1. Applicator shall designate a single individual as project foreman who shall be on site at all times during installation.
  2. Contractor must show and have QCA Qualified Contractor/Applicator paperwork from the manufacturer of the coating system, as required to obtain a long-term jobsite specific warranty.
- D. Convene a pre-application meeting before the start of application of polished concrete system. Require attendance of parties directly affecting work of this section, including: Architect, contractor, applicator, and authorized representative of the coating system manufacturer and interfacing trades. Review the following:
1. Drawings and specifications affecting work of this section.
  2. Protection of adjacent surfaces.
  3. Surface preparation and substrate conditions.
  4. Application.
  5. Desired aggregate exposure, reflective clarity and reflective sheen.
  6. Field quality control.
  7. Protection of coating system.
  8. Repair of polished concrete system.
  9. Coordination with other work.

- E. Mockups: Before casting concrete, build mockups to verify selections made under Sample submittals and to demonstrate typical joints, surface finish, tolerances, and standard of workmanship. Build mockups to comply with the following requirements, using materials indicated for the completed Work:
1. Build mockups in the location and of the size indicated or, if not indicated, as directed by Architect.
  2. Demonstrate curing, finishing, and protecting of polished concrete.
  3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

#### **1.71.8 DELIVERY, STORAGE AND HANDLING**

- A. Delivery: Materials shall be delivered to the job site in sealed, undamaged containers. Each container shall be clearly marked with manufacturer's label showing type of material, color, and lot number.
- B. Storage: Store all materials in a clean, dry place with a temperature range in accordance with manufacturer's instructions.
- C. Handling: Handle products carefully to avoid damage to the containers. Read all labels and Safety Data Sheets prior to use.

#### **1.81.9 FIELD CONDITIONS**

- A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.
- B. Maintain environmental conditions (temperature and weather) within the limits recommended by the manufacturer.
- C. Before any work is started, the applicator shall examine all surfaces for any deficiencies. Should any deficiencies exist, the architect, owner or general contractor shall be notified in writing and any corrections necessary shall be made.
- D. Protect concrete slabs from staining prior to application of concrete polishing system.
- E. Diaper hydraulic powered equipment.
- F. Place drop cloths under parked vehicles.
- G. Do not store structural steel or metal fabrications on slab.
- H. Do not allow pipe-cutting machine on slab.

## **PART 2 - PRODUCTS**

### **2.1 STAIN MATERIALS**

- A. Penetrating Stain: Water-based, acrylic latex, penetrating stain with colorfast pigments.
  - 1. Basis of Design Manufacturer: Subject to compliance with requirements, provide Westcoat Fast Stain Polish System, or products by one of the following:
    - a. Americrete, Inc.
    - b. Bomanite Co.
    - c. Bon Tool Co.
    - d. NewLook International, Inc.
    - e. Scofield, a Business Unit of Sika Corporation.
    - f. SuperStone, Inc.

### **2.2 LIQUID FLOOR TREATMENTS**

- A. Penetrating Liquid Floor Treatments for Polished Concrete Finish: Clear, waterborne solution of inorganic silicate or silicate materials and proprietary components; odorless; that penetrates, hardens, and is suitable for polished concrete surfaces.
  - 1. Basis of Design Manufacturer: Subject to compliance with requirements, provide Westcoat Specialty Coating products or by one of the following:
    - a. ARDEX Americas.
    - b. Euclid Chemical Company (The); an RPM company.
    - c. Laticrete International, Inc.
    - d. MAPEI Corporation.
    - e. PROSOCO, Inc.

### **2.3 COMPONENTS**

- A. Cementitious Patching Compound:
  - 1. TC-29 Concrete Patch (10 lb. bag) No substitutes will be considered.
- B. Concrete Densifier:
  - 1. SC-21 Lithium Silicate (1 & 5 gal pails) No substitutes will be considered.
- C. Concrete Dye Stain:
  - 1. SC-36 Fast Stain (1 & 5 gal units) No substitutes will be considered.
- D. Concrete Polish Guard:
  - 1. SC-24 Polish Guard (1 & 5 gal pails) No substitutes will be considered.



## **2.4 ACCESSORIES**

### **A. Supplemental Materials:**

1. Polyurea Joint Filler such as Hi-Tech Systems shall be used for joint treatments.
2. Grouting Materials: Contact Westcoat for Grouting material options.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

#### **A. Verification of conditions.**

1. Inspect all surfaces to receive the Polished Concrete System. Verify that surfaces are dry, clean, and free of contaminants, grease, oil, dust or curing agents.
2. The concrete must be a minimum 2,500 psi, 3 ½ inches thick and meet local building codes.
3. Be sure to examine the floor for any metal, rebar or other foreign material that may damage diamond tooling.
4. Determine the hardness of the concrete by using a MOHS Hardness Test Kit.
5. Before starting work, report in writing to the owner any unsatisfactory conditions.

### **3.2 SURFACE PREPARATION**

#### **A. General:**

1. Remove existing floor coatings, paint, all non-concrete materials, dirt, laitance and any foreign material.
2. Complete surface preparation per manufacturer's written instructions.

### **3.3 POLISHING**

#### **A. Polish: Level 3: High sheen, 800 grit.**

#### **B. Apply polished concrete finish system to cured and prepared slabs to match accepted mockup.**

1. Machine grind floor surfaces to receive polished finishes level and smooth and to depth required to reveal aggregate to match approved mockup.
2. Apply penetrating liquid floor treatment for polished concrete in polishing sequence and according to manufacturer's written instructions, allowing recommended drying time between successive coats.
3. Apply penetrating stain for polished concrete in polishing sequence and according to manufacturer's written instructions.
4. Continue polishing with progressively finer-grit diamond polishing pads to gloss level, to match approved mockup.
5. Control and dispose of waste products produced by grinding and polishing operations.

6. Neutralize and clean polished floor surfaces.

### **3.4 STAINING**

- A. Prepare surfaces according to manufacturer's written instructions and as follows:
  1. Clean concrete thoroughly by scraping, applying solvents or stripping agents, sweeping and pressure washing, or scrubbing with a rotary floor machine and detergents recommended by stain manufacturer. Rinse until water is clear and allow surface to dry.
  2. Test surfaces with droplets of water. If water beads and does not penetrate surface, or penetrates only in some areas, profile surfaces by grinding, sanding, or abrasive blasting. Retest and continue profiling surface until water droplets immediately darken and uniformly penetrate concrete surfaces.
- B. Allow concrete surface to dry before applying stain. Verify readiness of concrete to receive stain according to ASTM D4263 by tightly taping 18-by-18-inch (450-by-450-mm), 4-mil- (0.1-mm-) thick polyethylene sheet to a representative area of concrete surface. Apply stain only if no evidence of moisture has accumulated under sheet after 16 hours.
- C. Penetrating Stain: Apply penetrating stain to concrete surfaces according to manufacturer's written instructions and as follows:
  1. Apply first coat of stain to dry, clean surfaces by airless sprayer or by high-volume, low-pressure sprayer.
  2. Allow to dry four hours and repeat application of stain in sufficient quantity to obtain color consistent with approved mockup.
  3. Rinse until water is clear. Control, collect, and legally dispose of runoff.

### **3.5 FIELD QUALITY CONTROL**

- A. Verify other materials are as specified.
- B. Verify coverages and finish of the system as work progresses.
- C. Manufacturer's representative shall provide technical assistance and guidance for surface preparation and application of Polished Concrete System.

### **3.6 PROTECTION AND CLEAN-UP**

- A. Installation areas must be kept free from traffic and other trades during the application procedure and cure time.
- B. Protect finished surfaces of Polished Concrete System from damage during construction.
- C. Touch-up, repair or replace damaged Polished after substantial completion.

- D. Clean area and remove all debris upon completion of work. Dispose of empty containers properly according to current Local, State and Federal regulations.
- E. Allow material to cure 4 to 6 hours before light pedestrian traffic is permitted, 24 hours before heavy traffic and an additional 48 hours before heavy objects are placed on the surface.

**3.7 MAINTENANCE**

- A. Contractor shall provide to owner, maintenance and cleaning instructions for the Polished Concrete System upon completion of work. Owner is required to clean and maintain the surfaces to maintain manufacturer's warranty.

**END OF SECTION 03 35 43**

## **SECTION 09 30 00 - TILING**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. Section includes ceramic, porcelain, and glass tile.

#### **1.2 PERFORMANCE REQUIREMENTS**

- A. General: Provide floor tiles complying with one of the following standard and performance requirements.
- B. Dynamic Coefficient of Friction (DCOF): For tile installed on walkway surfaces, provide products with the following value as determined by testing identical products by the DCOF AcuTest Method per ANSI 137.1, 2012 Edition.
  - 1. Walkway Surfaces: Minimum 0.42.

#### **1.3 ACTION SUBMITTALS**

- A. Product Data: For each product indicated.
- B. Shop Drawings: Submit shop drawings showing the extent of each type of movement joint. Show widths, details, and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.
- C. Samples: Submit samples showing full range of color and texture variations expected.
  - 1. Full size units of each type, composition, color, and finish of tile. Submit at least three samples of each tile proposed. Where tile size is smaller than 6- by-6-inches (150-by-150-mm), submit sample boards a minimum of 12-by-12-inches (300-by-300-mm) showing variation of color and finish.
  - 2. Assembled samples with grouted joints for each color grout and for each type, composition, color, and finish of tile. Minimum size 12-by-12-inches (300-by-300-mm) or 3 full tiles.
  - 3. Metal edge strip in 6-inch (150-mm) lengths, each type.

#### **1.4 INFORMATIONAL SUBMITTALS**

- A. Test Reports: Submit test reports from qualified independent testing laboratory indicating and interpreting test results relative to compliance of tile products with requirements specified for slip resistance.

- B. Master Grade Certificates: Submit master grade certificates for each shipment, type, and composition of tile, signed by tile manufacturer and Installer.
- C. Product Certificates: Submit manufacturer's certifications for each type of grout and bonding material being provided suitable for the intended use and meet or exceed the referenced standards and the requirements of this Specification.

## **1.5 CLOSEOUT SUBMITTALS**

- A. Maintenance Instructions: Submit maintenance instructions for each type of product specified.

## **1.6 MAINTENANCE MATERIAL SUBMITTALS**

- A. Provide attic stock equal to the following for each type, color, pattern, and size (or fraction thereof) of tile provided for the Project. Supply in manufacturer's unopened containers, identified with name, brand type, grade, class and all other qualifying information, to a location where directed by the Owner.
  - 1. Two percent of amount installed but not less than one box.

## **1.7 QUALITY ASSURANCE**

- A. Installer: Engage an installer, with a minimum of 5 years of successful commercial tile installations similar in material, design, and scope to that indicated.
- B. Source Limitations for Tile: Obtain tile from one source or producer, and from same production run, and of consistent quality in appearance and physical properties for each contiguous area.
- C. Field-Constructed Sample Installations: Before installing tile, erect sample installations for each form of construction and finish required to verify selections made under sample submittals and to demonstrate aesthetic effects as well as qualities of materials and execution. Build sample installations to comply with the following requirements, using materials indicated for final unit of Work.
  - 1. Locate sample installations on site, in locations and size indicated or, if not shown or indicated, as directed by Architect but not less than 100 sq. ft. (9.29 sq. m) area for floors, and not less than 100 sq. ft. (9.29 sq. m) area for walls.
  - 2. Retain and maintain sample installations during construction in undisturbed condition as a standard for judging completed unit of Work.
  - 3. Approved sample installations may become part of the completed Work if undisturbed at time of Substantial Completion.

## **1.8 PREINSTALLATION MEETING**

- A. Prior to the installation of tile, and at the Contractor's direction, meet at the Project site to review the material selections, substrate preparations, installation procedures, coordination with other trades, special details and conditions, standard of workmanship, and other pertinent topics related to the Work. The meeting shall include the Owner, Architect, the Contractor, tile installer, tile and setting material manufacturer's representatives, and representatives of other trades or subcontractors affected by the installation.

## **1.9 DELIVERY STORAGE AND HANDLING**

- A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirement in ANSI A137.1 for labeling sealed tile packages.
- B. Prevent damage or contamination to materials by water, freezing, foreign matter, and other causes.

## **1.10 FIELD CONDITIONS**

- A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.
- B. Provide minimum 28 day cure of concrete and concrete masonry units before the installation of the tile work.
- C. Maintain temperatures within range recommended by the mortar and grout manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C), in spaces during tile setting. After installation maintain temperatures within range recommended by the mortar and grout manufacturer
- D. Close spaces to traffic during tile flooring installation.
- E. Close spaces to traffic for 72 hours after tile flooring installation.
- F. Shade all tile, materials and the work area from direct sunlight during the installation as needed to prevent rapid evaporation caused by excessive heat or wind.

## **PART 2 - PRODUCTS**

### **2.1 TILE PRODUCTS, GENERAL (TL##)**

- A. ANSI Ceramic Tile Standard: Provide 'Standard Grade' tile that complies with ANSI A137.1 "Specifications for Ceramic Tile," ANSI A137.2, "Specifications for Glass Tile," ANSI A137.3, "Specifications for Gauged Porcelain Tiles and Gauged Porcelain Tile Panels/Slabs" for types, compositions, and other characteristics indicated.
  - 1. Products and Manufacturers: Provide tile matching the Architect's samples which have been selected from the product lines and manufacturers indicated in Finish Schedule on Drawings.
- B. Mounting: For factory-mounted tile, provide back- or edge-mounted tile assemblies as standard with manufacturer, unless otherwise indicated.
- C. Tile Trim Units: Matching characteristics of adjoining flat tile and coordinated with sizes and coursing where applicable.
- D. Rectified Tile Edges: Provide all tile units having a face dimension of greater than 8" x 8" (200 x 200 mm) with factory rectified edges.

### **2.2 ACCESSORY MATERIALS**

- A. Waterproofing for Toilet Room ~~and Kitchen~~ Tile Installations:
  - 1. Fabric-Reinforced and Unreinforced Fluid-Applied Product: System consisting of liquid-latex rubber, with a VOC content of 65 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24), and fabric reinforcement which are compatible with mortar bed specified and complying with ANSI A118.10; one of the following:
    - a. Custom Building Products; 9240 Waterproofing and Anti-Fracture Membrane. which is manufactured in the plant closest to the geographic location of the project.
    - b. LATICRETE International Inc.; Laticrete 9235 Waterproof Membrane. which is manufactured in the plant closest to the geographic location of the project.
    - c. MAPEI Corporation; Mapelastac AquaDefense, which is manufactured in the plant closest to the geographic location of the project.
    - d. Ardex; Ardex WPC which is manufactured in the plant closest to the geographic location of the project.
- B. Crack Isolation Membrane for Tile Installations:
  - 1. Fabric-Reinforced, Fluid-Applied Product: System consisting of liquid-latex rubber, with a VOC content of 65 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24) (ASTM D 3960), and fabric reinforcement which are compatible with mortar bed specified and complying with ANSI A118.12; one of the following:

- a. Custom Building Products; 9240 Waterproofing and Anti-Fracture Membrane. which is manufactured in the plant closest to the geographic location of the project.
- b. LATICRETE International Inc.; Laticrete 9235 Waterproof Membrane, which is manufactured in the plant closest to the geographic location of the project.
- c. MAPEI Corporation; Mapelastac AquaDefense, which is manufactured in the plant closest to the geographic location of the project.

## **2.3 SETTING AND GROUTING MATERIALS**

- A. **Manufacturers and Plant Locations:** Provide products manufactured in the plant closest to the geographic location of the project.
- B. **Source Limitations:** For each tile installation, obtain compatible formulations of setting and grouting materials and waterproofing materials containing latex or latex additives from a single manufacturer.
- C. **Latex-Portland Cement Mortar (Thin Set):**
  1. Prepackaged dry-mortar mix combined with dry powder latex additive, the following:
    - a. **For Thin Set Placed over Slabs on Grade:** Complying with ANSI A118.4 one of the following:
      - 1) Ultraflex 2 Mortar; MAPEI Corporation.
      - 2) Laticrete 253 Gold; Laticrete International Inc.
      - 3) Versabond Flex; Custom Building Products.
    2. For wall applications, provide nonsagging mortar.
    3. For glass tile applications where a low temperature coating has not been factory applied to the tile, use mortar that will not show through glass tile bodies. For glass tile installations where a low temperature coating has been factory applied follow the glass tile manufacturers written recommendations for mortar selection and application.
- D. **Dry Set Mortar for Large and Heavy Tile (LHT Mortar):** Complying with ANSI A118.4:
  1. Prepackaged dry-mortar mix combined with additives to minimize slump and facilitate a thicker bond coat, and specifically manufactured and recommended in writing by the mortar and underlayment manufacturer for use in LHT mortar assemblies; one of the following:
    - a. Ultraflex LFT Mortar; MAPEI Corporation.
    - b. Laticrete 4-XLT; Laticrete International Inc.
- E. **Polymer-Modified Tile Grout (For Typical Applications):** Complying with ANSI A118.7 compounded with calcium aluminate cement, non-shrinking, efflorescence free grout. Provide, and stockpile, grout for each exposed color from a single manufactured and packaged batch source for the entire Project.



1. Polymer Type: Dry, redispersible latex/polymer powder form, prepackaged with other dry ingredients, one of the following:
    - a. Prism; Custom Building Products.
    - b. Permacolor; Laticrete International Inc.
    - c. Ultracolor Plus FA; Mapei Corporation.
  2. Colors: As selected by Architect from manufacturers standards to match tile being grouted.
- F. Epoxy Grout (For ~~Kitchen Applications~~ wet locations (restrooms, shower areas)): Complying with ANSI A118.3, water-cleanable epoxy with a VOC content of 65 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24)(ASTM D 3960).
1. ~~At food preparation areas provide product capable of withstanding continuous and intermittent exposure to temperatures of up to 140 deg F (60 deg C) and 212 deg F (100 deg C), respectively, and that are resistant to staining, fats, oils, and aggressive cleaning compounds, and certified by grout manufacturer for use in commercial and hotel kitchens and food preparation areas.~~ One of the following:
    - a. Kerapoxy IEG CQ; Mapei Corporation.
    - b. Spectralock 2000 by Laticrete. International Inc.
  2. Colors: As selected by Architect from manufacturers standards to match tile being grouted.

## 2.4 MISCELLANEOUS MATERIALS

- A. Joint Sealants:
1. Typical Surfaces: "Mildew-Resistant Silicone Sealant", as specified in Section 07 92 00 "Joint Sealants."
  2. Floor Joints: "Two-Part Polyurethane Sealant for Paving Applications," as specified in Section 07 92 00 "Joint Sealants."
- B. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.
- C. Grout Sealer: Grout manufacturers recommended product for sealing cementitious grout joints and that does not change color or appearance of grout.
- D. Underlayment Product for Leveling and Patching Floors indicated to receive Tiles: Latex-modified, cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.
1. Either Ultraplan or Novaplan Underlayment; MAPEI Corporation.
  2. NXT Level Plus Underlayment; Laticrete International Inc.

- E. Metal Edge Strips for Wall Applications: Metallic, angle or L-shaped, depth to match tile and setting-bed thickness and having an integral provision for anchorage to substrate; aluminum alloy exposed-edge material; furnish in longest lengths available.
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. Blanke Corporation.
    - b. Ceramic Tool Company, Inc.
    - c. Schluter Systems L.P.
- F. Divider, Transition, and Movement Joint Strips:
1. Divider and Transition Strips: Stainless steel shapes and flat bar trims fabricated from ASTM A 666 (for flat bar) and ASTM A 276 (for shapes) Type 304 stainless steel, 1/4 inch (6.35 mm) wide at top edge unless otherwise indicated, depth as required to suit conditions shown and having an integral provision for anchorage to mortar bed or substrate, unless otherwise indicated. Provide NAAMM #4 satin finish at exposed top edge in the long direction, furnish in longest lengths available.
  2. Movement Joint Strips: Laminations of extruded aluminum or formed stainless steel angle shapes, depth as required to finish flush with top surface of adjacent tile flooring fields, back to back installed with full height flexible filler to accommodate movement. Control joints shall have either an exposed approximately 5/8 inch (16 mm) wide interlocking continuous top to conceal prefabricated flexible filler or an exposed custom flexible prefabricated filler to accommodate movement. Joint assembly shall have a total movement capability of approximately 1/4 +1/8 inch/-3/32 /inch (5 mm+3 mm/-2 mm). Finish of exposed top to be satin. One of the following:
    - a. Basis of Design: Emseal Series ESF 16 AL; Emseal Joint Systems, Ltd.
    - b. Schluter; Dilex - EDP, fabricated to comply with the specified requirements.
    - c. CTC (Ceramic Tool Company); CTC Joint custom fabricated to comply with the specified requirements.
    - d. Vexcolt; Ti-Lock Metal, TAM NL 42151 (for thickset) or TAM NA 1212 (for medium and thinset).

## **2.5 MIXING MORTARS AND GROUT**

- A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions. Add materials and liquid latex additives in accurate proportions. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine substrates, areas, and conditions where tile will be installed, with Installer present.
  - 1. Verify that substrates for setting tile are sound and free of voids, bugholes, rock pockets, honeycombs, and protrusions, and which are dry, clean, free of oil, waxy films, and curing compounds. Grind or scarify concrete substrates to remove existing floor adhesive and mortar residues (if any), laitance, films, sealing and curing compounds if they are determined to be present on the substrate.
  - 2. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed before installing tile.
  - 3. Verify that joints and cracks in the existing floor substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.
  - 4. Do not commence installation of flooring materials until floor substrate is within the following tolerances in all directions. If substrate is not within tolerance, level the substrate using a method and an underlayment product(s) that is compatible with and acceptable to the setting materials manufacturer.
    - a. Subfloor Surfaces to Receive Thinset and LHT Mortar Setting Beds: +/- 1/8 inch in 10 feet (3 mm in 3.05 m) non-cumulative.
    - b. No valleys or ridges greater than 1/8 inch (3 mm).
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 PREPARATION**

- A. Remove paint, coatings, including curing compounds and other substances that are incompatible with tile-setting materials.
- B. Blending: Color blend tiles at Project site before installing.
  - 1. Furnish the same lots, batches, etc. within the same contiguous areas of the site (i.e. corridors on the same floors, common rooms which adjoin each other, etc.).

### **3.3 INSTALLATION, GENERAL**

- A. Tile Installation Standards: Comply with parts of ANSI A108 Series "Specifications for Installation of Ceramic Tile" and the TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" that apply to types of setting and grouting materials and to methods indicated.
- B. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions, unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.

- C. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.
1. Glass Tile Cutting: Use a blade suitable for cutting glass which must be constantly kept wet with water. Cut tiles with the colored surface turned upwards. Cutting shall not be carried out near the edges of the individual tiles. Smooth off any sharp edges with sandpaper. Holes can be made with a drill bit specifically recommended for drilling glass with a diameter up to 5/16-inch (8-mm). Apply water continually while drilling.
- D. Jointing Pattern: Lay tile in grid pattern, unless otherwise indicated. Align joints when adjoining tiles on floor, base, walls, and trim are same size. Lay out tile work and center tile fields in both directions in each space or on each wall area beginning at thresholds. Adjust to minimize tile cutting. Provide uniform joint widths, unless otherwise indicated.
1. For tile mounted in sheets, make joints between tile sheets same width as joints within tile sheets so joints between sheets are not apparent in finished work.
- E. Finished Surfaces: Unless otherwise accepted in the sample installation(s), if any, finished surfaces shall present a flat, even appearance, free from waver, projections, and depressions.
- F. Movement (Contraction, Control, Expansion, and Isolation Joints) Joints: Locate sealant filled movement joints where recommended by the manufacturer of mortar and grout materials, but not less than the requirements of TCNA EJ171 which follows, and as accepted by the Architect. Form movement joints and other sealant-filled joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles. Where movement joints are to be butted, the ends shall touch and align.
1. Spacing Guidelines:
- a. 20 to 25 feet (6,096 to 7,620-mm) in each direction where interior tile work is not exposed to direct sunlight or moisture.
  - b. 8 to 12 feet (2,438 to 3,658-mm) in each direction where interior tile work is exposed to direct sunlight and moisture.
  - c. Where tilework abuts restraining surfaces such as perimeter walls, dissimilar floors, curbs, columns, pipes, ceilings, and where changes occur in backing materials, but not at drain strainers.
  - d. In the joint between tiles making up the inside corner of planes.
  - e. All contraction, control, expansion, isolation, seismic and cold joints in the horizontal structure and vertical surfaces shall continue through the tile surfaces, but not through membranes.
  - f. Vertical and Horizontal Joints Widths: Widths for quarry tile and paver tile shall be the same as the grout joint but not less than 1/4 inch (6-mm) or the width of the contraction, control, expansion, seismic, isolation joint whichever is greater; widths for ceramic mosaic tile and glazed wall tile shall not be less than 1/8 inch (3-mm) or the width of the control, expansion, seismic, joint whichever is greater.
  - g. Keep movement joints free from dirt, debris, grout, mortar, and setting bed materials. Prepare joints and apply sealants to comply with requirements in Section 07 92 00 "Joint Sealants."

- G. Metal Edge Strips: Install where exposed edge of wall tile meets other wall finishes that finish flush with or below face of tile and the manufacturer of the field tile does not manufacture a tile edge transition trim. Where metal edge strips are indicated and full length single units are not available, joints are to be butted, ends shall touch and align.
- H. Grout Sealer: Apply grout sealer to cementitious grout joints in tile floors according to grout sealer manufacturer's written instructions. As soon as sealer has penetrated grout joints, remove excess sealer and sealer from tile faces by wiping with soft cloth.

### 3.4 WATERPROOFING INSTALLATION

- A. Install waterproofing to comply with ANSI A108.13 and waterproofing manufacturer's written instructions to produce waterproof membrane of uniform thickness bonded securely to substrate.
  - 1. Do not install tile over waterproofing until waterproofing has cured, and at each horizontal installation, has been tested for water tightness. Test waterproofing membrane for watertightness by damming the floor drain, and creating a dam at the perimeter of the waterproofed basin followed by filling the basin with water, marking the height, and verifying the same height after 48 hours. Repair leaks before continuing with the installation of subsequent tile.

### 3.5 CRACK ISOLATION MEMBRANE INSTALLATION

- A. Install crack isolation membrane to comply with ANSI A108.17 and manufacturer's written instructions to produce membrane of uniform thickness and bonded securely to substrate.
  - 1. Do not install tile or setting materials over crack isolation membrane until membrane has cured.

### 3.6 FLOOR TILE INSTALLATION

- A. Thinset Tile over Concrete Slabs (Typical ~~and at Kitchens~~): Install in accordance with the mortar manufacturer's recommendations and requirements indicated below for setting bed methods, installation methods related to types of subfloor construction, and grout installation methods and grout types. Where recommendations and methods conflict, the manufacturer's recommendations shall apply.
  - 1. Mortar: Latex-Portland Cement Mortar: ANSI A108.5.
  - 2. Concrete Subfloors, Interior: TCNA F113.
    - a. With a trowel, having notches sized as recommended by the mortar manufacturer, comb the surface of the mortar with the notched side of the trowel removing excess mortar. Spread only as much mortar as can be covered in the time limits established by the mortar manufacturer's recommendations.
    - b. Wipe the back of each tile, with a damp sponge, to remove all dust or dirt immediately before applying mortar to tiles.

- c. Immediately after wiping tile backs, but prior to placing tile, the mortar shall be troweled to back of tile for 100 percent coverage to thickness of not less than 1/16-inch (1.5-mm).
  - d. Place tiles onto mortar bed, maintaining 1/8-inch (3-mm) wide joints, and true accurate pattern as shown. Exercise care to quickly remove spillage from faces of tile using damp sponge. Rake out joints to depth required to receive grout as tile units are set.
  - e. Prohibit foot and wheel traffic on tiled floors for period of time as recommended by the mortar manufacturer.
3. Grout Installation: Do not begin grouting tiles until they are firmly set and, in no case, in less than 48 hours after they have been installed. Remove spacers, if any, prior to grouting. For typical installations, comply with latex-portland cement: ANSI A108.10; ~~grout installation for kitchen installations, epoxy grout: ANSI A108.6.~~ Fill joints of cushion edged tile to the depth of the cushion; fill joints of square edge tile flush with the tile surface. Do not permit mortar, mounting mesh, or spacer material to show through grouted joints. Provide hard finished grout, which is uniform in color, smooth, and without voids, pinholes, or low spots. Tool surfaces with shallow concave profile.
- B. Thinset Tile over Waterproof Membrane (Toilet Rooms ~~and at Kitchens~~): Install in accordance with the mortar manufacturer's recommendations and requirements indicated below for setting bed methods, installation methods related to types of subfloor construction, and grout installation methods and grout types. Where recommendations and methods conflict, the manufacturer's recommendations shall apply.
1. Mortar: Latex-Portland Cement Mortar: ANSI A108.5.
  2. Concrete Subfloors, Interior: TCNA F122 (on ground) and F122A (above ground).
    - a. Apply the mortar to waterproofed slab with the flat side of the trowel.
    - b. With a trowel, having notches sized as recommended by the mortar manufacturer, comb the surface of the mortar with the notched side of the trowel removing excess mortar. Spread only as much mortar as can be covered in the time limits established by the mortar manufacturer's recommendations.
    - c. Wipe the back of each tile, with a damp sponge, to remove all dust or dirt immediately before applying mortar to tiles.
    - d. Immediately after wiping tile backs, but prior to placing tile, the mortar shall be troweled to back of tile for 100 percent coverage to thickness of not less than 1/16-inch (1.5-mm).
    - e. Place tiles onto mortar bed, maintaining 1/8-inch (3-mm) wide joints, and true accurate pattern as shown. Exercise care to quickly remove spillage from faces of tile using damp sponge. Rake out joints to depth required to receive grout as tile units are set.
    - f. Prohibit foot and wheel traffic on tiled floors for period of time as recommended by the mortar manufacturer.

3. Grout Installation: Do not begin grouting tiles until they are firmly set and, in no case, in less than 48 hours after they have been installed. Remove spacers, if any, prior to grouting. For typical installations, comply with latex-portland cement: ANSI A108.10;~~grout installation for kitchen installations, epoxy grout: ANSI A108.6.~~ Fill joints of cushion edged tile to the depth of the cushion; fill joints of square edge tile flush with the tile surface. Do not permit mortar, mounting mesh, or spacer material to show through grouted joints. Provide hard finished grout, which is uniform in color, smooth, and without voids, pinholes, or low spots. Tool surfaces with shallow concave profile.
- C. Thinset Tile over Crack Isolation Membrane: Install in accordance with the mortar manufacturer's recommendations and requirements indicated below for setting bed methods, installation methods related to types of subfloor construction, and grout installation methods and grout types. Where recommendations and methods conflict, the manufacturer's recommendations shall apply.
1. Mortar: Latex-Portland Cement Mortar: ANSI A108.5.
  2. Concrete Subfloors, Interior: TCNA F125-Full.
    - a. Apply the mortar to crack isolation membrane covered slab with the flat side of the trowel.
    - b. With a trowel, having notches sized as recommended by the mortar manufacturer, comb the surface of the mortar with the notched side of the trowel removing excess mortar. Spread only as much mortar as can be covered in the time limits established by the mortar manufacturer's recommendations.
    - c. Wipe the back of each tile, with a damp sponge, to remove all dust or dirt immediately before applying mortar to tiles.
    - d. Immediately after wiping tile backs, but prior to placing tile, the mortar shall be troweled to back of tile for 100 percent coverage to thickness of not less than 1/16-inch (1.5-mm).
    - e. Place tiles onto mortar bed, maintaining 1/8-inch (3-mm) wide joints, and true accurate pattern as shown. Exercise care to quickly remove spillage from faces of tile using damp sponges. Rake out joints to depth required to receive grout as tile units are set.
    - f. Prohibit foot and wheel traffic on tiled floors for period of time as recommended by the mortar manufacturer.
  3. Grout Installation: Do not begin grouting tiles until they are firmly set and, in no case, in less than 48 hours after they have been installed. Remove spacers, if any, prior to grouting. Comply with Latex-portland cement: ANSI A108.10. Fill joints of cushion edged tile to the depth of the cushion; fill joints of square edge tile flush with the tile surface. Do not permit mortar, mounting mesh, or spacer material to show through grouted joints. Provide hard finished grout, which is uniform in color, smooth, and without voids, pinholes, or low spots. Tool surfaces with shallow concave profile.
- D. LHT Set Tile (Only where indicated): Install in accordance with the mortar manufacturer's recommendations and requirements indicated below for setting bed methods, installation methods related to types of subfloor construction, and grout installation methods and grout types. Where recommendations and methods conflict, the manufacturer's recommendations shall apply.

1. Mortar: Latex-Portland Cement Mortar: ANSI A108.5.
2. Concrete Subfloors, Interior: TCNA F205 (on-ground slabs) and TCNA F205A (above ground slabs) except apply LHT bed in thickness of 3/4" unless otherwise indicated.
  - a. Where required by the conditions indicated, apply underlayment using methods and within time limits recommended by the mortar manufacturer.
  - b. With a trowel, having notches sized as recommended by the mortar manufacturer, place and comb the surface of the mortar with the notched side of the trowel removing excess mortar. Spread only as much mortar as can be covered in the time limits established by the mortar manufacturers recommendations.
  - c. Wipe the back of each tile, with a damp sponge, to remove all dust or dirt immediately before applying mortar to tiles.
  - d. Immediately after wiping tile backs, but prior to placing tile, the mortar shall be troweled to back of tile for 100% coverage to thickness of not less than 1/16-inch (1.5-mm).
  - e. Place tiles onto mortar bed, maintaining 1/8-inch (3-mm) wide joints, and true accurate pattern as shown. Exercise care to quickly remove spillage from faces of tile using damp sponges. Rake out joints to depth required to receive grout as tile units are set.
  - f. Prohibit foot and wheel traffic on tiled floors for period of time as recommended by the mortar manufacturer.
3. Grout Installation: Do not begin grouting tiles until they are firmly set and, in no case, in less than 48 hours after they have been installed. Remove spacers, if any, prior to grouting. Comply with Latex-portland cement: ANSI A108.10. Fill joints of cushion edged tile to the depth of the cushion; fill joints of square edge tile flush with the tile surface. Do not permit mortar, mounting mesh, or spacer material to show through grouted joints. Provide hard finished grout, which is uniform in color, smooth, and without voids, pinholes, or low spots. Tool surfaces with shallow concave profile.

### **3.7 WALL TILE INSTALLATION**

- A. Install in accordance with the mortar manufacturer's recommendations and requirements indicated below for ANSI setting bed methods, TCNA installation methods related to types of construction, and grout ANSI installation methods and grout types. Where recommendations and methods conflict, the manufacturer's recommendations shall apply.
  1. Latex Portland Cement Mortar Installation (using specified latex portland cement mortar material): ANSI A108.5.
  2. Gypsum Wallboard, Interior (Latex Portland Cement Mortar) Method: TCNA W243, place tiles maintaining 1/8-inch (3-mm) wide joints, and true accurate pattern as shown.
  3. Cementitious Backerboard (Latex Portland Cement Mortar) Method: TCNA W244C, place tiles maintaining 1/8-inch (3-mm) wide joints, and true accurate pattern as shown.



4. Grout Installation: Do not begin grouting tiles until they are firmly set and, in no case, in less than 48 hours after they have been installed. Remove spacers, if any, prior to grouting. Comply with Latex-portland cement: ANSI A108.10. Fill joints of cushion edged tile to the depth of the cushion; fill joints of square edge tile flush with the tile surface. Do not permit mortar, mounting mesh, or spacer material to show through grouted joints. Provide hard finished grout, which is uniform in color, smooth, and without voids, pinholes, or low spots. Tool surfaces with shallow concave profile.

### **3.8 CLEANING AND PROTECTING**

- A. Cleaning: On completion of placement and grouting, clean all tile surfaces so they are free of foreign matter.
  1. Remove grout residue from tile as soon as possible.
  2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions, but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.
- B. Finished Tile Work: Leave finished installation clean and free of cracked, chipped, broken, unbonded, and otherwise defective tile work. Replace all cracked, chipped, and broken tile units with matching tile units; patched tile units will not be permitted.
- C. When recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear.
- D. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.

**END OF SECTION 09 30 00**

## SECTION 10 28 00 - TOILET ACCESSORIES

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Public-use washroom accessories.
2. Public-use shower room accessories.
- ~~3. Warm air dryers.~~
- 4.3. Underlavatory guards.

B. Related Requirements:

1. Section 08 83 00 "Mirrors" for frameless mirrors.

#### 1.2 COORDINATION

- A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.
- B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

#### 1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Include anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
- ~~3. Include electrical characteristics.~~

B. Samples: Full size, for each exposed product and for each finish specified.

1. Approved full-size Samples will be returned and may be used in the Work.

C. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.

1. Identify locations using room designations indicated.
2. Identify accessories using designations indicated.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Sample Warranty: For manufacturer's special warranty.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For accessories to include in maintenance manuals.

#### 1.6 WARRANTY

- A. Manufacturer's Special Warranty for Mirrors: Manufacturer agrees to repair or replace mirrors that fail in materials or workmanship within specified warranty period.
1. Failures include, but are not limited to, visible silver spoilage defects.
  2. Warranty Period: 15 years from date of Substantial Completion.

### PART 2 - PRODUCTS

#### ~~2.1 PERFORMANCE REQUIREMENTS~~

- ~~A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.~~

#### 2.22.1 PUBLIC-USE WASHROOM ACCESSORIES

- A. Source Limitations: Obtain public-use washroom accessories from single source from single manufacturer.
- B. Toilet Tissue (Roll) Dispenser: ~~B-6997~~ OFCI
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. American Specialties, Inc.; ASI Group.
    - b. Bobrick Washroom Equipment, Inc.
    - c. Bradley Corporation.
    - d. GAMCO Specialty Accessories; a division of Bobrick.
  2. Description: Single-roll dispenser.
  3. Mounting: Recessed.
  4. Operation: Noncontrol delivery with standard spindle.
  5. Capacity: Designed for 4-1/2- or 5-inch- (114- or 127-mm-) diameter tissue rolls.
  6. Material and Finish: Stainless steel, No. 4 finish (satin).
- C. Combination Toilet Tissue Dispenser: ~~B-3094~~ B-3574 (TDP-1) and B-35745 (TDP-2)

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
    - a. American Specialties, Inc.; ASI Group.
    - b. Bobrick Washroom Equipment, Inc.
    - c. Bradley Corporation.
    - d. GAMCO Specialty Accessories; a division of Bobrick.
  2. Description: Combination unit with double-roll toilet tissue dispenser and the following:
    - a. Removable sanitary-napkin waste receptacle with self-closing, disposal-opening cover.
    - a-b. Seat-cover dispenser with minimum capacity of 500 single or half-fold seat covers.
  3. Mounting: Recessed.
  4. Toilet Tissue Dispenser Capacity: 4-1/2- or 5-inch- (114- or 127-mm-) diameter tissue rolls.
  5. Toilet Tissue Dispenser Operation: Noncontrol delivery with theft-resistant spindles.
  6. Material and Finish: Stainless steel, No. 4 finish (satin).
  7. Lockset: Tumbler type.
- D. Combination Towel (Folded) Dispenser/Waste Receptacle: ~~B-39003~~ OFCI
1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
    - a. American Specialties, Inc.; ASI Group.
    - b. Bobrick Washroom Equipment, Inc.
    - c. Bradley Corporation.
    - d. GAMCO Specialty Accessories; a division of Bobrick.
  2. Description: Combination unit for dispensing C-fold or multifold towels, with removable waste receptacle.
  3. Mounting: Recessed.
    - a. Designed for nominal 6-inch (150-mm) wall depth.
  4. Minimum Towel-Dispenser Capacity: 600 C-fold or 800 multifold paper towels.
  5. Minimum Waste-Receptacle Capacity: 12 gal. (45.4 L).
  6. Material and Finish: Stainless steel, No. 4 finish (satin).
  7. Liner: Reusable, vinyl waste-receptacle liner.
  8. Lockset: Tumbler type for towel-dispenser compartment and waste receptacle.
- E. Liquid-Soap Dispenser: OFCI
1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
    - a. American Specialties, Inc.; ASI Group.
    - b. Bobrick Washroom Equipment, Inc.

- c. Bradley Corporation.
  - d. GAMCO Specialty Accessories; a division of Bobrick.
2. Description: Designed for dispensing antibacterial soap in liquid or lotion form.
  3. Mounting: Deck mounted on vanity.
  4. ~~Lockset: Tumbler type.~~
  5. ~~Refill Indicator: Window type.~~
- F. Grab Bar: B-5806 x 36 (GB-1) and B-5806 x 42 (GB-2) and B-68616.99 (GB-3)
1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
    - a. American Specialties, Inc.; ASI Group.
    - b. Bobrick Washroom Equipment, Inc.
    - c. Bradley Corporation.
    - d. GAMCO Specialty Accessories; a division of Bobrick.
  2. Mounting: Flanges with concealed fasteners.
  3. Material: Stainless steel, 0.05 inch (1.3 mm) thick.
    - a. Finish: Smooth, No. 4 finish (satin).
  4. Outside Diameter: 1-1/4 inches (32 mm) and 1-1/2 inches (38 mm).
  5. Configuration and Length: As indicated on Drawings.
- G. Seat-Cover Dispenser: B-221OFCI
1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
    - a. American Specialties, Inc.; ASI Group.
    - b. Bobrick Washroom Equipment, Inc.
    - c. Bradley Corporation.
    - d. GAMCO Specialty Accessories; a division of Bobrick.
  2. Mounting: Surface mounted.
  3. Minimum Capacity: 250 seat covers.
  4. Exposed Material and Finish: Stainless steel, No. 4 finish (satin) .
  5. Lockset: Tumbler type.
- H. Mirror Unit: ~~B-293; B-1658; B-290 24 36 (M-1) and B-290 1830 (M-2)~~
1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
    - a. American Specialties, Inc.; ASI Group.
    - b. Bobrick Washroom Equipment, Inc.
    - c. Bradley Corporation.
    - d. GAMCO Specialty Accessories; a division of Bobrick.

2. Frame: Stainless-steel ~~channel Stainless steel, fixed tilt angle, 0.05 inch (1.3 mm) thick.~~
  - a. Corners: ~~Mitered and mechanically interlocked~~ Welded and ground smooth.
3. Hangers: Produce rigid, tamper- and theft-resistant installation, using method indicated below.
  - a. One-piece, galvanized-steel, wall-hanger device with spring-action locking mechanism to hold mirror unit in position with no exposed screws or bolts.
  - b. Wall bracket of galvanized steel, equipped with concealed locking devices requiring a special tool to remove.
4. Size: As indicated on Drawings.

### 2.32.2 PUBLIC-USE SHOWER ROOM ACCESSORIES

- A. Source Limitations: Obtain public-use shower room accessories from single source from single manufacturer.
- B. Shower Curtain Rod: B-207 x 60 (CR-1)
  1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
    - a. American Specialties, Inc.; ASI Group.
    - b. Bobrick Washroom Equipment, Inc.
    - c. Bradley Corporation.
    - d. GAMCO Specialty Accessories; a division of Bobrick.
  2. Description: 1-inch (25.4-mm) OD; fabricated from nominal 0.0375-inch- (0.95-mm-) thick stainless steel.
  3. Mounting Flanges: Stainless-steel flanges designed for ~~exposed~~ concealed fasteners.
  4. Finish: Stainless steel, No. 4 finish (satin).
- C. Shower Curtain:
  1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
    - a. American Specialties, Inc.; ASI Group.
    - b. Bobrick Washroom Equipment, Inc.
    - c. Bradley Corporation.
    - d. GAMCO Specialty Accessories; a division of Bobrick.
  2. Size: Minimum 12 inches (305 mm) wider than opening by 72 inches (1828 mm) high.
  3. Material: Nylon-reinforced vinyl, minimum 10 oz. (284 g) or 0.008-inch- (0.2-mm-) thick vinyl, with integral antibacterial agent.
  4. Color: As selected from manufacturer's full range.
  5. Grommets: Corrosion resistant at minimum 6 inches (152 mm) o.c. through top hem.

6. Shower Curtain Hooks: Chrome-plated or stainless-steel, spring wire curtain hooks with snap fasteners, sized to accommodate specified curtain rod. Provide one hook per curtain grommet.

D. Folding Shower Seat: B-5181 (SHW-1)

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - a. American Specialties, Inc.; ASI Group.
  - b. Bobrick Washroom Equipment, Inc.
  - c. Bradley Corporation.
  - d. GAMCO Specialty Accessories; a division of Bobrick.
2. Configuration: L-shaped seat, designed for wheelchair access.
3. Seat: Phenolic or polymeric composite of slat-type or one-piece construction in color as selected by Architect.
4. Mounting Mechanism: Stainless steel, No. 4 finish (satin).

E. Robe Hook: B-6717

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - a. American Specialties, Inc.; ASI Group.
  - b. Bobrick Washroom Equipment, Inc.
  - c. Bradley Corporation.
  - d. GAMCO Specialty Accessories; a division of Bobrick.
2. Description: ~~Double~~Single-prong unit.
3. Material and Finish: Stainless steel, No. 4 finish (satin).

~~2.4~~ **WARM AIR DRYERS**

~~A. Source Limitations: Obtain warm air dryers from single source from single manufacturer.~~

~~B. High Speed Warm Air Dryer :~~

- ~~1. Basis of Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - ~~a. American Dryer, Inc.~~
  - ~~b. American Specialties, Inc.; ASI Group.~~
  - ~~c. Bradley Corporation.~~
  - ~~d. Excel Dryer Inc.~~
  - ~~e. GAMCO Specialty Accessories; a division of Bobrick.~~
  - ~~f. World Dryer Corporation.~~~~
- ~~2. Description: High speed, warm air hand dryer for rapid hand drying.~~

- ~~3. Mounting: Recessed.~~
- ~~4. Operation: Electronic sensor activated with operation time of 10 to 20 seconds.~~
- ~~5. Cover Material and Finish: Stainless steel, No. 4 finish (satin).~~
- ~~6. Electrical Requirements: 115 V, 15 A, 1725 W.~~

### 2.52.3 UNDERLAVATORY GUARDS

- A. Underlavatory Guard:
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
    - a. Plumberex Specialty Products, Inc.
    - b. Truebro by IPS Corporation.
  - 2. Description: Insulating pipe covering for supply and drain piping assemblies that prevents direct contact with and burns from piping; allow service access without removing coverings.
  - 3. Material and Finish: Antimicrobial, molded plastic, white.

### 2.62.4 MATERIALS

- A. Stainless Steel: ASTM A 666, Type 304, 0.031 inch (0.8 mm) minimum nominal thickness unless otherwise indicated.
- B. Steel Sheet: ASTM A 1008/A 1008M, Designation CS (cold-rolled, commercial steel), 0.036 inch (0.9 mm) minimum nominal thickness.
- C. Galvanized-Steel Sheet: ASTM A 653/A 653M, with G60 (Z180) hot-dip zinc coating.
- D. Galvanized-Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.
- E. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.
- F. Chrome Plating: ASTM B 456, Service Condition SC 2 (moderate service).
- G. Mirrors: ASTM C 1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.

### 2.72.5 FABRICATION

- A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.



- B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.
- B. Grab Bars: Install to withstand a downward load of at least 250 lbf (1112 N), when tested according to ASTM F 446.

#### **3.2 ADJUSTING AND CLEANING**

- A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.
- B. Remove temporary labels and protective coatings.
- C. Clean and polish exposed surfaces according to manufacturer's written instructions.

**END OF SECTION 10 28 00**

## **SECTION 10 51 00 - SOLID SURFACE LOCKERS**

### **PART 1 - GENERAL**

#### **1.1 SECTION INCLUDES**

- A. Solid surface athletic lockers.
- B. Solid surface grid lockers.

#### **1.2 RELATED REQUIREMENTS**

- A. Section 06 10 53 "Miscellaneous Rough Carpentry" for locker anchorage.
- B. Division 16 - Electrical for power wiring.
- C. Division 26 Sections for power and data.

#### **1.3 REFERENCE STANDARDS**

- A. ANSI A208.2 - Medium Density Fiberboard for Interior Use.
- B. ANSI-BHMA A156.9 - Cabinet Hardware.
- C. ASTM D 256 - Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics.
- D. ASTM D 570 - Standard Test Method for Water Absorption of Plastics.
- E. ASTM D 638 - Standard Test Method for Tensile Properties of Plastics.
- F. ASTM D 785 - Standard Test Method for Rockwell Hardness of Plastics and Electrical Insulating Materials.
- G. ASTM D 790 - Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
- H. ASTM D 2583 - Standard Test Method for Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor.

#### **1.4 SUBMITTALS**

- A. Comply with Section 01 33 23 - Shop Drawings, Product Data, Samples.
- B. Product Data: Submit manufacturer's product data, including installation instructions.

1. Rated capacities, construction details, material descriptions, dimensions of individual components, profiles, and finishes.
  2. Delivery, storage, handling, and installation instructions and recommendations.
  3. Maintenance instructions and recommendations.
- C. Shop Drawings: Submit manufacturer's shop drawings, including plans, elevations, sections, and details, indicating dimensions, tolerances, materials, components, fabrication, edge treatment, corners, seam locations, fasteners, hardware, finish, options, and accessories.
1. Show locations and sizes of cutouts and holes for lighting, technology components, graphics, and other items to be installed in lockers.
  2. Show system layouts, room locations, clearances, spacing, and relationship to adjacent construction.
- D. Samples: Submit manufacturer's samples of solid surface material in each color and finish specified.
1. Size: Minimum 2 inches by 2 inches.
- E. Manufacturer's Certification: Submit manufacturer's certification that materials comply with specified requirements and are suitable for intended application.
- F. Manufacturer's Project References: Submit manufacturer's list of successfully completed solid surface locker projects, including project name and location, name of Architect, and type and quantity of locker furnished.
- G. Installer's Project References: Submit installer's list of successfully completed locker projects, including project name and location, name of Architect, and type and quantity of lockers installed.
- H. Care and Maintenance Instructions: Submit manufacturer's care and maintenance instructions, including cleaning and repairing instructions.
- I. Warranty Documentation: Submit manufacturer's standard warranty.
- J. Closeout Submittals: Submit operations and maintenance data for adjusting, repairing and replacing components and accessories.

## **1.5 QUALITY ASSURANCE**

- A. Locker Construction: Locker construction shall include the following features: solid surface locker frame construction, bolt-through construction; modular construction, all parts repairable and replaceable; embedded metal insert construction.
- B. Manufacturer's Qualifications: Manufacturer has regularly engaged, for past 2 years, in manufacturing of solid surface lockers of similar type to that specified.
- C. Installer's Qualifications:

1. Installer regularly engaged, for past 2 years, in installation of solid surface lockers in use in similar environments, including project size, and complexity, and with the production capacity to meet the construction and installation schedule.
  2. Employ persons trained for installation of solid surface lockers.
- D. Mock-Up: Provide a prototype unit or mock-up for evaluation of fabrication, materials and installation workmanship.
1. Full mockup, including lighting, for Owner review.
  2. Finish areas designated by Architect including shims, sealants, and accessories.
  3. Provide full size units, if accepted, units may remain as part of the completed work.
  4. Do not proceed with remaining work until workmanship is approved by Architect.
  5. Refinish mock-up area as required to produce acceptable work.

## **1.6 PRE-INSTALLATION MEETINGS**

- A. Convene at the project site a minimum of two weeks prior to starting work of this section.

## **1.7 DELIVERY, STORAGE, AND HANDLING**

- A. Delivery Requirements: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.
- B. Do not deliver lockers until spaces to receive them are clean, dry, and ready for their installation. Ship to jobsite only after roughing-in, painting and other finishing work has been completed, installation areas are ready to accept work.
- C. Field Measurements: Verify field measurements as indicated on Shop Drawings. Where measurements are not possible, provide control dimensions and templates.
1. Coordinate installation and location of blocking and supports as requested.
  2. Verify openings, clearances, storage requirements and other dimensions relevant to the installation and final application.
- D. Storage and Handling Requirements:
1. Store and handle materials in accordance with manufacturer's instructions.
  2. Keep materials in manufacturer's original, unopened containers and packaging until installation.
  3. Store materials in clean, dry area indoors.
  4. Store materials on flat, level surface, raised above floor, with adequate support to prevent sagging.
  5. Store materials out of direct sunlight.
  6. Keep materials from freezing.
  7. Protect materials during storage, handling, and installation from dirt, stains, cracks, scratches, and other damage.

## **1.8 WARRANTY**

- A. Warranty Period:
  - 1. Solid Surface Material:
    - a. LG Hausys HI-MACS : 15 years.
    - b. Dupont Corian : 10 years.
  - 2. Lockers: Lifetime. See Shield's Limited Lifetime Warranty terms at [www.shieldcasework.com](http://www.shieldcasework.com).

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURER**

- A. Shield Casework, 1120 Ellerbrook Road, North Kansas City MO 64116. Phone 816.875.3317. Fax 816.875.3307. Website [www.shieldcasework.com](http://www.shieldcasework.com). E-mail [info@shieldcasework.com](mailto:info@shieldcasework.com).
- B. Hollman, Inc.
- C. Longhorn.

### **2.2 MATERIALS**

- A. Locker Material: LG Hausys HI-MACS or Dupont Corian 100 percent acrylic solid surface.
  - 1. Certification:
    - a. NSF 51 certified for food preparation area.
    - b. Greenguard certified for indoor air quality.
  - 2. Nonporous.
  - 3. Seamless.
  - 4. Microbial resistant.
  - 5. Solid, uniform, and consistent color throughout material thickness.
  - 6. Recycled Content: Maximum 41 percent.
- B. Solid Surface Material Physical Properties: LG Hausys HI-MACS.
  - 1. Rockwell Hardness, ASTM D 785: 90.
  - 2. Barcol Hardness, ASTM D 2583: 65.
  - 3. Tensile Strength, ASTM D 638: 5,500 psi.
  - 4. Tensile Modulus, ASTM D 638:  $1.35 \times 10^6$  psi.
  - 5. Flexural Strength, ASTM D 790: 11,424 psi.
  - 6. Flexural Modulus, ASTM D 790:  $1.34 \times 10^6$  psi.
  - 7. Izod Impact Strength, ASTM D 256: 0.26 ft-lbs per in.

8. Water Absorption, ASTM D 570, 1/2-inch sheet: 0.04 percent.
- C. Solid Surface Material Physical Properties: Dupont Corian.
1. Rockwell Hardness, ASTM D 785: Greater than 85.
  2. Barcol Hardness, ASTM D 2583: 56.
  3. Tensile Strength, ASTM D 638: 6,000 psi.
  4. Tensile Modulus, ASTM D 638:  $1.5 \times 10^6$  psi.
  5. Flexural Strength, ASTM D 790: 10,000 psi.
  6. Flexural Modulus, ASTM D 790:  $1.2 \times 10^6$  psi.
  7. Izod Impact Strength, ASTM D 256: 0.28 ft-lbs per in.
  8. Water Absorption, ASTM D 570, 1/2-inch sheet: 0.06 percent.
- D. Locker Construction: ~~1/2"~~ 3/4 inch solid surface folded seamed frame with embedded metal inserts securing connections.
1. Single, full height as indicated on the Drawings.
  2. Upper Door, Frame, Sides, Tops, Bottoms, Dividers, and Shelves: 1/2 inch thick solid surfacing plastic with matte textured finish.
  3. End Panels: 3/8 inch thick solid surfacing plastic with matte texture finish.
- E. Locker Interior and Sides: Solid surface with folded square seamed corners.
- F. Locker Backer: Solid surface Melamine.
- G. Locker Door: Solid surface Wood veneer.
- H. Shelves: Solid surface.
- I. Solid Surface Thickness: ~~1/2"~~ 3/4 inch.
- J. Cabinet Toe Kick: 1" SierraPine Medex or Medite (to be covered by finish material).
1. Moisture-resistant, industrial-grade, medium density fiberboard (MDF).
  2. Formaldehyde-free adhesive system.
  3. Pre-consumer recycled wood fiber.
  4. ANSI A208.2, Grade 155.
- K. Hardware:
1. Pulls: As indicated on drawings.
  2. Concealed Hinges: Zinc-coated steel.
  3. Embedded Metal Inserts: Stainless steel, to secure hardware.
  4. Levelers: Mounted to base with 2" minimum variation.
  5. Cleat Bracket: Adjustable bracket to attach to the wall.
  6. Screws: Stainless steel.

## **2.3 ACCESSORIES**

- A. Locker Bench: Fixed seat, open front.
- B. Nameplates: Laminate nameplate housing with acrylic name panels.
- C. Coat Hooks, Hanging Rods and Other Accessories:
- D. Locker Color: As selected from manufacturer's full range.
- E. Door Color: As selected from manufacturer's full range.
- F. Shelf Color: As selected from manufacturer's full range.
- G. Back Color: As selected from manufacturer's full range.
- H. Bench Seat Color: As selected from manufacturer's full range.
- I. Locks:
  - 1. Lock Type: Keyed Lock.
- J. Locker Unit Connectors:
  - 1. Metal joint connector nuts and mount-on bolts with internal thread, brushed or chrome-finished.

## **2.4 FABRICATION**

- A. Shop fabricate solid surface locker. Fabricate locker frame/box from a single sheet of solid surface with corners fused together. Provide all welded construction of locker parts without dovetail joints or metal fasteners. Add embedded metal inserts for all hardware connections.
- B. Fabricate seams in solid surface locker to appear virtually seamless.
- C. Center Dividers: Full-depth, vertical partitions between bottom and shelf; finished to match lockers.
- D. Hardware Attachment: All hinges, handles, hasps, hooks, latch bars, and locks attached with tamper-resistant screws.
- E. Provide ventilated panels where indicated.
- F. Filler Panels: Fabricated in unequal leg angle shape; finished to match lockers.
- G. Finished End Panels: Fabricated with 1/2 inch wide edge dimension, configured to conceal fasteners and holes at exposed ends of solid surfacing lockers.
- H. Locker Dimensions: As indicated on drawings.

## **2.5 FINISHES**

- A. Color: As selected from manufacturer's standard colors.
- B. Solid surface locker of same color from same production batch.

## **2.6 SOURCE QUALITY CONTROL**

- A. Visual Inspection of Solid Surface Material: Do not shop fabricate solid surface locker that does not pass visual inspection of solid surface material at supplier's factory.
  - 1. Warping: Less than 1/8 inch per 10 feet of material.
  - 2. Foreign Particles: Less than 0.005 inch.
  - 3. Color Match: Same lot.
  - 4. White Spots: Less than 3 visible particles per sheet.
  - 5. Discoloration: None.
  - 6. Particle Distribution: Even distribution.
  - 7. Pit Holes: None.
  - 8. Uneven Sanding: None.
  - 9. Hairline Cracks: None.
  - 10. Concave: None.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine areas and substrates to receive solid surface lockers.
- B. Verify surfaces to support solid surface locker are clean, dry, flat, level, plumb, stable, rigid, and capable of supporting the weight.
- C. Notify Architect of conditions that would adversely affect installation or subsequent use.
- D. Do not begin installation until unacceptable conditions are corrected.

### **3.2 INSTALLATION**

- A. Install solid surface lockers in accordance with manufacturer's instructions at locations indicated on the Drawings.
- B. Acclimate solid surface lockers to room temperature before installation.
- C. Install solid surface lockers plumb, level, and square.
- D. Anchor solid surface lockers securely in place to supports.



- E. Install scribe or frames as specified in manufacturer's instructions at locations indicated on the Drawings.

### **3.3 ADJUSTING**

- A. Adjust operating hardware to operate smoothly without binding.
- B. Repair minor damages to finish in accordance with manufacturer's instructions and as approved by Architect.
- C. Remove and replace with new material, damaged components that cannot be successfully repaired, as determined by Architect.

### **3.4 CLEANING**

- A. Clean solid surface lockers promptly after installation in accordance with manufacturer's instructions.
- B. Remove surface scratches in accordance with manufacturer's instructions.

### **3.5 PROTECTION**

- A. Protect installed solid surface lockers from dirt, stains, cracks, scratches, and other damage during construction to avoid additional cleanup after installation.
- B. Do not use installed solid surface lockers as work surfaces or storage during construction.

**END OF SECTION 10 51 00**

## **SECTION 21 00 00 - FIRE SUPPRESSION PIPING SYSTEMS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Divisions 22 and 23.

#### **1.2 REVISION TO DIVISION NUMBERING**

- A. These documents have been revised to reflect new numbering standards. All Mechanical documents were previously contained within Division 15. These documents have now been divided into Fire Protection, Plumbing and HVAC and renumbered as Divisions 21, 22 and 23, respectively.

#### **1.3 COORDINATION OF DIVISIONS 21, 22 AND 23.**

- A. Divisions 21, 22 and 23 are used to communicate the requirements for the total Mechanical scope of work. It is intended for these three Divisions to serve as a single document, communicating the Mechanical scope of work.

#### **1.4 SCOPE OF WORK/DESIGN CRITERIA**

- A. Fire Protection work scope is limited to modification of the existing fire protection system to accommodate revised walls and ceilings in the Womens Basketball Locker Room area. See architectural plans and mechanical plans for details of revisions. Relocate existing sprinkler heads, branch pipes as required to maintain a fully functional fire protection system. Re-use existing sprinkler heads where they are not corroded or non-functional. Replace any corroded or non-functional sprinkler heads with new heads. Install all new escutcheon plates. If necessary, re-route branch piping around obstacles such as ducts, pipes, conduits, light fixtures or any ceiling mounted fixtures or equipment.
- B. The meaning and intention of these specifications, in conjunction with the drawing(s), is to cover a completely installed, fully operating fire sprinkler protection system for the remodeled area. To accomplish this purpose, the Contractor shall provide all design, materials, equipment and labor necessary and required, and bear all expenses incidental to the satisfactory completion of the work.
- C. It shall be the Contractor's responsibility to design and install the system so that no interferences exist between the fire protection piping, and equipment and systems installed by other disciplines.
- D. Comply with applicable local codes, state and local Fire Marshal's standards, International Building Code, International Fire Code, NFPA 13, and University's insurance underwriter for

installation and design of systems.

- E. The design shall be governed first and foremost by code compliance and secondly by the specifications/contract documents. If a discrepancy exists between code and contract documents, the stricter shall be complied with. If such discrepancy exists, notification is expected and an addendum will be issued.
- F. Contractor is responsible for fees and permit costs related to installing system except as noted.
- G. Contractor shall perform hydrostatic testing of all system piping in accordance with NFPA Pamphlet 13. Provide complete Contractor Material and Test Certificates for each system/portion of system tested.
- H. Provide and install water flow detection switches for each sprinkler zone. Provide supervisory valve tamper switches for all sprinkler control valves. The installation of site exterior piping and valving is not indicated on Division 23 drawings. The Section 211000 contractor shall provide required tamper switches for exterior valves.
- I. Piping shown on the project drawings is considered diagrammatic. The drawings include the locations of all major system equipment and bulk mains. Locations of the interior piping may vary from the drawing as approved by the Engineer and as coordinated with the Contractor. The Contractor shall field fit piping as required in areas such as Mechanical Rooms. Contractor shall provide all required incidental devices, valves, switches, piping, etc., to achieve a complete system whether indicated on the drawings or not.
- J. Interface with Building Fire Alarm system in accordance with code.

## **1.5 APPROPRIATE USE OF CONSTRUCTION DOCUMENTS**

- A. These specifications and accompanying drawings are intended to communicate the design concept for this project and outline the scope of work. They should not be viewed as a comprehensive document that details every specific task, item, or piece of equipment required to complete the project. It is understood that industry knowledge and experience is required to establish an accurate and complete scope of work from these documents, and it is assumed that the Division 21 Contractor possesses that knowledge and experience. Work not specifically noted in these specifications or the accompanying drawings, but which is required to complete the project, shall be included by the Division 21 Contractor as part of his/her scope of work.
- B. These specifications and the accompanying drawings are intended to supplement each other. Information included in either one shall be incorporated into the project as if included in both. In the event of any conflicts, the most stringent requirements shall be considered the governing scope of work until and unless clarification can be obtained by the Contractor.
- C. In the event of dimensional discrepancies between Division 21 documents and other disciplines, Architectural and Structural documents take precedence over Division 21. Refer to this information for sufficient understanding to the extent that it impacts the Division 21 scope of work.
- D. Drawings are intended to indicate the general arrangement of piping, ductwork, equipment and other components of Division 21 systems. They shall be followed as closely as possible, but shall be considered diagrammatic in nature. They are not intended to show every component, fitting,

offset, etc. Components, fittings, offsets, etc. as required to meet the intent of the documents and to achieve coordination with other trades shall be included in the Division 21 scope of work. Note that more detailed information about routing may be provided for certain areas of the project where special constraints exist. It is the intent of this detailed information to better communicate the constraints, but these drawings and details shall still be considered diagrammatic in nature as outlined above.

## 1.6 REFERENCES

### A. General

1. Division 00 and Division 01 of these specifications shall govern Division 21 work, including Bidding Requirements, Conditions of the Contract, and Supplementary Conditions. It is the Division 21 Contractor's responsibility to be aware of all information and requirements included in these locations, and to include those requirements as part of the Division 23 scope of work.
2. It shall be understood by the Division 21 Contractor that the Division 21 scope of work is intended to involve a coordinated effort with all other Divisions of work. Refer to other sections of the documents for additional related requirements and to ensure a coordinated effort.
3. References to industry standards, testing procedures, etc. are noted in individual sections of these specifications. The requirements and standards from the referenced documents shall be considered part of the requirements of these specifications.
4. It shall be understood by the Contractor that the Division 21 information is intended to serve as a single document, and each section of these specifications directly or indirectly relates to all other sections. As such, each section does not attempt to identify every other Division 21 section that is related. Significant references to information outside of Division 21 are, however, occasionally provided for informational purposes. This information is provided to assist in coordination, but the lack of a reference to another portion of the Contract Documents does not relieve the Contractor of the responsibility for coordination with other sections of Division 21 and all other trades.
5. Fire Protection Piping
6. ANSI/ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800
7. ANSI/ASME B16.3 - Malleable Iron Threaded Fittings, Class 150 and 300
8. ANSI/ASME B16.4 - Cast Iron Threaded Fittings, Class 125, and 250
9. ASME/ANSI B16.5 - Pipe Flanges and Flanged Fittings
10. ASME/ANSI B16.9 - Factory-made Wrought Steel Buttwelding Fittings
11. ASME B16.11 - Forged Steel Fittings, Socket-welding and Threaded
12. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings

13. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
  14. ASME B16.25 - Buttwelding Ends
  15. ASME B36.10 - Welded and Seamless Wrought Steel Pipe
  16. ASTM A47 - Malleable Iron Castings
  17. ASTM A53 - Pipe, Steel, Black and Hot-Dipped, Zinc-coated Welded and Seamless
  18. ASTM A135 - Electric-Resistance-Welded Steel Pipe
  19. ASTM A234 - Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures
  20. ASTM A795 - Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use
  21. ASTM B32 - Solder Metal
  22. ASTM B75 - Seamless Copper Tube
  23. ASTM B88 - Seamless Copper Water Tube
  24. ASTM B251 - General Requirements for Wrought Seamless Copper and Copper-Alloy Tube
  25. AWS D109 - Specifications for Qualification of Welding Procedures and Welders for Piping and Tubing
  26. AWWA C110 - Ductile Iron and Gray Iron Fittings
  27. AWWA C151 - Ductile Iron Pipe, Centrifugally Cast
  28. UL – Fire Protection Equipment Directory
- B. Miscellaneous
1. UL 262 - Gate Valves for Fire-Protection Service
  2. UL 312 - Check Valves for Fire-Protection Service
  3. UL 405 - Fire Department Connections
  4. NFPA 13 - Installation of Sprinkler Systems
  5. NFPA 24 - Installation of Private Fire Service Mains and their Appurtenances
  6. UFC - Uniform Fire Code

## 1.7 SYSTEM DESCRIPTIONS

- A. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to water supply. 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.

## **1.8 SUBMITTALS**

- A. General

- 1. Product data for specified materials.
- 2. Shop Drawings: Diagram power, signal, and control wiring.
- 3. Fire-hydrant flow test report.
- 4. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations, if applicable.
- 5. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in [NFPA 13] [NFPA 13 and NFPA 14] [NFPA 14]. Include "Contractor's Material and Test Certificate for Aboveground Piping" and "Contractor's Material and Test Certificate for Underground Piping."
- 6. Welding certificates.

## **1.9 OPERATION AND MAINTENANCE MATERIALS**

- A. General: Product data for specified items.

## **1.10 QUALITY ASSURANCE**

- A. Installer Qualifications:

- 1. Installer's responsibilities include designing, fabricating, and installing fire-suppression 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: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.

- C. NFPA Standards: Fire-suppression-system equipment, specialties, accessories, installation, and testing shall comply with the following:

- 1. NFPA 13, "Installation of Sprinkler Systems."

2. NFPA 13R, "Installation of Sprinkler Systems in Residential Occupancies up to and Including Four Stories in Height."
  3. NFPA 14, "Installation of Standpipe, Private Hydrant, and Hose Systems."
  4. NFPA 24, "Installation of Private Fire Service Mains and Their Appurtenances."
  5. NFPA 230, "Fire Protection of Storage."
- D. All mechanical equipment shall have an AIC rating of 100,000 or otherwise specified on electrical one-line diagrams fault current for each piece of equipment.

### **1.11 COORDINATION**

- A. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

### **1.12 EXTRA MATERIALS**

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Sprinkler Cabinets: Finished, wall-mounting, steel cabinet with hinged cover, 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 on Project.

## **PART 2 PRODUCTS**

### **2.1 FIRE SUPPRESSION PIPING, ABOVE GRADE**

- A. NPS 2 and Smaller
1. Pipe: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795; Schedule 40 black, standard weight steel pipe.
  2. Fittings
    - a. Cast-Iron Threaded Flanges: ASME B16.1.
    - b. Malleable-Iron Threaded Fittings: ASME B16.3.
    - c. Gray-Iron Threaded Fittings: ASME B16.4.
    - d. Steel Threaded Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106, Schedule 40, seamless steel pipe. Include ends matching joining method.
    - e. Steel Threaded Couplings: ASTM A 865.

## **2.2 LISTED GENERAL FIRE-PROTECTION VALVES**

- A. Valves shall be UL listed or FMG approved, with 175-psig (1200 kPa) minimum pressure rating. Valves shall have 300-psig (2070-kPa) pressure rating if valves are components of high-pressure piping system.
- B. Manufacturers
  - 1. Central
  - 2. Grinnell
  - 3. Kennedy
  - 4. Stockham
  - 5. Victaulic
- C. Ball Valves: Comply with UL 1091, except with ball instead of disc.
  - 1. NPS 1-1/2 (DN 40) and Smaller: Bronze body with threaded ends.
  - 2. NPS 2 and NPS 2-1/2 (DN 50 and DN 65): Bronze body with threaded ends or ductile-iron body with grooved ends.
  - 3. NPS 3 (DN 80): Ductile-iron body with grooved ends.
- D. Butterfly Valves: UL 1091.
  - 1. NPS 2 (DN 50) and Smaller: Bronze body with threaded ends.
  - 2. NPS 2-1/2 (DN 65) and Larger: Bronze, cast-iron, or ductile-iron body; wafer type or with flanged or grooved ends.
- E. Check Valves NPS 2 (DN 50) and Larger: UL 312, swing type, cast-iron body with flanged or grooved ends.
- F. Gate Valves: UL 262, OS&Y type.
  - 1. NPS 2 (DN 50) and Smaller: Bronze body with threaded ends.
  - 2. NPS 2-1/2 (DN 65) and Larger: Cast-iron body with flanged ends.

## **2.3 MANUAL CONTROL STATIONS**

- A. Manual Control Stations: UL listed or FMG approved, hydraulic operation, with union, NPS 1/2 (DN 15) 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.



## 2.4 SPRINKLERS

- A. Manufacturers
  - 1. Central Sprinkler Corp.
  - 2. Grinnell Fire Protection
  - 3. Reliable Automatic Sprinkler Co., Inc.
  - 4. Star Sprinkler Inc.
  - 5. Victaulic Co. of America
  - 6. Viking Corp.
- B. Sprinklers shall be UL listed or FMG approved, with 175-psig (1200-kPa) minimum pressure rating. Sprinklers shall have 300-psig (2070-kPa) pressure rating if sprinklers are components of high-pressure piping system.
- C. Automatic Sprinklers: With heat-responsive element complying with the following:
  - 1. UL 199, for nonresidential applications.
  - 2. UL 1626, for residential applications.
  - 3. UL 1767, for early-suppression, fast-response applications.
- D. Sprinkler Types and Categories: Nominal 1/2-inch (12.7-mm) orifice for "Ordinary" temperature classification rating, unless otherwise indicated or required by application.
- E. Sprinkler Finishes: Chrome plated, bronze, and painted.
- 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, 2 piece, with 1-inch (25-mm) vertical adjustment.
  - 2. Sidewall Mounting: Chrome-plated steel, one piece, flat.
- G. Sprinkler Guards: Wire-cage type, including fastening device for attaching to sprinkler.

## 2.5 SPRINKLER SPECIALTY FITTINGS

- A. Sprinkler specialty fittings shall be UL listed or FMG approved, with 175-psig (1200-kPa) minimum working-pressure rating, and made of materials compatible with piping. Sprinkler specialty fittings shall have 300-psig (2070-kPa) working-pressure rating if fittings are components of high-pressure piping system.
- B. Outlet Specialty Fittings:

1. Mechanical-T and -Cross Fittings: UL 213, ductile-iron housing with gaskets, bolts and nuts, and threaded, locking-lug, or grooved outlets.
2. Snap-On and Strapless Outlet Fittings: UL 213, ductile-iron housing or casting with gasket and threaded outlet.
- C. Sprinkler Drain and Alarm Test Fittings: Cast- or ductile-iron body; with threaded or locking-lug inlet and outlet, test valve, and orifice and sight glass.
- D. Sprinkler Branch-Line Test Fittings: Brass body with threaded inlet, capped drain outlet, and threaded outlet for sprinkler.
- E. Sprinkler Inspector's Test Fitting: Cast- or ductile-iron housing with threaded inlet and drain outlet and sight glass.
- F. Drop-Nipple Fittings: UL 1474, adjustable with threaded inlet and outlet, and seals.
- G. Dry-Pipe-System Fittings: UL listed for dry-pipe service.

**2.6 UNLISTED GENERAL-DUTY VALVES: REFER TO SECTION 220523.**

**PART 3 EXECUTION**

**3.1 PREPARATION**

- A. Perform fire-hydrant flow test according to NFPA 13, NFPA 14, and NFPA 291. Use results for system design calculations required in Part 1 "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 thicknesses, 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 PIPING APPLICATIONS, GENERAL**

- A. Shop weld pipe joints where welded piping is indicated.
- B. Flanges, flanged fittings, unions, nipples, and transition and special fittings with finish and pressure ratings same as or higher than system's pressure rating may be used in aboveground applications, unless otherwise indicated.

### 3.4 VALVE APPLICATIONS

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
  - 1. Listed Fire-Protection Valves: UL listed and FMG approved for applications where required by NFPA 13 and NFPA 14.
    - a. Shutoff Duty: Use ball, butterfly, or gate valves.
  - 2. Unlisted General-Duty Valves: For applications where UL-listed and FMG-approved valves are not required by NFPA 13 and NFPA 14.
    - a. Shutoff Duty: Use ball, butterfly, or gate valves.
    - b. Throttling Duty: Use ball or globe valves.

### 3.5 JOINT CONSTRUCTION

- A. Refer to Division 22 Section "Basic Mechanical Materials and Methods" for basic piping joint construction.
- B. Threaded Joints: Comply with NFPA 13 for pipe thickness and threads. Do not thread pipe smaller than NPS 8 (DN 200) with wall thickness less than Schedule 40 unless approved by authorities having jurisdiction and threads are checked by a ring gauge and comply with ASME B1.20.1.
- C. Twist-Locked Joints: Insert plain-end piping into locking-lug fitting and rotate retainer lug one-quarter turn.
- D. Pressure-Sealed Joints: Use UL-listed tool and procedure. Include use of specific equipment, pressure-sealing tool, and accessories.
- E. Grooved Joints: Assemble joints with listed coupling and gasket, lubricant, and bolts.
  - 1. Ductile-Iron Pipe: Radius-cut-groove ends of piping. Use grooved-end fittings and grooved-end-pipe couplings.
  - 2. Steel Pipe: Square-cut or roll-groove piping as indicated. Use grooved-end fittings and rigid, grooved-end-pipe couplings, unless otherwise indicated.
  - 3. Copper Tube: Roll-groove tubing. Use grooved-end fittings and grooved-end-tube couplings.
  - 4. Dry-Pipe Systems: Use fittings and gaskets listed for dry-pipe service.
- F. Dissimilar-Metal Piping Joints: Construct joints using dielectric fittings compatible with both piping materials.
  - 1. NPS 2 (DN 50) and Smaller: Use dielectric unions, couplings, or nipples.

2. NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Use dielectric flanges.
3. NPS 5 (DN 125) and Larger: Use dielectric flange insulation kits.

### **3.6 PIPING INSTALLATION**

- A. Refer to Division 22 Section "Basic Plumbing Materials and Methods" for basic piping installation.
- B. 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.
- C. Install underground copper service-entrance piping according to NFPA 24.
- D. Use approved 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 (DN 50) and smaller. Unions are not required on flanged devices or in piping installations using grooved joints.
- F. Install flanges or flange adapters on valves, apparatus, and equipment having NPS 2-1/2 (DN 65) and larger connections.
- G. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, sized and located according to NFPA 13.
- H. Install sprinkler piping with drains for complete system drainage.
- I. Install sprinkler zone control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.
- J. Install drain valves on standpipes.
- K. Install ball drip valves to drain piping between fire department connections and check valves. Drain to floor drain or outside building.
- L. Install alarm devices in piping systems.
- M. Hangers and Supports: Comply with NFPA 13 for hanger materials.
  1. Install standpipe system piping according to NFPA 14.
  2. Install sprinkler system piping according to NFPA 13.
- N. Earthquake Protection: Install piping according to NFPA 13 to protect from earthquake damage.
- O. Install pressure gauges on riser or feed main, at each sprinkler test connection, and at top of each

standpipe. Include pressure gauges with connection not less than NPS 1/4 (DN 8) and with soft metal seated globe valve, arranged for draining pipe between gauge and valve. Install gauges to permit removal, and install where they will not be subject to freezing.

- P. Drain dry-type standpipe piping.
- Q. Drain dry-pipe sprinkler piping.
- R. Pressurize and check dry-pipe sprinkler system piping and air-pressure maintenance devices.
- S. Fill wet-standpipe system piping with water.
- T. Fill wet-pipe sprinkler system piping with water.
- U. Install flexible connectors on fire-pump and pressure-maintenance-pump supply and discharge connections and in fire-suppression piping where indicated.

### **3.7 SPRINKLER APPLICATIONS**

- A. Drawings indicate sprinkler types to be used. Where specific types are not indicated, use the following sprinkler types:
  - 1. Rooms without Ceilings: Upright sprinklers.
  - 2. Rooms with Suspended Ceilings: Recessed sprinklers
  - 3. Wall Mounting: Sidewall sprinklers.
  - 4. Spaces Subject to Freezing: Upright, pendent, dry sprinklers; and sidewall, dry sprinklers.
  - 5. Deluge-Sprinkler Systems: Upright and pendent, open sprinklers.
  - 6. Sprinkler Finishes:
    - a. 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.
    - b. Concealed Sprinklers: Rough brass, with factory-painted white cover plate.
    - c. Flush Sprinklers: Bright chrome, with painted white escutcheon.
    - d. Recessed Sprinklers: Bright chrome, with bright chrome escutcheon.

### **3.8 SPRINKLER INSTALLATION**

- A. Install sprinklers in suspended ceilings in center of narrow dimension of acoustical ceiling panels and tiles.
- B. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing. Use dry-type

sprinklers with water supply from heated space.

### **3.9 CONNECTIONS**

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.
- C. Connect water-supply piping to fire-suppression piping. Include backflow preventer between potable-water piping and fire-suppression piping. Refer to Division 22 Section "Domestic Water Piping Systems" for backflow preventers.
- D. Install ball drip valves at each check valve for fire department connection. Drain to floor drain or outside building.
- E. Connect piping to specialty valves, hose valves, specialties, fire department connections, and accessories.
- F. Connect excess-pressure pumps to the following piping and wiring:
  - 1. Sprinkler system, hydraulically.
  - 2. Pressure gauges and controls, hydraulically.
  - 3. Electrical power system.
  - 4. Alarm device accessories for pump.
  - 5. Fire alarm.
- G. Electrical Connections: Power wiring is specified in Division 26.
- H. Connect alarm devices to fire alarm.
- I. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- J. Connect wiring according to Division 26 Section "Building Voltage Electrical Power Conductors and Cables."
- K. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

### **3.10 LABELING AND IDENTIFICATION**

- A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13/14 and in Section 220553.

### **3.11 FIELD QUALITY CONTROL**

- A. Perform the following field tests and inspections and prepare test reports:
1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
  2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
  3. Energize circuits to electrical equipment and devices.
  4. Start and run excess-pressure pumps.
  5. Start and run air compressors.
  6. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
  7. Flush, test, and inspect standpipe systems according to NFPA 14, "System Acceptance" Chapter.
  8. Coordinate with fire alarm tests. Operate as required.
  9. Coordinate with fire-pump tests. Operate as required.
  10. Verify that equipment hose threads are same as local fire department equipment.
- B. Report test results promptly and in writing to Architect and authorities having jurisdiction.

### **3.12 CLEANING AND PROTECTION**

- A. Clean dirt and debris from sprinklers.
- B. Remove and replace sprinklers with paint other than factory finish.
- C. Protect sprinklers from damage until Substantial Completion.

### **3.13 DEMONSTRATION**

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain specialty valves.

**END OF SECTION 21 00 00**

## **SECTION 22 00 00 - GENERAL PLUMBING REQUIREMENTS**

### **PART 1 GENERAL**

#### **1.1 SCOPE OF WORK**

- A. It is intended for the Division 22 scope of work to include complete and functional plumbing systems - including all required materials, labor, equipment, and services necessary to achieve the desired final product. It is further intended for the Division 22 scope of work to include coordination with Divisions 21 and 23 and all work required by Division 22 for complete Fire Protection and HVAC systems.

#### **1.2 REVISION TO DIVISION NUMBERING**

- A. These documents have been revised to reflect new numbering standards. All Mechanical documents were previously contained within Division 15. These documents have now been divided into Fire Protection, Plumbing and HVAC and renumbered as Divisions 21, 22 and 23, respectively.

#### **1.3 COORDINATION OF DIVISIONS 21, 22 AND 23.**

- A. Divisions 21, 22 and 23 are used to communicate the requirements for the total Mechanical scope of work. It is intended for these three Divisions to serve as a single document, communicating the Mechanical scope of work.

#### **1.4 REFERENCES**

- A. Division 00 and Division 01 of these specifications shall govern Division 22 work, including Bidding Requirements, Conditions of the Contract, and Supplementary Conditions. It is the Division 22 Contractor's responsibility to be aware of all information and requirements included in these locations, and to include those requirements as part of the Division 22 scope of work.
- B. It shall be understood by the Division 22 Contractor that the Division 22 scope of work is intended to involve a coordinated effort with all other Divisions of work. Refer to other sections of the documents for additional related requirements and to ensure a coordinated effort.
- C. References to industry standards, testing procedures, etc. are noted in individual sections of these specifications. The requirements and standards from the referenced documents shall be considered part of the requirements of these specifications.



- D. This section applies to all Division 22 work. The Division 22 Contractor shall ensure that all Division 22 work described throughout other specification sections and on the drawings is in accordance with this section.
- E. It shall be understood by the Contractor that the Division 22 information is intended to serve as a single document, and each section of these specifications directly or indirectly relates to all other sections. As such, each section does not attempt to identify every other Division 22 section that is related. Significant references to information outside of Division 22 are, however, occasionally provided for informational purposes. This information is provided to assist in coordination, but the lack of a reference to another portion of the Contract Documents does not relieve the Contractor of the responsibility for coordination with other sections of Division 22 and all other trades.
- F. Definitions
- G. The following definitions shall apply to the use of these words when used in Division 22. These definitions are not intended to define use of these words outside of Division 22.
- H. Acceptance: The Owner's assumption of ownership of the plumbing system.
- I. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- J. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.
- K. Contractor (The Contractor, This Contractor, Division 22 Contractor, etc.): The contractor responsible for the Division 22 scope of work.
- L. Date of Acceptance: The official date when Acceptance occurs. This will coincide with the granting of Substantial Completion unless noted otherwise by the Owner's Representative. It shall not be assumed that the Date of Acceptance has deviated from Substantial Completion unless written documentation is provided by the Owner's Representative indicating differently.
- M. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- N. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- O. 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, crawlspace, and tunnels.
- P. Mechanical: Shall refer in a consolidated manner to and be interchangeable with "Divisions 21, 22 and 23".

- Q. Plumbing: Shall be considered interchangeable with “Division 22”.
- R. Owner’s Representative: The Architect or his designated representative, as outlined in the General Conditions.
- S. Provide: Furnish and install.

## 1.5 ABBREVIATIONS

- A. The following are industry abbreviations used in these specifications: ABS: Acrylonitrile-butadiene-styrene plastic; ASJ: All-service jacket; BR: Butyl rubber; Buna-N: Nitrile rubber; CPVC: Chlorinated polyvinyl chloride plastic; CR: Chlorosulfonated polyethylene synthetic rubber; CSM: Chlorosulfonyl-polyethylene rubber; CWP: Cold working pressure; DDC: Direct digital control; DOP: Dioctyl phthalate or bis-(2-ethylhexyl) phthalate; EMCS: Energy Management and Control System; EPDM: Ethylene-propylene-diene terpolymer rubber; FOG: Fats, oils, and greases; FRP: Fiberglass-reinforced plastic; FSK: Foil, scrim, kraft paper; FSP: Foil, scrim, polyethylene; HDPE: High-density polyethylene plastic; HEPA: High-efficiency particulate air; I/O: Input/output; LLDPE: Linear, low-density polyethylene plastic; MS/TP: Master slave/token passing; MSS: Manufacturers Standardization Society for The Valve and Fittings Industry Inc.; NBR: Acrylonitrile-butadiene rubber; NC: Noise criteria; NR: Natural rubber; NUSIG: National Uniform Seismic Installation Guidelines; PE: Polyethylene plastic; PEX: Crosslinked polyethylene plastic; PC: Personal computer; PID: Proportional plus integral plus derivative; PMMA: Polymethyl methacrylate (acrylic) plastic; PP: Polypropylene plastic; PTFE: Polytetrafluoroethylene plastic; PUR: Polyurethane plastic; PVC: Polyvinyl chloride plastic; PVDC: Polyvinylidene chloride; RC: Room criteria; RTD: Resistance temperature detector; SSL: Self-sealing lap; SWP: Steam working pressure; TFE: Tetrafluoroethylene plastic; TPE: Thermoplastic elastomer; ULPA: Ultra low penetration air.

## 1.6 APPLICABLE CODES

- A. Division 22 work shall be performed in accordance with applicable codes and standards as adopted by the authorities having jurisdiction including amendments. Following is a listing of major codes and standards, the requirements of which shall be considered part of the scope of this project. This list should not be considered comprehensive, and codes or standards not included in this list should not be considered to be excluded from the scope of the project.
  - 1. Americans with Disabilities Act (ADA)
  - 2. Applicable State and Local Codes and Ordinances
  - 3. National Electrical Code
  - 4. International Building Code
  - 5. International Fire Code

6. International Mechanical Code
7. Uniform Plumbing Code
8. Washington State Non-Residential Energy Code
9. Washington State Indoor Air Quality Code
10. Washington State Boiler and Unfired Pressure Vessel Code.

## **1.7 PERMITS AND FEES**

- A. All permits and inspections required to complete the Division 22 scope of work shall be included in the Division 22 bid price. All certifications provided as part of the permit and inspection process shall be provided to the Owner as part of the Division 22 scope of work as specified in these documents.
- B. All fees required by utility providers shall be included in the Division 22 bid price, including water, gas, sanitary sewer, and storm sewer connections. This shall include all charges to the project by these agencies, including but not limited to general fees, equipment charges (meters, vaults, etc.), tap fees, and utility main installation charges.

## **1.8 ALTERNATES (REFER TO DIVISION 01)**

- A. The bid price for the scope of work shall be separated into base bid and alternate values when indicated. Both base bid and alternate bid prices shall reflect a complete and working plumbing system, with specific features and/or portions of the systems designated as base bid or alternate as described.

## **1.9 SCOPE AND APPROPRIATE USE OF BID DOCUMENTS**

- A. These specifications and accompanying drawings are intended to communicate the design concept for this project and outline the scope of work. They should not be viewed as a comprehensive document that details every specific task, item, or piece of equipment required to complete the project. It is understood that industry knowledge and experience is required to establish an accurate and complete scope of work from these documents, and it is assumed that the Division 22 Contractor possesses that knowledge and experience. Work not specifically noted in these specifications or the accompanying drawings, but which is required to complete the project, shall be included by the Division 22 Contractor as part of his scope of work.
- B. These specifications and the accompanying drawings are intended to supplement each other. Information included in either one shall be incorporated into the project as if included in both. In the event of any conflicts, the most stringent requirements shall be considered the governing scope of work until and unless clarification can be obtained by the Contractor.

- C. In the event of dimensional discrepancies between Division 22 documents and other disciplines, Architectural and Structural documents take precedence over Division 22. Refer to this information for sufficient understanding to the extent that it impacts the Division 22 scope of work.
- D. Drawings are intended to indicate the general arrangement of piping, ductwork, equipment and other components of Division 22 systems. They shall be followed as closely as possible, but shall be considered diagrammatic in nature. They are not intended to show every component, fitting, offset, etc. Components, fittings, offsets, etc. as required to meet the intent of the documents and to achieve coordination with other trades shall be included in the Division 22 scope of work. Note that more detailed information about routing may be provided for certain areas of the project where special constraints exist. It is the intent of this detailed information to better communicate the constraints, but these drawings and details shall still be considered diagrammatic in nature as outlined above.

#### **1.10 ROUTING AND LOCATIONS**

- A. It is the Contractor's responsibility to coordinate equipment locations and system routing with available space and with all other trades.
- B. It is the Contractor's responsibility to coordinate and verify the exact locations and routing of equipment and systems prior to fabrication and installation. If discrepancies become apparent as part of the verification process, the Contractor shall ask for written clarification/direction. Alteration, removal and/or replacement of work already installed as a result of failure to verify and/or coordinate locations and routing prior to fabrication and/or installation shall be at the Contractor's expense.
- C. Locations of equipment shown on the drawings are approximate unless specifically dimensioned.
- D. All ductwork, piping, tubing, conduit, etc. shall be concealed within building construction unless noted otherwise. Mechanical rooms are considered to be within building construction for the purposes of this requirement.
- E. Existing utilities, piping, and ductwork have been indicated as closely as possible. The Contractor can assume that points of connection to existing utilities have been shown within 10 feet (3 meters) of the actual location. When actual points of connection are more than 10 feet (3 meters) from the location shown on the drawings, the Contractor shall notify the Owner's Representative prior to commencing this portion of the work.
- F. The Contractor is responsible for any remedial work required from failure to locate and preserve underground utilities. This shall include all work necessary to repair any damaged utilities to their original condition.

#### **1.11 SCHEDULING**

- A. It is understood that while drawings are to be followed as closely as circumstances permit, the Contractor shall be responsible for installation of systems according to the true intent and meaning of Contract Documents. Anything not clear or in conflict will be explained by making application to Owner's Representative. The Contractor shall familiarize himself with his scope of work as well as the required coordination with other trades and the scheduling of other trades sufficiently to address coordination issues in a timely manner such that they do not result in remedial work for other trades.
- B. Should conditions arise where certain changes would be advisable, secure approval from Owner's Representative for those changes before proceeding with work. Proceeding without written approval is at the Contractor's risk and at the Contractor's expense.
- C. The contractor shall coordinate with the work of various trades when installing interrelated work. Before installation of plumbing items, proper provisions shall be made to avoid interferences. Changes required in work specified in Division 22 caused by neglect to do so shall be made at no cost to Owner.
- D. Inserts and supports required by Division 22 shall be furnished and installed unless otherwise noted. Furnish sleeves, inserts, supports, and equipment that are an integral part of other Divisions of the Work to those involved in sufficient time to be built into construction as the Work proceeds. Locate these items and see that they are properly installed. Expense resulting from improper location or installation of items above shall be borne under Division 22.

#### **1.12 CUTTING AND PATCHING**

- A. The Division 22 Contractor shall be responsible for all cutting and patching required to complete the Division 22 scope of work.
- B. All patching shall be performed such that it matches existing finishes.
- C. The Contractor shall not cut any structural members without first getting approval from the Owner's Representative to do so.
- D. All cutting and patching required to correct defective or otherwise unacceptable work shall be the responsibility of the Division 22 Contractor.

#### **1.13 GUARANTEE (REFER TO DIVISION 01)**

- A. All Division 22 systems and equipment shall be guaranteed for a minimum period of one year.
- B. Specific equipment and/or systems requiring warranties beyond one year are indicated in the table at the end of this section.
- C. The guarantee shall begin at the Date of Acceptance, unless written documentation is provided noting otherwise. When more than one Date of Acceptance is indicated for various portions or

specific equipment, the guarantee shall begin at the Date of Acceptance independently for each portion of the system or piece of equipment.

- D. Permission to use Division 22 systems or equipment for temporary heating or other contractor use prior to the Date of Acceptance, as outlined elsewhere in these specifications, shall not constitute the beginning of the guarantee period. The contractor shall make any necessary arrangements to extend equipment and/or system warranties sufficient to maintain the designated guarantee period from the Date of Acceptance.
1. Exception: When temporary heating and or other system use is requested by the Owner for the Owner's benefit prior to the Date of Acceptance, the guarantee period for the portions of the system or specific equipment requested for use may begin at the time it is put into service. This can only be assumed to have occurred if written documentation is provided indicating such.

#### **1.14 QUALITY ASSURANCE**

- A. Material and Equipment Qualifications
1. Provide materials and equipment that are standard products of manufacturers regularly engaged in the manufacture of such products, which are of a similar material, design and workmanship. Standard products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year use shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been for sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2 year period.
  2. Alternative Qualifications: Products having less than a two-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturer's factory or laboratory tests, can be shown.
- B. Service Support: The equipment items shall be supported by service organizations. When requested to gain approval, submit a certified list of qualified permanent service organizations for support of the equipment which includes their addresses and qualifications. These service organizations shall be reasonably convenient to the equipment installation and able to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.
- C. Manufacturer's Nameplate: Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.
- D. UL Listings: All equipment shall be provided with a UL or approved equivalent label when labeling is available for that type of equipment.

- E. Fuel-fired equipment shall be labeled by the appropriate nationally recognized label for the fuel type (i.e. AGA).
- F. All control panels shall be UL listed (or equivalent approved label).
- G. Pressure vessels shall be provided in accordance with applicable pressure vessel ordinances.
- H. All mechanical equipment shall have an AIC rating of 100,000 or otherwise specified on electrical one-line diagrams fault current for each piece of equipment.

#### **1.15 SUBSTITUTIONS (REFER TO DIVISION 01)**

- A. When multiple manufacturers are listed in these specifications, equipment can be used from those manufacturers providing they can meet the requirements of the specifications and drawings. This shall include meeting capacity requirements, efficiencies, space and weight limitations, electrical provisions, etc. The detailed information in the specifications, scheduled equipment information, additional drawing information and any specific references to a particular manufacturer and/or model of equipment shall be considered the basis of design. Other listed manufacturers, even when listed in these specifications, will only be allowed if they meet or exceed that basis of design.
- B. Substitutions involving manufacturers not listed in these specifications will not be allowed without written approval. When written approval is requested, information will be reviewed in preliminary fashion for general conformance only. Any approved manufacturers will still be required to meet the requirements of these specifications and the drawings, and final approval during submittal review will only be granted if the equipment meets or exceeds the requirements of the documents.
- C. It is the Contractor's responsibility when utilizing approved substituted equipment to ensure the equipment will fit within the constraints of the project as detailed using the basis of design equipment (space, weight, power, etc.). Any required alterations by Division 22 or any other Division of work to accommodate differences between the substituted equipment and the basis of design equipment shall be the responsibility of the Division 22 Contractor, including the cost of design for the required changes.
- D. If the changes required by substituted equipment cannot be accommodated, the Contractor shall be responsible for replacing the substituted equipment with the basis of design equipment.
- E. Proposed substituted equipment will not be considered equal if it requires an increase of more than 5% in power usage at design conditions.

#### **1.16 PLUMBING COST BREAKDOWN (REFER TO DIVISION 01)**

- A. Provide a breakdown of construction costs within 30 days of Notice to Proceed, with separate costs for each of the items listed in the table at the end of this section.

### **1.17 PAYMENT REQUESTS**

- A. Submittals and operation and maintenance data must be received and approved before payment requests will be considered for materials and equipment.

### **1.18 SUBMITTALS (REFER TO DIVISION 01)**

- A. Submittal information shall be provided and approved on all materials and equipment prior to ordering.
- B. Provide indication of which options and accessories are to be included.
- C. Include all scheduled information for equipment listed in schedules on the drawings.
- D. Review will be for general conformance only, and shall not relieve the Contractor for any deviations from the requirements of the documents unless clear written reference is made by the Contractor in the submittal to proposed deviations.
- E. All Division 22 information shall be provided in one complete submittal, indexed by specification section.
  - 1. Exceptions: At the discretion of the Owner's Representative, partial submittals may be provided. If allowed, provide a table indicating submittal status with each submittal, and provide an initial submittal with all required tabs and space for all current and future submittals.
- F. Provide operation and maintenance data for individual equipment after initial submittals have been reviewed.
- G. Efficiency Standards
  - 1. Units requiring more than a 5% increase in power input beyond the scheduled equipment to meet design capacities will not be considered equal.
  - 2. Units requiring more than a 5% increase in fan brake horsepower over the scheduled equipment to meet the design flow and external static pressure requirements will not be considered equal and will not be accepted.

### **1.19 DELIVERY, STORAGE, AND HANDLING**

- A. Follow manufacturer's directions in delivery, storage, protection, and installation of equipment and materials.
- B. Promptly notify Owner's Representative in writing of conflicts between requirements of Contract Documents and Manufacturer's directions and obtain written instructions from Owner's Representative before proceeding with work. The Contractor shall bear expenses arising from



correcting deficiencies of work that do not comply with manufacturer's directions or such written instructions from Owner's Representative.

- C. Handle, store, and protect equipment and materials to prevent damage before and during installation in accordance with the manufacturer's recommendations, and as approved by the Contracting Officer. Replace damaged or defective items.

#### **1.20 OPERATION AND MAINTENANCE MANUALS**

- A. Provide a consolidated Operation and Maintenance Manual for Divisions 21, 22 and 23. Refer to Section 230000 for requirements.

#### **1.21 OPERATION AND MAINTENANCE TRAINING**

- A. Provide consolidated training for Divisions 21, 22 and 23. Refer to Section 230000 for requirements.

#### **1.22 EXTRA MATERIALS**

- A. A list of extra materials to be provided under this contract has been included at the end of this section. Refer to individual specification sections for specific requirements of extra materials to be furnished under this contract.
- B. Turn extra materials over to Owner.
  - 1. Provide summarized list of extra materials that have been furnished. List shall include verification by Owner's Representative that parts have been furnished. Incorporate into O&M Manual. Extra materials list shall be similar to that provided at the end of this section.

#### **1.23 CLEANING**

- A. Leave all equipment and systems in a clean and new condition at the completion of the project. Clean all piping and ductwork exposed in finished spaces. Remove all stickers from equipment in finished spaces (plumbing fixtures, etc.). Repair all scratched and damaged equipment to new condition, to include touch-up painting.

#### **1.24 RECORD DRAWINGS**

- A. Maintain a set of Contract Documents dedicated for record drawings. These documents shall incorporate all clarifications and changes provided by the Owner's Representative, as well as field changes made by the Contractor. All markings shall be neat and legible. Turn over documents to the Owner's Representative at the completion of the project.

**1.25 PUNCH LISTS**

- A. Notify the Owner's Representative in writing when the project is ready for punch lists.
- B. When all punch list items have been addressed, notify the Owner's Representative in writing that the project is ready for a backcheck of completed punch list items. Include a copy of the original punch list with each completed item initialed and any required notation indicating if something was not completed and why.
- C. If, at the time of the backcheck, items are found that continue to be in nonconformance with the project documents, these items will be forwarded to the Contractor. Completion of these items shall be required to achieve substantial completion. All site visits required beyond the initial punch list and initial back check visits, including visits required to verify completion of these remaining outstanding items, shall be charged to the Contractor at normal billing rates.

**1.26 VISITING THE PROJECT SITE**

- A. The premises shall be examined and conditions shall be understood which may affect performance of work of this Division before submitting proposals for this work.
- B. No subsequent allowance for time or money will be considered for any consequence related to failure to examine existing site conditions.

**PART 2 PRODUCTS (NOT USED)**

**PART 3 EXECUTION (NOT USED)**

**PART 4 TABLES**

**4.1 PLUMBING COST BREAKDOWN TABLE**

<b>Plumbing Cost Breakdown Table</b>		
<b>Category</b>	<b>Material Cost</b>	<b>Labor / Installation Cost</b>
Mobilization		
Supervision		
Site Utilities		
Plumbing Seismic Restraint		
Plumbing Identification		
Plumbing Insulation		
Domestic Water Rough-In		
Waste and Vent Rough-In		
Miscellaneous Rough-In		
Plumbing Equipment (Floor Drains, Roof Drains, Water Hammer Arrestors, Valves, Hot Water Tanks, etc.)		
Water Heaters		
Plumbing Fixtures		
Commissioning Assistance		

4.2 SUBMITTAL TABLE

<b>Submittal Table</b>				
	<b>Submittal Data Included</b>	<b>Submittal Previously Approved</b>	<b>O&amp;M Data Included</b>	<b>O&amp;M Previously Approved</b>
<b>220500 – Basic Plumbing Materials and Methods</b>				
Access Doors				
Dielectric Fittings				
Escutcheons				
Mechanical Sleeve Seals				
Welding Certificates				
<b>220523 – Plumbing General Duty Valves</b>				
Ball Valves				
Butterfly Valves				
Check Valves – Horizontal Swing				
Check Valves – Lift Disc, Spring Loaded				
<b>220529 – Plumbing Hangers and Supports</b>				
Fastener Systems				
Thermal Hanger Shield Inserts				
Metal Framing Systems				
Welding Certificates				
<b>220553 – Plumbing Identification</b>				
Access Panel and Door Markers				
Ceiling Tacks				
Nameplates				
Pipe Markers				
Tags				
Valve Schedules - A preliminary chart shall be submitted at submittal time, and				

<b>Submittal Table</b>				
	<b>Submittal Data Included</b>	<b>Submittal Previously Approved</b>	<b>O&amp;M Data Included</b>	<b>O&amp;M Previously Approved</b>
shall be updated as part of the as-built documentation process.				
List of all equipment/items to receive nameplates indicating designation to be printed on nameplate.				
<b>220700 – Plumbing Insulation</b>				
Pipe Insulation – Cellular Foam				
Pipe Insulation – Glass Fiber				
Pipe Insulation – Calcium Silicate				
Pipe Insulation – Cellular Glass				
Pipe Jacketing				
Equipment Insulation – Glass Fiber				
Schedule Including Piping Systems, Insulation Type, Insulation Thickness Relative To Pipe Size				
Schedule Including Equipment, Insulation Type, Insulation Thickness				
<b>221100 – Domestic Water Piping Systems</b>				
Water Piping, Buried				
Water Piping, Above Grade				
Air Vents				
Double-Check Backflow Preventers				
Intermediate Atmospheric Vent Backflow Preventers				
Reduced Pressure Backflow Preventers				
Clothes Washer Outlet Box				
Drain Valves				

<b>Submittal Table</b>				
	<b>Submittal Data Included</b>	<b>Submittal Previously Approved</b>	<b>O&amp;M Data Included</b>	<b>O&amp;M Previously Approved</b>
Flow Control Balancing Valves				
Non-Freeze Ground Hydrants				
Hose Bibbs/Wall Hydrants				
Hose Stations				
Mixing Valves				
Post Hydrants				
Strainers				
Trap-Seal Primer Valves				
Trap-Seal Primer Systems				
Water Hammer Arresters				
Water Meters				
Water Pressure Reducing Valves				
<b>Section 221300 – Sanitary Waste and Vent Piping Systems</b>				
Waste and Vent Piping (Unpressurized), Buried				
Waste and Vent Piping (Unpressurized), Above Grade				
Waste and Vent Piping (Pressurized), Buried				
Waste and Vent Piping (Pressurized), Above Grade				
Flexible, Nonpressure Pipe Couplings				
Shielded Nonpressure Pipe Couplings				
Rigid, Unshielded, Nonpressure Pipe Couplings				
Pressure Pipe Couplings				
Flexible Ball Joints				

<b>Submittal Table</b>				
	<b>Submittal Data Included</b>	<b>Submittal Previously Approved</b>	<b>O&amp;M Data Included</b>	<b>O&amp;M Previously Approved</b>
Wall Penetration Fittings				
Backwater Valves				
Cleanouts				
Floor Drains				
Trap-Seal Primers				
Grease Interceptors				
<b>Section 223400 – Water Heaters</b>				
Commercial Water Heaters – Gas-Fired, Storage, High Efficiency				
Waste and Vent Piping (Unpressurized), Above Grade				
<b>224000 - Plumbing Fixtures (Submit by P-Numbers)</b>				
Counter-Mounted Lavatories (Vitreous China)				
Drinking Fountains				
Electric Water Coolers				
Emergency Eye-Wash				
Emergency Showers				
Floor-Mounted Flush Valve Water Closets				
Floor-Mounted Service Sinks				
Floor-Mounted Tank Type Water Closets				
Showers				
Stainless Steel Sinks				
Tubs				
Urinals				

<b>Submittal Table</b>				
	<b>Submittal Data Included</b>	<b>Submittal Previously Approved</b>	<b>O&amp;M Data Included</b>	<b>O&amp;M Previously Approved</b>
Wall-Mounted Flush Valve Water Closets				
Wall-Mounted Lavatories (Cast Iron)				
Wall-Mounted Lavatories (Vitreous China)				
Wall-Mounted Service Sinks				
Wall-Mounted Tank Type Water Closets				



**4.3 EXTRA MATERIALS LIST**

<b>Extra Materials List</b>				
<b>Specification Section</b>	<b>Mechanical Equipment</b>	<b>Extra Materials</b>	<b>Verified By</b>	<b>Date</b>
221100	Domestic Water Piping Systems	Two (2) Loose Keys for Frost Proof Wall Hydrants		
224000	Plumbing Fixtures	10% (minimum of two (2)) Sets of Faucet Washers and O-Rings for Each Type/Size Installed		
224000	Plumbing Fixtures	10% (minimum of two (2)) of Each Different Filter Cartridge Type		
224000	Flush Valves	Flush Valve Service Kits		

**4.4 EXTENDED WARRANTY LIST**

<b>Extended Warranty List</b>		
<b>Specification Section</b>	<b>Plumbing Equipment</b>	<b>Warranty Description</b>
223400	Water Heater	Heat Exchangers: 5 year warranty
223400	Water Heater/Storage Tank	Tanks: 3 year warranty

**END OF SECTION 22 00 00**

## SECTION 22 05 00 COMMON WORK RESULTS FOR PLUMBING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Where contradictions occur between this Section and Division 01, the more stringent of the two shall apply. Architect shall decide which is more stringent.
- C. These basic requirements shall apply to the entire Division 22 work.
- D. All referenced and related provisions of Divisions 21, 23 and Division 26 shall also apply to the work of this Section as if fully repeated herein.

#### 1.2 WORK OF THIS SECTION

- A. This Section includes the following:
  - 1. Adjust list below to suit Project.
  - 2. Piping materials and installation instructions common to most piping systems.
  - 3. Transition fittings.
  - 4. Dielectric fittings.
  - 5. Mechanical sleeve seals.
  - 6. Sleeves.
  - 7. Escutcheons.
  - 8. Grout.
  - 9. Plumbing demolition.
  - 10. Equipment installation requirements common to equipment sections.
  - 11. Painting and finishing.
  - 12. Concrete bases.
  - 13. Supports and anchorages.

### 1.3 SUMMARY

- A. The definitions of Division 01 and the General Conditions of the specification also apply to the Division 22 contract.
- B. “Contract Documents” constitute the drawings, specifications, general conditions, project manuals, etc. prepared by the engineer (or design professional in association with the engineer) for contractor’s bid or contractor’s negotiations with the Owner. The Division 22 drawings and specifications prepared by the engineer are not “Construction Documents”
- C. “Construction Documents”, “construction drawings”, and similar terms for Division 22 work refer to installation diagrams, shop drawings and coordination drawings prepared by the contractor using the design intent indicated on the engineer’s contract documents. These specifications detail the contractor’s responsibility for “Engineering by Contractor” and for the preparation of construction documents.
- D. “(N)” indicates “new” equipment and/or to be provided under this contract.
- E. “(E)” indicates “existing” equipment on site which may or may not need to be relocated as part of this work.
- F. (“R”) indicates existing equipment to be relocated as part of this work.
- G. “Furnish” means to “supply” and usually refer to an item of equipment.
- H. “Install” means to set in place, connect and place in full operational order.
- I. “Provide” means to “furnish and install”.
- J. “Equal” or “Equivalent” means “meets the specifications of the referenced product or item in all significant aspects”. Significant aspects shall be as determined by the Owner’s Representative.
- K. “Work by other(s) divisions”, “re \_\_\_\_ Division”, and similar expressions means work to be performed under the contract documents, but not necessarily under the division or section of the work on which the note appears. It is the contractor’s sole responsibility to coordinate the work of the contract between his/her suppliers, sub-contractors and employees. If clarification is required, consult the Owner’s Representative before submitting bid.
- L. By interference, any reference to a “contractor” or “sub-contractor” means the entity, which has contracted with the Owner for the work of the contract documents.
- M. “Engineer” means the design professional firm, which has prepared these contract documents. All questions, submittals, etc. of this division shall be routed to the Engineer (through proper contractual channels).

### 1.4 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, 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.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. The following are industry abbreviations for plastic materials:
  - 1. Retain abbreviations that remain after this Section has been edited.
  - 2. ABS: Acrylonitrile-butadiene-styrene plastic.
  - 3. CPVC: Chlorinated polyvinyl chloride plastic.
  - 4. PE: Polyethylene plastic.
  - 5. PVC: Polyvinyl chloride plastic.
- G. The following are industry abbreviations for rubber materials:
  - 1. Retain abbreviations that remain after this Section has been edited.
  - 2. EPDM: Ethylene-propylene-diene terpolymer rubber.
  - 3. NBR: Acrylonitrile-butadiene rubber.

## **1.5 QUALITY ASSURANCE**

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of plumbing fixtures of type, style, and configuration required, whose products have been in satisfactory use in similar service for not less than 3 years.

## **1.6 Regulatory Requirements**

- A. PDI Compliance: Comply with standards established by PDI pertaining to plumbing fixture supports.
- B. U.L. Compliance: Construct water coolers in accordance with UL 399, and provide UL listing and label.
- C. ASHRAE Compliance: Test and rate water coolers in accordance with ASHRAE 18.
- D. ANSI Standards: Comply with applicable ANSI barrier-free plumbing fixture standards.

- E. Delete first two paragraphs below if no welding. AWS states that welding qualifications remain in effect indefinitely unless welding personnel have not welded for more than six months or there is a specific reason to question their ability.
- F. Electrical Characteristics for Plumbing Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.
- G. All cast iron pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute (CISPI) and be listed by NSF International.

### **1.7 DELIVERY, STORAGE, AND HANDLING**

- A. Delivery plumbing fixtures individually wrapped in factory-fabricated containers.
- B. Handle plumbing fixtures carefully to prevent breakage, chipping, and scoring fixture finish. Do not install damaged plumbing fixtures; replace damaged units
- C. 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.
- D. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

### **1.8 COORDINATION WITHIN DIVISION 22**

- A. Contract Documents
  - 1. General: The contract documents are diagrammatic showing certain physical relationships, which must be established within Division 22 work and its interface with other work. Such establishment is the exclusive responsibility of the contractor.
  - 2. Drawings shall not be scaled for the purpose of establishing dimensions, clearances or material quantities.
  - 3. Supplemental Instructions: The exact location for some items in this specification may not be shown on the Drawings. The location of such items may be established by the Owner's Representative during the progress of the work.
  - 4. Discrepancies
    - a. Examine drawings and specifications of all Divisions of the work.
    - b. Report any discrepancies to the Owner's Representative and obtain written instructions before proceeding.
  - 5. Should there be a conflict within or between the specifications or drawings, the most stringent or higher quality requirements shall apply.

6. Items called for either in the specifications or on the drawings shall be required as if called for in both.
- B. Constructability
  1. Examine drawings and specifications of all Divisions of the work.
  2. Report any issues to the Owner's Representative which may prevent installation of Division 22 work in accordance with the Contract Documents and the original construction contract.
- C. Contractor shall be responsible for providing proper documentation of equipment product data and shop drawings to all entities providing services.
- D. Coordination Drawings: Prepare coordination drawings in accordance with Section 01 33 00 – Submittal Procedures to scale of 1/8" = 1'-0" or larger for floor plans and 1/4" = 1'-0" for equipment rooms and restrooms, detailing major elements, components, and systems mechanical equipment (i.e. equipment rooms, and exterior equipment areas) and materials in relationship with other system, installations, and building components. Indicate locations where space is limited for installation and access and where sequencing and coordination of installations are important to the efficient flow of the work, including (but not necessarily limited to) the following:
- E. Indicate all major piping (HVC, Plumbing and Fire Protection), electrical equipment and conduits, structural, and architectural elements in the areas as well.
- F. Sizes and locations of required concrete pads, piers, curbs and bases.
- G. Provide all necessary sections and elements for clarification.
- H. Indicate all seismic restraint and support systems to be used for all plumbing equipment throughout the project.
- I. Ductwork and piping transitions from rooftop units to shafts or horizontal ducts.
- J. Failure to produce or submit coordination drawings does not dismiss the contractor's responsibility for translating the design intent of the contract documents into construction drawings.
- K. CAD Drawings: For the purposes of facilitating the contractor's shop drawings and record drawings electronic files may be purchased from IBE Engineers. Contact the IBE project manager for details.

## **1.9 Existing Conditions**

- A. Before submitting proposals for this work, each bidder shall be familiar with plans and specifications and shall have examined the premises and understood the conditions under which he/she will be obliged to operate in performing his/her contract.
- B. No allowance will be made subsequently in this connection, on behalf of the contractor, for any error through negligence on his/her part.

- C. Drawings of existing conditions may be available. Contractor is strongly encouraged to obtain relevant drawings to assist in his/her performance of the contract.

#### **1.10 Utility Connections**

- A. Coordinate the connection of plumbing systems with utilities and services.
- B. Comply with regulations of utility suppliers.
- C. The contract documents indicate the available information on existing utilities and services, and on new services (if any) to be provided to the project by utility companies and agencies.
  - 1. Notify the Owner's Representative immediately if discrepancies are found.
- D. Coordinate mechanical utility interruptions one week in advance in writing with the Owner's Representative and the utility company.
  - 1. Plan work so that duration of the interruption is kept to a minimum.
- E. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for plumbing installations.
- F. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- G. Coordinate requirements for access panels and doors for plumbing items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Section 08 31 13 – Access Doors and Frames.

#### **1.11 COORDINATION WITH OTHER DIVISIONS**

- A. General
  - 1. Coordinate the Division 22 work with the progress of the work of the other trades.
  - 2. Complete the entire installation as soon as the condition of the building will permit.
  - 3. Contractor is responsible for coordination of his / her work with Owner's facility staff engaged in building automation, commissioning of systems, fire alarm system, etc.
- B. Coordination with Electrical work: Refer to Section 26 05 00 – Common Work Results for Electrical.
- C. Cutting and patching: Refer to Division 01 Section – Cutting and Patching and Section 02 41 19 – Selective Structure Demolition for general demolition requirements and procedures.
- D. Support Dimensions: Provide dimensions and drawings so that concrete bases and other equipment supports to be provided under other sections of the specifications can be built at the proper time.

**1.12 COORDINATION WITH EXISTING OCCUPIED AREAS**

- A. Minimize disruptions to operation of existing plumbing systems in occupied areas.
- B. Coordinate any required disruptions with the Owner's Representative, one week in advance, in writing.
- C. Provide temporary connections to prevent long disruptions.

**1.13 DEMOLITION AND WORK IN EXISTING AREA**

- A. Remove existing equipment and materials as required and as noted.
- B. Verify the size and location of all existing services and utility prior to connection. The Drawings show diagrammatically the approximate location of utilities where information is available, but the drawings are not exact as to quantity, extent or location. Exercise extreme caution during all phases of the work to locate, identify and protect existing services and utilities which are encountered as a result of work under this contract.
- C. Do work in a manner which will not cause inconvenience or danger to the occupants of the building, nor interfere with the other occupants; activities.
- D. Make all necessary alterations and additions to connect the existing with the new work so that when the work is complete, it will be in satisfactory operable condition. Provide all cutting and patching including concrete saw cutting and core drilling as required. Obtain approval from the structural engineer prior to performing concrete sawing or core drilling operations.
- E. All equipment and materials removed shall be legally disposed of or recycled off-site, unless otherwise noted and directed.

**1.14 ENGINEERING BY CONTRACTOR**

- A. The construction of this building requires the contractor to design several systems or sub systems. All such designs shall be the complete responsibility of the contractor.
- B. Systems or sub-systems which require responsibility by the contractor and submitted to the engineer for review include, but are not limited to:
- C. Equipment and piping supports.
- D. Pipe hangers and anchors not specified in these documents, or cataloged by the manufacturer.
- E. Vibration Isolation / Seismic Restraint.
- F. Underground piping distribution systems.
- G. Thermal pipe stress analysis



**1.15 REGULATORY REQUIREMENTS**

A. General

1. Regulatory compliance: Work performed under this Division shall comply with the latest currently adopted editions of Codes and Regulations including, but not limited to those listed below.
2. Minimum requirements: The requirements of the drawings and specifications are the minimum that will be allowed, unless such requirements are exceeded by applicable codes or regulations, in which case the code or regulation requirement shall govern.
3. Code Changes: Should a code change occur during time of proposal and date of permit issue, and the Contractor has unnecessarily delayed the acquisition or permits, the contractor shall hold the Owner free of additional expense resulting from such code change.

**1.16 Codes: Comply with currently adopted (at time of contract award) following code:**

- A. Local Municipal Code, Ordinances and Regulations.
- B. Local Fire Department Regulations and Requirements.
- C. Local County Department of Health Services Regulations and Requirements.
- D. Local County Public Works Department Regulations and Requirements.
- E. Local County Industrial Waste Division Regulations and Requirements.
- F. Local County Fire Department Regulations and Requirements.
- G. National Electrical Code (NEC), Latest Edition.
- H. State Elevator Safety Regulations (SESR).
- I. National Fire Protection Association NFPA-101, Life Safety Code, Latest Edition for JCAHO accreditation.
- J. American Disability Act Regulations and Requirements (ADA).
- K. State of California Water Resources Control.

**1.17 Comply with the latest Editions of Applicable Regulations and Standards, including:**

- A. National Fire Protection Associations (NFPA).
- B. Underwriters Laboratory, Inc. (UL).
- C. American National Standards Institute (ANSI).
- D. American Society of Testing and Materials (ASTM).

- E. American Society of Mechanical Engineers (ASME).
- F. American Welding Society Code (AWSC).
- G. American Water Works Association AWWA).
- H. Compressed Gas Association (CGA).
- I. Cast Iron Soil Pipe Institute (CISPI).
- J. Manufacturers Standardization Society (MSS).
- K. National Bureau of Standards (NBS).
- L. Plumbing and Drainage Institute (PDI).
- M. Sheet Metal and Air Conditioning Contractors National Association (SMACNA).
- N. Requirements of Local Utility Companies: Comply with rules and regulations of local utility companies. Include in bid the cost of all valves, valve boxes, meter boxes, meters and such accessory equipment, which will be required for the project.
- O. Additional Regulations: Follow additional regulations which appear in individual sections of these specifications.
- P. Contradictions: Where codes are contradictory, follow the most stringent, unless otherwise indicated in plans or specifications. The Owner's Representative shall determine which is most stringent.

#### **1.18 Contract Documents Not in Compliance**

- A. Where it is not noted that the drawings and specifications do not comply with the minimum requirements of the codes, either notify the Owner's Representative in writing during the bidding period of the revisions required to meet code requirements. After entering into the contract, contractor will be held to complete all work necessary to meet Code requirements without additional expense to the Owner.
- B. Follow drawings and specifications where they are superior to code requirements.

#### **1.19 Permits**

- A. Contractor shall pay for and obtain all permits required by authorities and agencies having jurisdiction for the work of this Division.
- B. Post permits as required.

#### **1.20 Inspections and Tests**

- A. Arrange for all required inspections and tests.

1. Pressure Tests:
    - a. All piping must be tested prior to receiving insulation.
    - b. Test pressures shall be minimum 1 1/2 times system operating pressure or as specified by the Design Professional.
    - c. Prior to filling the systems, all joints and potential leak sources shall be painted with a water-power blue line caulk mixture and allowed to dry.
    - d. During the test each joint shall be visually inspected.
    - e. Pressure tests must be witnessed and acknowledged in writing by the Owner's Authorized Representative.
  2. Piping Systems Disinfection
    - a. Before being placed into service, all new water lines, except those used exclusively as fire lines, shall be disinfected in accordance with AWWA standards. Final connections to existing water lines shall not be made until this procedure is completed satisfactorily.
    - b. The University shall be notified in advance of the date and time that the disinfection is to begin. The University shall witness the process.
- B. Pay all charges.
- C. Notify the Owner's Representative in writing 72 hours before tests.
- D. Submit one copy for Owner's record of permits. Licenses, inspection reports and test reports.

### **1.21 EQUIVALENTS AND SUBSTITUTIONS**

- A. The applicable paragraphs for General Requirements, Division 01 apply herein.
- B. Basis for Design: The Manufacturers Name and product listed on the drawings, or listed first of several names in these specifications, is used as a basis for design to establish space requirements, a standard of quality and performance.
- C. Equivalents: Products of one or more other manufacturers names listed in these specifications following the words "or equal" may be selected, subject to paragraph below titled "Contractors Responsibility for Equivalent and Substitutions".
- D. Other Options
  1. For products specified by naming only one manufacturer, refer to paragraph below under "Substitutions".
  2. For products specified only by performance characteristics or reference standards, select any manufacturer meeting the requirements.

- E. Substitutions: Requests for acceptance of a product of manufacturers name not listed in these specifications will be considered if any one of the following conditions is met:
1. The named product is not available because of strike or discontinuance of manufacturer, and the proposed product is equivalent to the named product.
  2. The proposed product is superior to the named product, in the opinion of the Owner's Representative.
  3. The proposed product is equivalent to the named product and its use will be to the advantage to the Owner, by the Owner receiving an equitable credit or cost savings. The Owner's Representative reserves the right to reject any substitution.
  4. Submit proposed substitutions with bid along with alternate price, complete descriptive data and a comparison of the substitute Manufacturers product with specified product. Request for acceptance of a product of Manufacturers name not listed in these specifications, is subject to the paragraph titled "Contractors Responsibility Equivalents and Substitutions".

#### **1.22 Contractors Responsibility for Equivalents and Substitutions**

- A. Items submitted as a substitution to the basis of design or listed general equivalents shall be identified as such and shall include a written request for substitution indicating the following:
1. Contract Price adjustment.
  2. Contract time adjustment.
  3. Item by item breakdown of differences between basis of design and substituted item.
  4. Operation, maintenance and energy cost difference.
- B. Products of manufacturer must match the features, construction, performance and size of those selected for design. Standard catalogued may require certain modifications to meet specified requirements.
- C. The responsibility for providing that specified requirements have been met remains with the manufacturer and contractor. Should the substituted item fail to perform in accordance with the specifications, replace same with the originally specified item without extra cost to the contract.
- D. When requesting review of an equivalent or substituted product, submit a comparison chart listing features, construction, performance and sizes of named product versus equivalent or substituted product.
- E. Submittals for review of an equivalent or substituted product will be reviewed for acceptability when all the above requirements are met. Contractor shall be responsible for all costs incurred by the architect and engineer for review of equivalency beyond initial review.
- F. Coordinate the installation of the product with all trades.
- G. Contractor shall be responsible for all changes in electric wiring, materials and all other additional costs of construction by all trades involved to accommodate the product to perform same as

product used on the "Basis of Design." Coordination of General Equivalents and Substitutions: Where Contract Documents permit selection from general equivalents, or where substitutions are authorized, coordinate clearance and other interface requirements with Mechanical and Electrical and all other trades affected by this work.

- H. Provide necessary additional items so that selected or substituted item operates equivalent to the Basis of Design and properly fits in the available space allocated for the Basis of Design.
- I. Contractor is responsible for assuring that piping, conduit, duct, flue and other service locations for general equivalents or substitutions do not cause access, service or operational difficulties any greater than would be encountered with the Basis of Design.
- J. Failure to comply with these requirements will result in immediate rejection of the request for substitution.

### **1.23 GENERAL SUBMITTAL REQUIREMENTS**

- A. Refer to Division 01.
- B. Coordination and Sequencing
- C. Plumbing products requiring approval by the State of California Dept. of Industry, Labor and Human Relations must be approved or have pending approval at the time of shop drawing submission.
- D. Welding certificates and requirements.
- E. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- F. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
- G. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
- H. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- I. Coordinate submittals 3 weeks (minimum) prior to expected order date so that work will not be delayed by submittals.
- J. Do not submit product data, or allow its use on the project until compliance, with requirements of Contract Documents has been confirmed by contractor.
- K. Submittal is for information and record, unless otherwise indicated, and is not a change order request.
- L. Submitting contractor is responsible for routing reviewed submittals to all parties affected by the work of this contract.

- M. Make submittals for group of similar products or materials such as valves, fixtures, pumps, insulation, etc., or area or work complete and at one time, not in piecemeal fashion.
- N. Identify submittals with Architects project name and number, with item designation as indicated on drawings, and referenced to applicable paragraphs of the specifications. Submit in brochure form.
- O. Submittals of products needed at start of project for its installation, or those requiring a long lead time for assembly or manufacturing, should be submitted before the others.

#### **1.24 Preparations of Submittals**

- A. Refer to Division 01 requirements.
- B. Provide permanent marking on each submittal to identify project, date, Contractor, Subcontractor, Supplier, submittal name and similar information to distinguish it from other submittals.
- C. Indicate any portions or work, which deviate from the Contract Documents.
  - 1. Explain the reasons for the deviations.
  - 2. Show how such deviations coordinate with interfacing portions of other work.
- D. Show contractors executed review and approval markings.
- E. Provide space for the Owners Representative "Action" marking.
- F. Submittals, which are received from sources other than the contractors office, will be returned "Without Action".
- G. Submittals shall be presented in a neat and legible fashion and shall be returned "Without Action" if presented in any other fashion.

#### **1.25 Quantities: Unless otherwise indicated in Division 01, submit 6 copies.**

- A. Refer to Division 01 requirements.
- B. Multiple Systems Items: Where a required submittal relates to an operational item of equipment used in more than one system, increase the number of final copies as necessary to complete the Maintenance Manuals for each system.
- C. General Distribution:
  - 1. Provide additional distribution of submittals (not included in foregoing copy submittal requirements) to Subcontractors, Suppliers, Fabricators, Installers, Governing Authorities and others as necessary for proper performance of the work.
  - 2. Include such additional copies in transmittal to Owners Representative where required to receive "Action" marking before final distribution.

3. Show such distributions on transmittal forms.

**1.26 Response to Submittals: Where standard product data have been submitted, it is recognized:**

- A. That the submittal has determined that the products fulfill the specified requirements.
- B. That the submittal is for the Owners Representative information only, but will be returned with appropriate action where observed to be not in compliance with the requirements.
- C. If more than two submittals (either for shop drawings, as-built drawings, or test and balance reports) are made by the contractor due to the incompleteness, non-compliance, errors, omissions, etc. the Owner reserves the right to charge the contractor for subsequent reviews by their consultants. Such extra fees shall be deducted from payments by the Owner to the contractor.

**1.27 SPECIFIC CATEGORY SUBMITTAL REQUIREMENTS**

- A. Manufacturer's Data
  1. Where pre-printed data covers more than one distinct product, size, type, material, trim, accessory group or other variation, mark submitted copy with black ink to indicate which of the variations is to be provided.
  2. Delete or mark out significant portions of pre-printed data, which are not applicable.
  3. Where operating ranges are shown, mark data to show portion of range required for project application.
  4. For each product, include the following:
    - a. Sizes.
    - b. Dimensions.
    - c. Weights.
    - d. Speeds.
    - e. Capacities.
    - f. Fixture Color.
    - g. Cabinet Finish.
    - h. Piping and Electrical connection sizes and locations.
    - i. Statements of compliance with the required standards and regulations.
    - j. Performance data.

- k. Manufacturers specifications and installation instructions.

**1.28 Shop Drawings: Prepare Plumbing Shop Drawings, except diagrams, to accurate scale.**

- A. Show clearance dimensions at critical locations.
- B. Show dimensions of spaces required for operation and maintenance.
- C. Show interfaces with other work including structural support.

**1.29 Test Reports**

- A. Submit test reports, which have been signed and dated by the firm performing the test.
- B. Prepare test reports in the manner specified in the standard or regulation governing the test procedure (if any) as indicated.

**1.30 Required Equipment and Shop Drawing Submittals**

- A. Provide a submittal schedule with bid.
- B. Provide equipment submittals for each item of equipment specified of scheduled in the Contract Documents.
- C. Submittal schedule shall show each item of equipment, applicable section of the specifications where it is described, applicable drawing number and schedule name where it is scheduled, date of contractors proposed submittal to the Owner's Representative and schedule order date.
- D. Provide a plumbing shop drawing schedule for submission to the Owner's Representative with the submittal schedule. Refer to Paragraph 1.7 above.

**1.31 CAPABILITY**

- A. General: provide products, which are compatible with other products of the Plumbing work, and with other work, requiring interface with the Plumbing work.
- B. Power Characteristics: Where power requirements are not stated in Division 22 Sections, refer to Sections of Division 26 and the electrical drawings for the power characteristics of each power driven item of plumbing equipment. Coordinated available power with electrical contractor before ordering equipment. Plumbing contractor shall be responsible for ordering equipment to meet the available power characteristics. If there is a conflict between Division 22 documents and Division 26 documents, provide a written notification to the Owner's Representative for direction. Do not order equipment prior to determining the proper electrical service. No contract cost adjustment will be allowed for equipment ordered in conflict with the available power characteristics.



### 1.32 RECORD DRAWINGS

#### A. Drawings

1. Record of Project progress: purchase from the architect a complete set of reproducible contract drawings and maintain drawings available at the job site for inspection. keep an accurate, legible and continuously updated record of installed locations and all project revisions other than revised drawings issued by the architect, including source and date of authorization. Utilize only contract drawing symbols for recording the work. Drawing notations to be sufficiently clear in the representation of the work, for utilization by a CADD operator (drafts person) who is not necessarily familiar with the installed work.
2. Record of installation: At the conclusion of the work, deliver 1 set of prints of the progress drawings to the Owner's Representative for review. Following the review, contractor shall have incorporated by a competent CADD operator all of the installed data represented on the project progress drawings.
3. Include in Record Drawings the Following
  - a. Revisions, including sketches, bulletins, change orders, written addenda and directives, clarifications and responses generated by requests for information (RFI's), regardless of source of the revision.
  - b. Location and configuration of equipment with related housekeeping pads.
  - c. Location of fixtures, drains and appurtenances.
  - d. Physical routing of piping, underground, exposed, and above ceiling with locations of valves and accessories plainly marked and identified.
  - e. Location of piping below building and exterior, valves, manholes, appurtenances and stub outs dimensioned from buildings and permanent structures, both horizontally and vertically.
  - f. Location of wall and ceiling access panels.

**1.33 Acceptance: As a condition for acceptance of the work, deliver 2 sets of AutoCAD latest version CD's and one set of stamped and dated reproducible drawings to the Owner's Representative and obtain a receipt.**

### 1.34 OPERATION AND MAINTENACE DATA

A. Refer to Division 01 Requirements.

B. Submission

1. Submit 3 typed and bound copies or Operating and Maintenance (O&M) Manuals for each type of fixture and piece of equipment prior to scheduling systems demonstrations for the Owner's Representative, as specified in Division 01.

2. Bind each Maintenance Manual in one or more vinyl covered, 3-ring binders, with pockets for folded drawings.
  3. Mark the spine of each binder with system identification and volume number.
- C. Required Contents
- a. Manuals shall have index with tab dividers for each major equipment section to facilitate locating information on a specific piece of equipment.
  - b. Identify data within each section with drawing code numbers as they appear on drawings and specifications. Include as a minimum the following data:
    - 1) Alphabetical list of system components, with the name, address and 24-hour telephone number of the company responsible for servicing each item during the first year of operation. Include point of contact for company.
    - 2) Operating instructions for complete system including:
  - c. Emergency procedures for fire and failure of major equipment.
  - d. Major start, operation and shut down procedures.
2. Maintenance instructions for each piece of equipment including:
- a. Equipment lists.
  - b. Proper lubricants and lubricating instructions for each piece of equipment.
  - c. Necessary cleaning, replacement and/or adjustment schedule.
  - d. Product data.
  - e. Installation instructions.
  - f. Parts list.
3. Marked or changed prints locating concealed parts and variations from the original system design (as-built drawings).
4. Valve schedule and associated piping schematics, see Section 22 05 53 – Identification for Plumbing Piping and Equipment.
5. Copies of any extended equipment warranties which are greater than one year.

### **1.35 WARRANTIES**

- A. The warranty period is one year after date of acceptance.
- B. During this period, provide labor and materials as required to repair or replace defects in the plumbing system at no additional cost to the Owner. Provide certificate with O&M manual submittal, which guarantees same day service response to Owner's call for all such warranty service.

- C. Provide certificate for such items of equipment, which have warranties in excess of one year. Insert copies in O&M Manuals.
- D. Provide extended manufacturers warranties to cover one full year from date of acceptance if standard warranty starts anytime time prior to that date.
- E. At time of bid, submit additional costs or extended warranties for principle equipment (e.g. domestic water pressure booster, vacuum pump, air compressor etc.).
- F. Refer to Division 01 for additional requirements.

### **1.36 SPARE PARTS, SPECIAL TOOLS**

- A. Deliver spare parts to the Owner's Representative and obtain receipts at the time operating instructions are given to Owner's personnel.
- B. Include the following:
  - 1. V-belts: One complete set of each size.
  - 2. Fuses: Each type used for all equipment utilizing fuses. Quantity 10 percent, but not less than two.
  - 3. Pilot light lamps: each type used on the project. Quantity 10 percent, but not less than two.
  - 4. Special Tools: Furnish special tools required for assembly, adjustment, setting or maintenance of equipment if such tool is not readily available on the commercial tool market.
  - 5. Maintenance Paint: Furnish one can of touch up paint for each different factory finish, which is to be the final finished surface of the product.
  - 6. Alternate Parts: Under the individual plumbing sections, there may be listed spare parts that need to be furnished under a bid alternate. Should the alternate be accepted, such spare parts shall be similarly delivered to the Owner.

### **1.37 SYSTEM ACCEPTANCE**

- A. Acceptance shall be contingent upon completion of final review and correction of all deficiencies. Satisfactory completion of the operational tests, which shall demonstrate compliance with all performance criteria, and the requirements of the contract documents.
- B. Request a final review prior to system acceptance after completion of the following:
  - 1. Installation of all systems required by contract documents.
  - 2. Submission and acceptance service manuals.
  - 3. Identification.

4. Cleaning.
5. Satisfactory operation of all systems for a period of one week.

### **1.38 MANDATORY GOVERNING PROVISION**

- A. Omissions of words or phrases, such as “the contractor shall”, in conformity with”, “shall be”, “as noted on the drawings”, “according to the drawings”, “an”, “the”, and “all” are intentional.

### **1.39 OWNER FURNISHED EQUIPMENT**

- A. All equipment called out in the specifications or shown on the drawings as “Owner Furnished Equipment” shall be installed and connected under this contract. Provide rough-ins for all future connections indicated unless otherwise specifically indicated on drawings.

### **1.40 TEMPORARY FACILITIES**

- A. Light, heat, power, etc.
- B. Contractor shall be responsible for providing temporary electricity, heat and other facilities as specified in Division 01.
- C. Contractor shall be responsible for maintaining the equipment in an as new condition. Equipment will not be turned over to the Owner until it is brought up to as new condition.

### **1.41 SAFETY PROVISIONS**

- A. Equipment Nameplates: Provide power oriented plumbing equipment with a permanent nameplate attached by the manufacturer, indicating:
  1. The manufacturer.
  2. Product name.
  3. Model number.
  4. Serial number.
  5. Speed.
  6. Capacity.
  7. Power characteristics.
  8. Labels of testing, or inspecting agencies.
  9. Other similar data.

10. Where manufacturer affixed nameplate is not available, contractor shall fabricate and attach nameplate.

B. Guards

1. Unless equivalent guards are provided integral with the equipment, enclose each belt drive (including sheaves) on both sides in a galvanized, one inch, mesh screen of No. 18 gage steel wire or expanded metal, fastened to an approved, structure steel frame, securely fastened to the equipment or floor.
2. Provide tachometer holes at shaft centers. Unless equivalent guards are provided integral with the equipment, install a solid guard of No. 20 gage galvanized steel over the coupling of each item of direct driven equipment.
3. Sides are not required on these guards except to ensure rigidity.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. See Editing Instruction No. 1 in the Evaluations for cautions about naming manufacturers and products.
- B. Edit this Article with other Part 2 articles in which manufacturers and products, or manufacturers only, are named. See Division 01 Section "Product Requirements" for an explanation of the terms "Available Manufacturers" and "Manufacturers" and the effect these terms have on "Comparable Product" and "Product Substitution" requirements.
- C. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
- D. Manufacturer's equipment used as "Basis of Design" for this Project is name indicated in Fixture and Equipment Schedule or specified herein for particular type of equipment or application. If no manufacturer is listed, "Basis of Design" is industry standard indicated.
- E. Fixture descriptions establish fixture type, quality, materials, features and size. Products of manufacturers determined to be equal by the Architect/Engineer will be accepted:
- F. Provide all plumbing fixtures complete with all necessary trim and accessories to insure the specified complete installation and operation of each fixture. Include trim and accessories, not to be limited to, rigid brass, supply pipes, stops, drains, strainers, tailpieces, P-traps, escutcheon plates and bolt caps.

### **2.2 PIPE, TUBE, AND FITTINGS**

- A. Refer to individual Division 22 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

### **2.3 JOINING MATERIALS**

- A. Refer to individual Division 22 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
  - 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
    - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
    - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
- C. AWWA C110, rubber, flat face, 1/8-inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- D. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- E. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- F. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- G. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAgl, silver alloy for refrigerant piping, unless otherwise indicated.
- H. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

### **2.4 Solvent Cements for Joining Plastic Piping**

- A. ABS Piping: ASTM D 2235.
- B. CPVC Piping: ASTM F 493.
- C. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
- D. PVC to ABS Piping Transition: ASTM D 3138.
- E. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

### **2.5 TRANSITION FITTINGS**

- A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.
- B. Manufacturers

1. Cascade Waterworks Mfg. Co.
  2. Dresser Industries, Inc.; DMD Div.
  3. Ford Meter Box Company, Incorporated (The); Pipe Products Div.
  4. JCM Industries.
  5. Smith-Blair, Inc.
  6. Viking Johnson.
- C. Underground Piping NPS 1-1/2 and Smaller: Manufactured fitting or coupling.
- D. Underground Piping NPS 2 and Larger: AWWA C219, metal sleeve-type coupling.
- E. Aboveground Pressure Piping: Pipe fitting.
- F. Plastic-to-Metal Transition Fittings: CPVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
- G. Manufacturers
1. Eslon Thermoplastics.
- H. Plastic-to-Metal Transition Adaptors: One-piece fitting with manufacturer's SDR 11 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
1. Manufacturers
    - a. Thompson Plastics, Inc.
- I. Plastic-to-Metal Transition Unions: MSS SP-107, CPVC four-part union. Include brass end, solvent-cement-joint end, rubber O-ring, and union nut.
1. Manufacturers
    - a. NIBCO INC.
    - b. NIBCO, Inc.; Chemtrol Div.
- J. Flexible Transition Couplings for Underground Nonpressure Drainage Piping: ASTM C 1173 with elastomeric sleeve, ends same size as piping to be joined, and corrosion-resistant metal band on each end.
- K. Manufacturers
- a. Cascade Waterworks Mfg. Co.
  - b. Fernco, Inc.
  - c. Mission Rubber Company.

- d. Plastic Oddities, Inc.

## 2.6 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Revise pressure ratings and temperatures in five paragraphs and associated subparagraphs below to suit Project or add other options for specific applications.
- D. Dielectric Unions: Factory-fabricated, union assembly, for 250 psig minimum working pressure at 180 degrees F.
  - 1. Manufacturers
    - a. Capitol Manufacturing Co.
    - b. Central Plastics Company.
    - c. Eclipse, Inc.
    - d. Epcos Sales, Inc.
    - e. Hart Industries, International, Inc.
    - f. Watts Industries, Inc.; Water Products Div.
    - g. Zurn Industries, Inc.; Wilkins Div.
- E. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150 or 300 psig minimum working pressure as required to suit system pressures.
  - 1. Manufacturers
    - a. Capitol Manufacturing Co.
    - b. Central Plastics Company.
    - c. Epcos Sales, Inc.
    - d. Watts Industries, Inc.; Water Products Div.
- F. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
- G. Manufacturers
  - 1. Advance Products & Systems, Inc.



2. Calpico, Inc.
  3. Central Plastics Company.
  4. Pipeline Seal and Insulator, Inc.
- H. Separate companion flanges and steel bolts and nuts shall have 150 or 300 psig minimum working pressure where required to suit system pressures.
- I. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300 psig minimum working pressure at 225 degrees F.
1. Manufacturers
    - a. Calpico, Inc.
    - b. Lochinvar Corp.
- J. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300 psig minimum working pressure at 225 degrees F.
1. Manufacturers
    - a. Perfection Corp.
    - b. Precision Plumbing Products, Inc.
    - c. Sioux Chief Manufacturing Co., Inc.
    - d. Victaulic Co. of America.

## **2.7 MECHANICAL SLEEVE SEALS**

- A. Units in this Article are usually furnished with EPDM sealing elements, plastic pressure plates, and carbon-steel bolts. NBR and silicone sealing elements, carbon- and stainless-steel pressure plates, and stainless-steel bolts are available for special applications.
- B. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
1. Manufacturers
    - a. Advance Products & Systems, Inc.
    - b. Calpico, Inc.
    - c. Metraflex Co.
    - d. Pipeline Seal and Insulator, Inc.

- C. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
- D. Pressure Plates: Carbon steel. Include two for each sealing element.
- E. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

## **2.8 SLEEVES**

- A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Sleeve in paragraph below is available with many end variations.
- D. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral water stop, unless otherwise indicated.
- E. Sleeve in paragraph below is without seepage holes and cannot be used instead of a floor drain.
- F. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
- G. Under deck Clamp: Clamping ring with set screws.
- H. PVC sleeves in first two paragraphs below may be prohibited by fire authorities having jurisdiction.
- I. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.

## **2.9 ESCUTCHEONS**

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Type: With set screw.
  - 1. Finish: Polished chrome-plated.
- D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
  - 1. Finish: Polished chrome-plated.
- E. One-Piece, Stamped-Steel Type: With set screw and chrome-plated finish.

- F. Split-Plate, Stamped-Steel Type: With concealed hinge, set screw, and chrome-plated finish.
- G. One-Piece, Floor-Plate Type: Cast-iron floor plate.
- H. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

## **2.10 GROUT**

- A. Description: ASTM C 1107, Grade B, non shrink and nonmetallic, dry hydraulic-cement grout.
  - 1. Characteristics: Post-hardening, volume-adjusting, non-staining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
  - 2. Design Mix: 5000 psi, 28-day compressive strength.
  - 3. Packaging: Premixed and factory packaged.

## **2.11 WALL PENETRATION SYSTEMS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. SIGMA
  - 2. ProSet
  - 3. Or Approved Equal
- B. Description: Wall-sleeve assembly, consisting of housing and gland, gaskets, and pipe sleeve.
- C. Carrier-Pipe Deflection: Up to 5 percent without leakage.
- D. Housing: Ductile-iron casting with hub, waterstop, anchor ring, and locking devices. Include gland, bolts, and nuts.
- E. Housing-to-Sleeve Gasket: EPDM rubber.
- F. Housing-to-Carrier-Pipe Gasket: AWWA C111, EPDM rubber.
- G. Pipe Sleeve: AWWA C151, ductile-iron pipe or ASTM A 53/A 53M, Schedule 40, zinc-coated steel pipe.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine roughing-in work of potable water and waste piping systems to verify actual locations of piping connections prior to installing fixtures.

- B. Examine floors, substrates, and conditions under which fixture work to be accomplished.
- C. Correct any incorrect locations of piping and other unsatisfactory conditions for installation of plumbing fixtures.
- D. Do not proceed with Work until unsatisfactory conditions corrected.
- E. Do not use new fixtures during construction unless approved in writing by the Owner.

### **3.2 INSTALLATION GENERAL REQUIREMENTS**

- A. Furnish, apply, install, connect, erect, clean, and condition manufactured materials and equipment as recommended in manufacturer's printed directions (maintained on job site during installation).
- B. Provide all attachment devices and materials necessary to secure materials together or to other materials.
- C. Make allowances for ample and normal expansion and contraction for all building components and piping systems that are not subject to such.
- D. Install materials only when conditions of temperature, moisture, humidity and conditions of adjacent building components are conducive to achieving the best installation results.
- E. Erect, install and secure components in a structurally sound and appropriate manner.
- F. Where necessary, temporarily brace, shore, or otherwise support members until final connections are installed.
- G. Leave all temporary bracing, shoring, or other structural supports in place as long as practical for safety and to maintain proper alignment.
- H. Handle materials in a manner to prevent scratching, abrading, distortion, chipping, breaking or other disfigurement.
- I. Conduct work in a manner to avoid injury or damage to previously placed work.
- J. Any work so impaired or damaged shall be replaced at no expense to the Owner.
- K. Fabricate and install materials true to line, plumb and level.
- L. Leave finished surfaces smooth and flat, free from wrinkles, warps, scratches, dents and other imperfections.
- M. Furnish materials in longest practical lengths and largest practical sizes to avoid all unnecessary jointing.
- N. Make all joints secure, tightly fitted, and as inconspicuous as possible by the best, accepted practice in joinery and fabrication.
- O. Consult the Owner's Representative for mounting or position of any unit not specifically indicated or located on drawings or specified in specifications.

- P. Job mixed multi component materials used in the work shall be mixed in such regulated and properly sized batches that materials can be used before it begins to set.
- Q. Mixing of a partially set batch with another batch of fresh materials will not be accepted and entire batch shall be discarded and removed from the site.
- R. Clean all mixing tools and appliances that can be contaminated prior to mixing of fresh materials.
- S. In addition to the above, refer to each section of the specifications for additional installation requirements for the proper completion of the work.

### **3.3 INSTALLATION OF PLUMBING FIXTURES**

- A. General: Install plumbing fixtures of types indicated where shown and at indicated heights, in accordance with fixture manufacturer's written instructions, roughing-in drawings, and recognized industry practices. Ensure plumbing fixtures comply with requirements and serve intended purposes. Comply with applicable requirements of Plumbing Code pertaining to installation of plumbing fixtures.

### **3.4 Installation**

- A. Set fixtures level and plumb. Secure in place to counters, floors and walls providing solid bearing and secure mounting. Bolt fixture carriers to floor and wall. Secure rough-in fixture piping behind or within wall to prevent movement of exposed piping.
- B. Install each fixture with trap easily removable for servicing and cleaning. Install fixture stops in readily accessible location for servicing.
- C. Install barrier free fixtures in compliance with ILHR 52 and Federal ADA Accessibility Guidelines. Install barrier free lavatory traps parallel and adjacent to wall and supplies and stops elevated to 27 inches above floor to avoid contact by wheelchair users.
- D. Provide unions at water connections to drinking fountains and electric water coolers.
- E. Cover pipe penetrations with escutcheons. Exposed traps, piping and escutcheons to be chrome plated brass. Cover exposed water closet bolts with bolt covers.
- F. Seal openings between walls, floors and fixtures with mildew-resistant silicone sealant same color as fixture.
- G. Protect fixtures during construction. At completion clean plumbing fixtures and trim using manufacturer's recommended cleaning methods and materials.
- H. Foodservice Equipment: Provide rough-in piping, traps, tailpieces, indirect waste lines and final connections for foodservice equipment. Install faucets, spray units, drains, lever drains, vacuum breakers, solenoid valves, check valves, flow control valves, water inlet fittings, filters, strainers, pressure reducing valves and gas valves furnished by foodservice equipment contractor. Provide condensate drain piping from cooler and freezer evaporators.

- I. Existing Fixtures: Where existing fixtures and fittings are indicated to be reused or relocated, this contractor is responsible for documenting condition prior to construction and for damages incurred during construction.
- J. Laboratory Sinks and Equipment: Rough-in installation, final connections by Laboratory equipment supplier.

### **3.5 PLUMBING DEMOLITION**

- A. Refer to Division 01 Section – Cutting and Patching and Section 02 41 19 – Selective Structure Demolition for general demolition requirements and procedures.
- B. Disconnect, demolish, and remove plumbing systems, equipment, and components indicated to be removed.
- C. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
- D. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
- E. Equipment to Be Removed: Disconnect and cap services and remove equipment.
- F. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
- G. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
- H. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

### **3.6 PIPING SYSTEMS - COMMON REQUIREMENTS**

- A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. No pipe shall pass in front of or interfere with any openings, door or window. Head room in front of openings and doors shall in no case be less than the top of the opening.

- 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. Piping shall not pass exposed through electrical rooms or be erected over any switchboard or other electrical gear.
- G. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- H. Install piping to permit valve servicing.
- I. Install piping at indicated slopes.
- J. Install piping free of sags and bends.
- K. Install fittings for changes in direction and branch connections.
- L. Pipe sizes shall be indicated on the plans at each change in direction and at all branch take off locations.
- M. Install piping to allow application of insulation.
- N. Provide 2 inch clearance between insulated piping and other obstructions.
- O. Select system components with pressure rating equal to or greater than system operating pressure.
- P. install valves according to the following:
  - 1. All valves on any one project shall be the product of one manufacturer.
  - 2. Locate valves in accessible locations, not more than six feet above the floor, if frequently used, and with a union on the downstream side of threaded end valves.
  - 3. Valves shall be right handed.
  - 4. Where possible, valves shall be installed with valve bonnet in an upright position to prevent deterioration or corrosion of bonnet and packing.
  - 5. Use gate valves for lines 3 inches and larger and ball valves for lines 2-1/2 inches and smaller for sectionalizing service. Globe valves will be used for flow modulation.
  - 6. Ball valves equipped with "characterizing discs" may be used for throttling purposes in lieu of globe valves. Design Professional shall prequalify with Owner's Authorized Representative the use of these valves.
  - 7. Specialty valves shall be employed where appropriate, such as check valves on a pump discharge, pressure regulating valves for equipment requiring lower-than-available system pressure, solenoid valves, etc.
  - 8. Valve body materials shall be compatible with piping system materials.
  - 9. Flanged or threaded end valves are preferred.

10. Balancing Valves
  - a. Balancing valves shall be installed in all 3-way control valve bypass lines and at all flow meters.
  - b. Gate valves shall be limited to shutoff service only. Gate valves shall not be used in a throttling application. Globe valves or ball valves shall be used.
  
- Q. Check Valves
  1. Where check valves are required, check valves shall be installed on the equipment side of all shutoff valves to facilitate servicing the check valve.
  
- R. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
  
- S. New Piping
  1. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type with polished chrome-plated finish.
  2. Insulated Piping: One-piece, stamped-steel type with spring clips.
  3. Bare Piping at Ceilings, Wall and Floor Penetrations in Finished Spaces and equipment and service areas: One-piece, cast-brass type with set screw and polished chrome-plated finish.
  
- T. Existing Piping: Use the following:
  1. Insulated Piping: Split-plate, stamped-steel type with concealed hinge and spring clips.
  2. Bare Piping at Ceiling and floor Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge and set screw with chrome plated finish.
  3. Bare Piping in Equipment Rooms and Service Spaces: Split-plate, stamped-steel type with set screw or spring clips with chrome plated finish.
  
- U. install system and equipment drains according to the following:
  1. All piping shall be arranged to completely drain the system. Drain locations shall be located at all system low points.
  2. Where sectionalizing valves are installed, a drain shall be installed on downstream side of valve to drain that section of the system.
  3. All system and equipment drains are to be piped to a floor drain.
  
- V. install sleeves for pipe penetrations according to the following:
  1. All pipes passing through wall or floor construction shall be fitted with sleeves. Each sleeve shall extend through its respective floor, wall or partition and shall be cut flush with each surface unless otherwise specified. Sleeves shall be two pipe sizes larger than the pipe when un-insulated and of sufficient size to allow for the insulation without binding.



2. Sleeves in bearing walls, masonry walls, masonry partitions, and floors shall be standard weight steel pipe finished with smooth edges. For other than masonry partitions, through suspended ceilings and for concealed vertical piping, sleeves shall be No. 22 USG galvanized steel.
  3. Install one-piece chrome-plated escutcheon plates with set screw at sleeves for all pipes exposed in finished areas.
  4. The annular space between sleeves and pipe shall be filled with fiberglass insulation and caulked in non-fire rated situations.
  5. Sleeves are not required for core-drilled holes.
- W. Permanent sleeves are not required for holes formed by removable PE sleeves.
- X. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.
- Y. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
1. Cut sleeves to length for mounting flush with both surfaces.
    - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 4 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
- Z. Install sleeves in new walls and slabs as new walls and slabs are constructed.
- AA. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
1. Steel Pipe Sleeves: For pipes smaller than NPS 6.
  2. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
  3. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Design of sleeves shall be such that waterproofing can be flashed into and around the sleeves. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Section 07 62 00 – Sheet Metal Flashing and Trim for flashing.
    - a. Seal space outside of sleeve fittings with grout.
- BB. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Section 07 92 00 – Joint Sealants for materials and installation.

**3.7 Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using 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.**

- A. Install steel pipe for sleeves smaller than 6 inches in diameter.
- B. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
- C. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

**3.8 Underground, Exterior-Wall Pipe Penetrations**

- A. Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- B. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

**3.9 Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Section 07 84 13 – Penetration Firestopping for materials.**

- A. UL approved system for through penetrations is required. The annular space around the pipes shall be packed with mineral wool or other noncombustible material and sealed at each exposed edge to maintain the rating of the system in accordance with the through penetration sealant manufacturer's recommendations.
- B. Verify final equipment locations for roughing-in.
- C. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

**3.10 PIPING JOINT CONSTRUCTION**

- A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
  - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- I. 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.
  - 2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
  - 3. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
  - 4. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
  - 5. PVC Nonpressure Piping: Join according to ASTM D 2855.
  - 6. PVC to ABS Nonpressure Transition Fittings: Join according to ASTM D 3138 Appendix.
  - 7. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.
  - 8. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
  - 9. Plain-End Pipe and Fittings: Use butt fusion.
  - 10. Plain-End Pipe and Socket Fittings: Use socket fusion

### **3.11 PIPING CONNECTIONS**

- A. Make connections according to the following, unless otherwise indicated:
  - 1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
  - 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
  - 3. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.
    - a. Dielectric unions shall be avoided whenever possible.

### **3.12 TRANSITION FITTING INSTALLATION**

- A. Install transition couplings at joints of dissimilar piping.
- B. Transition Fittings in Underground Domestic Water Piping
  - 1. NPS 1-1/2 and Smaller: Fitting-type coupling.
  - 2. NPS 2 and Larger: Sleeve-type coupling.
- C. Transition Fittings in Aboveground Domestic Water Piping NPS 2 and Smaller: Plastic-to-metal transition fittings or unions.

### **3.13 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, nipples and unions.
- C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges.

### **3.14 WALL PENETRATION SYSTEM INSTALLATION**

- A. Install wall penetration systems in new, exterior concrete walls.
- B. Assemble wall penetration system components with sleeve pipe. Install so that end of sleeve pipe and face of housing are flush with wall. Adjust locking devices to secure sleeve pipe in housing.

### **3.15 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS**

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install plumbing equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

### **3.16 PAINTING**

- A. Painting of plumbing systems, equipment, and components is specified in Sections 09 91 23 – Interior Painting and 09 91 13 – Exterior Painting.
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

### **3.17 CONCRETE BASES**

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
- B. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
- C. 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 the base.
- D. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
- E. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
- F. Install anchor bolts to elevations required for proper attachment to supported equipment.
- G. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
- H. Use 3000 psi, 28-day compressive-strength concrete and reinforcement as specified in Section 03 30 00 – Cast-in-Place Concrete.

### **3.18 FIELD QUALITY CONTROL**

- A. Upon completion of installation and after units are water pressurized, test fixtures to demonstrate capability and compliance with requirements. When possible, correct malfunctioning units at size, then retest to demonstrate compliance, or remove and replace with new units and proceed with retesting.

- B. Inspect each installed unit for damage to finish. If feasible, restore and match finish to original at site, or remove fixture and replace with new unit. Feasibility and match to be judged by the Engineer. Remove cracked or dented units and replace with new units.

### **3.19 ADJUSTING**

- A. Test fixtures to demonstrate proper operation. Replace malfunctioning units or components. Adjust self-closing lavatory faucets to 15 second cycle. Adjust shower valve temperature limit stops to 110 degree F maximum outlet temperature.
- B. Adjust water pressure at drinking fountains, faucets, shower valves, and flush valves to provide proper flow stream and specified gpm without splashing, noise or overflow.
- C. Adjust or replace washers to eliminate leaks at faucets or stops.

### **3.20 CLEANING**

- A. Clean plumbing fixtures, trim, and strainers of dirt debris upon completion of installation.

### **3.21 EXTRA STOCK**

- A. Furnish special wrenches and other devices necessary for servicing plumbing fixtures and trim to Owner with receipt. Furnish 1 device for every 10 units.

### **3.22 ERECTION OF METAL SUPPORTS AND ANCHORAGES**

- A. Refer to Section 05 50 00 – Metal Fabrications for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

### **3.23 ERECTION OF WOOD SUPPORTS AND ANCHORAGES**

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor plumbing materials and equipment.
- B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.
- C. Attach to substrates as required to support applied loads.

**3.24 GROUTING**

- A. Mix and install grout for plumbing equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

**END OF SECTION 22 05 00**

## **SECTION 22 05 23 GENERAL DUTY VALVES FOR PLUMBING PIPING**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Refer to Section 22 05 00 – Common Work Results for Plumbing.

#### **1.2 SUMMARY**

- A. Section Includes
  - 1. Bronze ball valves.
  - 2. Balancing Valves
  - 3. Bronze lift check valves.
  - 4. Bronze swing check valves.
- B. Related Sections
  - 1. Section 22 05 53 – Identification for Plumbing Piping and Equipment for valve tags and schedules.

#### **1.3 DEFINITIONS**

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene copolymer rubber.
- C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- D. NRS: Nonrising stem.
- E. OS&Y: Outside screw and yoke.
- F. RS: Rising stem.
- G. SWP: Steam working pressure.



## **1.4 SUBMITTALS**

- A. Product Data: For each type of valve indicated.

## **1.5 QUALITY ASSURANCE**

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance
  - 1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
  - 2. ASME B31.1 for power piping valves.
  - 3. ASME B31.9 for building services piping valves.
- C. NSF Compliance: NSF 61 for valve materials for potable-water service.

## **1.6 DELIVERY, STORAGE, AND HANDLING**

- A. Prepare valves for shipping as follows:
  - 1. Protect internal parts against rust and corrosion.
  - 2. Protect threads, flange faces, grooves, and weld ends.
  - 3. Set angle, gate, and globe valves closed to prevent rattling.
  - 4. Set ball and plug valves open to minimize exposure of functional surfaces.
  - 5. Set butterfly valves closed or slightly open.
  - 6. Block check valves in either closed or open position.
- B. Use the following precautions during storage:
  - 1. Maintain valve end protection.
  - 2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use hand wheels or stems as lifting or rigging points.

## **PART 2 - PRODUCTS**

### **2.1 GENERAL REQUIREMENTS FOR VALVES**

- A. Refer to valve schedule articles for applications of valves.

- B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- C. Valve Sizes: Same as upstream piping unless otherwise indicated.
- D. Valve Actuator Types
  - 1. Gear Actuator: For quarter-turn valves NPS 8 and larger.
  - 2. Handwheel: For valves other than quarter-turn types.
  - 3. Handlever: For quarter-turn valves NPS 6 and smaller except plug valves.
  - 4. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every 5 plug valves, for each size square plug-valve head.
  - 5. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator; of size and with chain for mounting height, as indicated in the "Valve Installation" Article.
- 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. Basis-of-Design Product: Subject to compliance with requirements, provide NIBCO Nib-seal handle extension.
  - 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, Full-Port, Bronze Ball Valves with Stainless-Steel Trim
  - 1. Manufacturers: Subject to compliance with requirements as indicated on the Drawings and specified herein.
  - 2. Provide NIBCO Inc T-685-80-66-LF or equal product by one of the following:
    - a. ConBraCo Industries, Inc.; Apollo Valves
    - b. Hammond Valve
    - c. Milwaukee Valve Company
    - d. Kennedy Valve

- e. Red-White Valve Corporation

3. Description

- a. Standard: MSS SP-110, NSF 61-G.
- b. CWP Rating: 600 psig.
- c. Body Design: Two piece.
- d. Body Material: Lead free bronze.
- e. Ends: Threaded.
- f. Seats: PTFE or TFE.
- g. Stem: Stainless steel.
- h. Ball: Stainless steel, vented.
- i. Port: Full.

B. Three-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim

- 1. Manufacturers: Subject to compliance with requirements as indicated on the Drawings and specified herein.
- 2. Provide NIBCO Inc T-595-Y-66-LF or equal product by one of the following:
  - a. ConBraCo Industries, Inc.; Apollo Valves
  - b. Hammond Valve
  - c. Milwaukee Valve Company
  - d. Kennedy Valve
  - e. Red-White Valve Corporation

3. Description

- a. Standard: MSS SP-110, NSF 61-G.
- b. CWP Rating: 600 psig.
- c. Body Design: Three piece.
- d. Body Material: Lead free bronze.
- e. Ends: Threaded.
- f. Seats: PTFE or TFE.
- g. Stem: Stainless steel.
- h. Ball: Stainless steel, vented.
- i. Port: Full.

## 2.3 BALANCING VALVES

A. Memory-Stop Balancing Valves

- 1. Manufacturers: Subject to compliance with requirements as indicated on the Drawings and specified herein.

2. Provide NIBCO S/T-685-80-LF Inc S/T-685-80-LF-M or equal product by one of the following:
  - a. ConBraCo Industries, Inc.
  - b. Hammond Valve
  - c. Milwaukee Valve Company
  - d. Red-White Valve Corp.
3. Standard: MSS SP-110 for two-piece, copper-alloy ball valves, NSF 61-G.
4. Pressure Rating: 400-psig minimum CWP.
5. Size: NPS 2 or smaller.
6. Body: Copper alloy.
7. Port: Full port.
8. Ball: Lead free bronze.
9. End Connections: Solder joint or threaded.
10. Handle: Vinyl-covered steel with memory-setting device.

## **2.4 BRONZE LIFT CHECK VALVES**

- A. Class 125, Lift Check Valves with Non Metallic Disc
  1. Manufacturers: Subject to compliance with requirements as indicated on the Drawings and specified herein.
  2. Provide NIBCO Inc T-480-Y-LF or equal product by one of the following:
    - a. ConBraCo Industries, Inc.; Apollo Valves
    - b. Hammond Valve
    - c. Milwaukee Valve Company
    - d. Kennedy Valve
    - e. Red-White Valve Corporation
  3. Description
    - a. Standard: MSS SP-80, Type 1, NSF 61-G.
    - b. CWP Rating: 200 psig.
    - c. Body Design: Vertical flow.
    - d. Body Material: ASTM B 584 Alloy C87850, lead free bronze.
    - e. Ends: Threaded.
    - f. Disc: TFE.

## **2.5 BRONZE SWING CHECK VALVES**

- A. Class 125, Bronze Swing Check Valves with Non Metallic Disc

1. Manufacturers: Subject to compliance with requirements as indicated on the Drawings and specified herein.
2. Provide NIBCO Inc T-413-Y-LF or equal product by one of the following:
  - a. ConBraCo Industries, Inc.; Apollo Valves
  - b. Hammond Valve
  - c. Milwaukee Valve Company
  - d. Kennedy Valve
  - e. Red-White Valve Corporation
3. Description
  - a. Standard: MSS SP-80, Type 3, NSF 61-G.
  - b. CWP Rating: 300 psig.
  - c. Body Design: Horizontal flow.
  - d. Body Material: ASTM B 584 Alloy C87850, lead free bronze.
  - e. Ends: Threaded.
  - f. Disc: TFE.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves.

#### **3.2 VALVE INSTALLATION**

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.

1. Install valves not more than six feet above the floor, if frequently used, and with a union on the downstream side of threaded end valves.
- 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 chain wheels on operators for ball gate and plug valves NPS 4 and larger and more than 96 inches above floor. Extend chains to 60 inches above finished floor.
- F. Install check valves for proper direction of flow and as follows:
  1. Swing Check Valves: In horizontal position with hinge pin level.
  2. Check Valves: In horizontal or vertical position, between flanges.
  3. Lift Check Valves: With stem upright and plumb.
- G. Provide each valve with a brass disc not less than 1-1/4" diameter engraved with numbers, piping service, and normal operating position (i.d. NO, NC) corresponding to valves shown on diagrams.
  1. Fasten discs to valves with #14 brass wire or #16 brass jack chain.

### **3.3 ADJUSTING**

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

### **3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS**

- A. If valve applications are not indicated, use the following:
  1. Shutoff Service: Ball or gate valves.
  2. Butterfly Valve Dead-End Service: Single-flange (lug) type.
  3. Throttling Service: ball valves.
  4. Pump-Discharge Check Valves:
    - a. NPS 2 and Smaller: Bronze swing check valves with bronze disc.
    - b. NPS 2-1/2 and Larger for Domestic Water: Iron swing check valves with lever and weight or with spring or iron, center-guided, metal-seat check valves.
    - c. NPS 2-1/2 and Larger for Sanitary Waste and Storm Drainage: Iron swing check valves with lever and weight or spring.
- 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.
  4. For Steel Piping, NPS 2 and Smaller: Threaded ends.
  5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
  6. For Steel Piping, NPS 5 and Larger: Flanged ends.
  7. For Grooved-End Copper Tubing and Steel Piping: Valve ends may be grooved.
- D. For soldering lead free valves use a water based flux containing zinc chloride and ammonium chloride to prevent oxidization. Due to soldering difference in varying copper alloys, contact the manufacturer for best practices.

**END OF SECTION 22 05 23**

## SECTION 220529 – HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Refer to Section 22 05 00 – Common Work Results for Plumbing.

#### 1.2 SUMMARY

- A. This Section includes the following hangers and supports for plumbing system piping and equipment:
  - 1. Steel pipe hangers and supports.
  - 2. Trapeze pipe hangers.
  - 3. Fiberglass pipe hangers.
  - 4. Metal framing systems.
  - 5. Fiberglass strut systems.
  - 6. Thermal-hanger shield inserts.
  - 7. Fastener systems.
  - 8. Pipe positioning systems.
  - 9. Equipment supports.
- B. Related Sections include the following:
  - 1. Section 05 50 00 – Metal Fabrications for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
  - 2. Division 21 Section "Water-Based Fire-Suppression Systems" for pipe hangers for fire-suppression piping.
  - 3. Section 22 05 16 – Expansion Fittings and Loops for Plumbing Piping for pipe guides and anchors.



4. Section 22 05 48 – Vibration and Seismic Controls for Plumbing Piping and Equipment for vibration isolation devices.

### **1.3 DEFINITIONS**

- A. MSS: Manufacturers Standardization Society for the Valve and Fittings Industry Inc.
- B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

### **1.4 PERFORMANCE REQUIREMENTS**

- A. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- C. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

### **1.5 SUBMITTALS**

- A. Product Data: For the following:
  1. Steel pipe hangers and supports.
  2. Fiberglass pipe hangers.
  3. Thermal-hanger shield inserts.
  4. Powder-actuated fastener systems.
  5. Pipe positioning systems.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following:
  1. Trapeze pipe hangers. Include Product Data for components.
  2. Metal framing systems. Include Product Data for components.
  3. Fiberglass strut systems. Include Product Data for components.
  4. Pipe stands. Include Product Data for components.

- 5. Equipment supports.
- C. Welding certificates.

## **1.6 QUALITY ASSURANCE**

- A. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel." AWS D1.4, "Structural Welding Code--Reinforcing Steel." ASME Boiler and Pressure Vessel Code: Section IX.
- B. Welding: Qualify procedures and personnel according to the following:
  - 1. AWS D1.1, "Structural Welding Code--Steel."
  - 2. AWS D1.2, "Structural Welding Code--Aluminum."
  - 3. AWS D1.4, "Structural Welding Code--Reinforcing Steel."
  - 4. ASME Boiler and Pressure Vessel Code: Section IX.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
  - 1. Manufacturers: Subject to compliance with requirements as indicated on the Drawings and specified herein.

### **2.2 STEEL PIPE HANGERS AND SUPPORTS**

- A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.
- B. Manufacturers: Provide Mason Industries or equal product by one of the following:
  - 1. Michigan Hanger Co.
  - 2. B-Line Systems
  - 3. Grinnell Corp.
  - 4. PHD Manufacturing, Inc.
  - 5. Tolco Inc.

## **HANGERS AND SUPPORTS FOR PIPING AND EQUIPIEMENT**

- C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.
- D. Nonmetallic Coatings: Plastic coating, jacket, or liner.
- E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

### **2.3 TRAPEZE PIPE HANGERS**

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.
- B. Manufacturers: Provide Mason Industries or equal product by one of the following:
  - 1. Michigan Hanger Co.
  - 2. B-Line Systems
  - 3. Grinnell Corp.
  - 4. PHD Manufacturing, Inc.
  - 5. Tolco Inc.

### **2.4 FIBERGLASS PIPE HANGERS**

- A. Clevis-Type, Fiberglass Pipe Hangers: Similar to MSS Type 1, steel pipe hanger except hanger is made of fiberglass and continuous-thread rod and nuts are made of polyurethane.
- B. Manufacturers: Provide Mason Industries or equal product by one of the following:
  - 1. Michigan Hanger Co.
  - 2. B-Line Systems
  - 3. Grinnell Corp.
  - 4. PHD Manufacturing, Inc.
  - 5. Tolco Inc.
  - 6. Cope, T. J., Inc.; Tyco International, Ltd.
  - 7. Seasafe, Inc.
  - 8. Unistrut Corp.; Tyco International, Ltd.
  - 9. Wesanco, Inc.

- C. Strap-Type, Fiberglass Pipe Hangers: Made of fiberglass loop with stainless-steel continuous-thread rod, nuts, and support hook.
  - 1. Manufacturers
    - a. Plasti-Fab, Inc.

## **2.5 METAL FRAMING SYSTEMS**

- A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.
- B. Manufacturers: Provide Mason Industries or equal product by one of the following:
  - 1. Michigan Hanger Co.
  - 2. B-Line Systems
  - 3. Grinnell Corp.
  - 4. PHD Manufacturing, Inc.
  - 5. Tolco Inc.
- C. Coatings: Manufacturer's standard finish unless bare metal surfaces are indicated.
- D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

## **2.6 FIBERGLASS STRUT SYSTEMS**

- A. Description: Shop- or field-fabricated pipe-support assembly, similar to MFMA-3, made of fiberglass channels and other components.
- B. Manufacturers: Provide Mason Industries or equal product by one of the following:
  - 1. Michigan Hanger Co.
  - 2. B-Line Systems
  - 3. Grinnell Corp.
  - 4. PHD Manufacturing, Inc.
  - 5. Tolco Inc.
  - 6. Cope, T. J., Inc.; Tyco International, Ltd.
  - 7. Seasafe, Inc.

8. Unistrut Corp.; Tyco International, Ltd.
9. Wesanco, Inc.

## **2.7 THERMAL-HANGER SHIELD INSERTS**

- A. Description: 100 psig minimum, compressive-strength insulation insert encased in sheet metal shield.
- B. Manufacturers: Provide Mason Industries or equal product by one of the following:
  1. Carpenter & Paterson, Inc.
  2. Michigan Hanger Co.
  3. PHS Industries, Inc.
  4. Pipe Shields, Inc.
  5. Value Engineered Products, Inc.
- C. Insulation-Insert Material for Cold Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with vapor barrier.
- D. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate.
- E. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- F. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- G. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

## **2.8 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.
  1. Manufacturers: Provide Hilti Inc or equal product by one of the following:
    - a. ITW Ramset/Red Head
    - b. Masterset Fastening Systems, Inc.
    - c. MKT Fastening, LLC

- d. Powers Fasteners
- B. Mechanical-Expansion Anchors: Insert-wedge-type zinc-coated steel, for use in hardened Portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- 1. Manufacturers: Provide Hilti Inc or equal product by one of the following:
    - a. B-Line Systems, Inc.; a division of Cooper Industries.
    - b. Empire Industries, Inc.
    - c. ITW Ramset/Red Head
    - d. MKT Fastening, LLC
    - e. Powers Fasteners

## **2.9 PIPE POSITIONING SYSTEMS**

- A. Description: IAPMO PS 42, system of metal brackets, clips, and straps for positioning piping in pipe spaces for plumbing fixtures for commercial applications.
- B. Manufacturers: Provide HOLDRITE Corp.; Hubbard Enterprises or equal product by one of the following:
  - 1. C & S Mfg. Corp.
  - 2. Samco Stamping, Inc.

## **2.10 EQUIPMENT SUPPORTS**

- A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

## **2.11 MISCELLANEOUS MATERIALS**

- A. Structural Steel: ASTM A 36/A 36M, 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 APPLICATIONS**

- A. Specific hanger and support requirements are specified 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 padded hangers for piping that is subject to scratching.
- 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 120 to 450 degrees F pipes, NPS 4 to NPS 16, 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 24, 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 noninsulated stationary pipes, NPS 3/4 to NPS 8.
  - 7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
  - 8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
  - 9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 2.

10. Split Pipe-Ring with or without Turnbuckle-Adjustment Hangers (MSS Type 11): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 8.
  11. Extension Hinged or 2-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated 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.
  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 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 2 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 20, 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 20.
  2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, 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 degrees 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 degrees F piping installations.
- I. 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.
- J. 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.
- K. 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 absorb 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 absorb 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 absorb 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:
  - a. Horizontal (MSS Type 54): Mounted horizontally.
  - b. Vertical (MSS Type 55): Mounted vertically.
  - c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.
- L. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.
- M. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.
- N. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.
- O. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

### **3.2 HANGER AND SUPPORT INSTALLATION**

- A. Steel 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 building structure.
- B. 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 above for individual pipe hangers.
  2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.
- 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.

### **HANGERS AND SUPPORTS FOR PIPING AND EQUIPMENT**

- F. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- G. 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.
- H. Pipe Positioning System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture. Refer to Division 22 Section "Plumbing Fixtures" for plumbing fixtures.
- I. Install hangers and supports complete with necessary 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 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 so maximum pipe deflections allowed by ASME B31.9 (for building services piping) are not exceeded.
- P. Insulated Piping: Comply with the following:
  - 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 according to 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: 24 inches long and 0.075-inch thick.
5. Pipes NPS 8 and Larger: Include wood inserts.
6. Insert Material: Length at least as long as protective shield.
7. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

### **3.3 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 smooth bearing surface.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

### **3.4 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 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 contours of welded surfaces match adjacent contours.

### **3.5 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.

### **3.6 PAINTING**

- A. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
- B. Touch Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 painting Sections.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

**END OF SECTION 22 05 29**

## **SECTION 22 07 00 - PLUMBING INSULATION**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Refer to Section 22 05 00 – Common Work Results for Plumbing.

#### **1.2 SUMMARY**

- A. Section Includes
  - 1. Insulation Materials
    - a. Calcium silicate.
    - b. Cellular glass.
    - c. Flexible elastomeric.
    - d. Mineral fiber.
  - 2. Adhesives.
  - 3. Mastics.
  - 4. Lagging adhesives.
  - 5. Sealants.
  - 6. Factory-applied jackets.
  - 7. Tapes.
- B. Related Sections include the following:
  - 1. Section 21 07 00 – Fire Suppression Systems Insulation.
  - 2. Section 23 07 00 – HVAC Insulation.

#### **1.3 SUBMITTALS**

- A. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).
- B. LEED Submittal
  - 1. Product Data for Credit EQ 4.1: For adhesives and sealants, including printed statement of VOC content.

C. Shop Drawings

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.
8. Detail field application for each equipment type.

D. Samples: For each type of insulation and jacket indicated. Identify each Sample, describing product and intended use. Sample sizes are as follows:

1. Sample Sizes

- a. Preformed Pipe Insulation Materials: 12 inches long by NPS 2.
- b. Sheet Form Insulation Materials: 12 inches square.
- c. Jacket Materials for Pipe: 12 inches long by NPS 2.
- d. Sheet Jacket Materials: 12 inches square.
- e. Manufacturer's Color Charts: For products where color is specified, show the full range of colors available for each type of finish material.

E. Qualification Data: For qualified Installer.

F. 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.

G. 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. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting 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 size and location of supports, hangers, and insulation shields specified in Section 22 05 29 – Hangers and Supports for Plumbing Piping and Equipment.
- B. Coordinate clearance requirements with piping Installer for piping insulation application and equipment Installer for equipment 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 Part 3 schedule articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

- D. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- E. 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, provide Pittsburgh Corning Corporation; Foamglas Super K. or equal product by one of the following:
    - a. Cell-U-Foam Corporation; Ultra-CUF.
  2. Block Insulation: ASTM C 552, Type I.
  3. Special-Shaped Insulation: ASTM C 552, Type III.
  4. Board Insulation: ASTM C 552, Type IV.
  5. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.
  6. Preformed Pipe Insulation with Factory-Applied ASJ: Comply with ASTM C 552, Type II, Class 2.
  7. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.
- F. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
- a. Products: Subject to compliance with requirements, provide Armacell LLC; AP Armaflex or equal product by one of the following:
  - b. Aeroflex USA Inc.; Aerocel.
  - c. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180
- G. Mineral-Fiber, Preformed Pipe Insulation
1. Products: Subject to compliance with requirements as indicated on the drawings, provide Johns Manville Insulation or equal product by one of the following:
    - a. CertainTeed Corp.
    - b. Knauf Insulation
    - c. Owens Corning Insulation
  2. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- H. 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 as indicated on the drawings, provide Johns Manville Insulation or equal product by one of the following:
  - a. CertainTeed Corp.
  - b. Knauf Insulation
  - c. Owens Corning 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. Calcium Silicate Adhesive: Fibrous, sodium-silicate-based adhesive with a service temperature range of 50 to 800 deg F.
  1. Products: Subject to compliance with requirements, provide Childers Products, Division of ITW; CP-97 or equal product by one of the following.
    - a. Foster Products Corporation, H. B. Fuller Company; 81-27/81-93.
    - b. Marathon Industries, Inc.; 290.
    - c. Mon-Eco Industries, Inc.; 22-30.
    - d. Vimasco Corporation; 760.
  2. 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).
- C. Cellular-Glass, Phenolic, Polyisocyanurate, and Polystyrene Adhesive: Solvent-based resin adhesive, with a service temperature range of minus 75 to plus 300 degrees F.
  1. Products: Subject to compliance with requirements, provide Childers Products, Division of ITW; CP-96. Or equal product by one of the following:
    - a. Foster Products Corporation, H. B. Fuller Company; 81-33.
  2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- D. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
  1. Products: Subject to compliance with requirements, provide Childers Products, Division of ITW; CP-82 or equal product by one of the following:
    - a. Foster Products Corporation, H. B. Fuller Company; 85-20.
    - b. ITW TACC, Division of Illinois Tool Works; S-90/80.
    - c. Marathon Industries, Inc.; 225.
    - d. Mon-Eco Industries, Inc.; 22-25.

2. 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).
- E. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
1. Products: Subject to compliance with requirements, provide Childers Products, Division of ITW; CP-82 or equal product by one of the following:
    - a. Foster Products Corporation, H. B. Fuller Company; 85-20.
    - b. ITW TACC, Division of Illinois Tool Works; S-90/80.
    - c. Marathon Industries, Inc.; 225.
    - d. Mon-Eco Industries, Inc.; 22-25.
  2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- F. PVC Jacket Adhesive: Compatible with PVC jacket.
1. Products: Subject to compliance with requirements, provide Dow Chemical Company (The); 739, Dow Silicone or equal product by one of the following:
    - a. Johns-Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
    - b. P.I.C. Plastics, Inc.; Welding Adhesive.
    - c. Speedline Corporation; Speedline Vinyl Adhesive.
  2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

### 2.3 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.
- B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.
1. Products: Subject to compliance with requirements, provide Childers Products, Division of ITW; CP-35 or equal product by one of the following:
    - a. Foster Products Corporation, H. B. Fuller Company; 30-90.
    - b. ITW TACC, Division of Illinois Tool Works; CB-50.
    - c. Marathon Industries, Inc.; 590.
    - d. Mon-Eco Industries, Inc.; 55-40.
    - e. Vimasco Corporation; 749.
  2. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43-mil dry film thickness.

3. Service Temperature Range: Minus 20 to plus 180 degrees F.
4. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.
5. Color: White.

## **2.4 LAGGING ADHESIVES**

- A. Description: Comply with MIL-A-3316C, Class I, Grade A, and shall be compatible with insulation materials, jackets, and substrates.
1. Products: Subject to compliance with requirements, provide Childers Products, Division of ITW; CP-52. Or equal product by one of the following:
    - a. Foster Products Corporation, H. B. Fuller Company; 81-42.
    - b. Marathon Industries, Inc.; 130.
    - c. Mon-Eco Industries, Inc.; 11-30.
    - d. Vimasco Corporation; 136.
  2. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over equipment and pipe insulation.
  3. Service Temperature Range: Minus 50 to plus 180 degrees F.
  4. Color: White.

## **2.5 SEALANTS**

- A. Joint Sealants
1. Joint Sealants for Cellular-Glass, Products: Subject to compliance with requirements, provide Childers Products, Division of ITW; CP-76 or equal product by one of the following:
    - a. Foster Products Corporation, H. B. Fuller Company; 30-45.
    - b. Marathon Industries, Inc.; 405.
    - c. Mon-Eco Industries, Inc.; 44-05.
    - d. Pittsburgh Corning Corporation; Pittseal 444.
    - e. Vimasco Corporation; 750.
  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 degrees F.
  5. Color: White or gray.
  6. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. FSK and Metal Jacket Flashing Sealants
1. Products: Subject to compliance with requirements, provide the following:

- a. Childers Products, Division of ITW; CP-76-8.
  - b. Foster Products Corporation, H. B. Fuller Company; 95-44.
  - c. Marathon Industries, Inc.; 405.
  - d. Mon-Eco Industries, Inc.; 44-05.
  - e. Vimasco Corporation; 750.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
  3. Fire- and water-resistant, flexible, elastomeric sealant.
  4. Service Temperature Range: Minus 40 to plus 250 degrees F.
  5. Color: Aluminum.
6. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants
1. Products: Subject to compliance with requirements, provide the following:
    - a. Childers Products, Division of ITW; CP-76.
  2. Materials shall be compatible with insulation materials, jackets, and substrates.
  3. Fire- and water-resistant, flexible, elastomeric sealant.
  4. Service Temperature Range: Minus 40 to plus 250 degrees F.
  5. Color: White.
  6. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

## **2.6 FACTORY-APPLIED JACKETS**

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
  2. 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. PVDC Jacket for Indoor Applications: 4-mil- thick, white PVDC biaxially oriented barrier film with a permeance at 0.02 perms when tested according to ASTM E 96 and with a flame-spread index of 5 and a smoke-developed index of 20 when tested according to ASTM E 84.
    - a. Products: Subject to compliance with requirements, provide the following:

- 1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.
5. PVDC Jacket for Outdoor Applications: 6-mil- thick, white PVDC biaxially oriented barrier film with a permeance at 0.01 perms when tested according to ASTM E 96 and with a flame-spread index of 5 and a smoke-developed index of 25 when tested according to ASTM E 84.
  - a. Products: Subject to compliance with requirements, provide the following:
    - 1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.

## 2.7 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 Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835. Or equal product by one of the following:
    - a. Compac Corp.; 104 and 105.
    - b. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.
    - c. 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 the following:
    - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
    - b. Compac Corp.; 110 and 111.
    - c. Ideal Tape Co., Inc., an American Biltrite Company; 491 AWF FSK.
    - d. Venture Tape; 1525 CW, 1528 CW, and 1528 CW/SQ.
  2. Width: 3 inches.
  3. Thickness: 6.5 mils.
  4. Adhesion: 90 ounces force/inch in width.
  5. Elongation: 2 percent.
  6. Tensile Strength: 40 lbf/inch in width.
  7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

- C. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
1. Products: Subject to compliance with requirements, provide the following:
    - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
    - b. Compac Corp.; 120.
    - c. Ideal Tape Co., Inc., an American Biltrite Company; 488 AWF.
    - 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.
- D. PVDC Tape: White vapor-retarder PVDC tape with acrylic adhesive.
1. Products: Subject to compliance with requirements, provide the following:
    - a. Dow Chemical Company (The); Saran 540 Vapor Retarder Tape.
  2. Width: 3 inches.
  3. Film Thickness: 4 mils.
  4. Adhesive Thickness: 1.5 mils.
  5. Elongation at Break: 145 percent.
  6. Tensile Strength: 55 lbf/inch in width.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
1. Verify that systems and equipment to be insulated have been tested and are free of defects.
  2. Verify that surfaces to be insulated are clean and dry.
  3. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 PREPARATION**

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:



1. 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 de-mineralized water.

### **3.3 GENERAL INSTALLATION REQUIREMENTS**

- A. Insulation is required for all hot water piping, cold water and industrial cold water piping.
- B. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment and piping including fittings, valves, and specialties.
- C. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment and pipe system as specified in insulation system schedules.
- D. 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.
- E. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- F. Install multiple layers of insulation with longitudinal and end seams staggered.
- G. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- H. Keep insulation materials dry during application and finishing.
- I. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- J. Install insulation with least number of joints practical.
- K. 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.
- L. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- M. 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.
    - a. For below ambient services, apply vapor-barrier mastic over staples.
  4. Cover joints and seams with tape as recommended by insulation material manufacturer 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.
- N. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- O. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- P. 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.
- Q. 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 07 84 13 – 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 07 84 13 – Penetration Firestopping.

### **3.5 EQUIPMENT, TANK, AND VESSEL INSULATION INSTALLATION**

- A. Mineral Fiber, Pipe and Tank Insulation Installation for Tanks and Vessels: Secure insulation with adhesive and anchor pins and speed washers.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of tank and vessel surfaces.

2. Groove and score insulation materials to fit as closely as possible to equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joints. Stagger end joints.
  3. Protect exposed corners with secured corner angles.
  4. Install adhesively attached or self-sticking insulation hangers and speed washers on sides of tanks and vessels as follows:
    - a. Do not weld anchor pins to ASME-labeled pressure vessels.
    - b. Select insulation hangers and adhesive that are compatible with service temperature and with substrate.
    - c. On tanks and vessels, maximum anchor-pin spacing is 3 inches from insulation end joints, and 16 inches o.c. in both directions.
    - d. Do not overcompress insulation during installation.
    - e. Cut and miter insulation segments to fit curved sides and domed heads of tanks and vessels.
    - f. Impale insulation over anchor pins and attach speed washers.
    - g. 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.
  5. Secure each layer of insulation with stainless-steel or aluminum bands. Select band material compatible with insulation materials.
  6. Where insulation hangers on equipment and vessels are not permitted or practical and where insulation support rings are not provided, install a girdle network for securing insulation. Stretch prestressed aircraft cable around the diameter of vessel and make taut with clamps, turnbuckles, or breather springs. Place one circumferential girdle around equipment approximately 6 inches from each end. Install wire or cable between two circumferential girdles 12 inches o.c. Install a wire ring around each end and around outer periphery of center openings, and stretch prestressed aircraft cable radially from the wire ring to nearest circumferential girdle. Install additional circumferential girdles along the body of equipment or tank at a minimum spacing of 48 inches o.c. Use this network for securing insulation with tie wire or bands.
  7. Stagger joints between insulation layers at least 3 inches.
  8. Install insulation in removable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection.
  9. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.
  10. For equipment with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.
- B. Flexible Elastomeric Thermal Insulation Installation for Tanks and Vessels: Install insulation over entire surface of tanks and vessels.
1. Apply 100 percent coverage of adhesive to surface with manufacturer's recommended adhesive.
  2. Seal longitudinal seams and end joints.

### 3.6 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions
1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
  2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
  3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
  4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
  5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.
  6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
  7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
  8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
  9. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

- D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
  2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
  3. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.
  4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
  5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

### 3.7 CELLULAR-GLASS INSULATION INSTALLATION

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 but 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.

### 3.8 MINERAL-FIBER INSULATION INSTALLATION

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 but 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.

### **3.9 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.
- E. Where PVDC jackets are indicated, install as follows:
1. Apply three separate wraps of filament tape per insulation section to secure pipe insulation to pipe prior to installation of PVDC jacket.
  2. Wrap factory-presizes jackets around individual pipe insulation sections with one end overlapping the previously installed sheet. Install presized jacket with an approximate overlap at butt joint of 2 inches over the previous section. Adhere lap seal using adhesive or



SSL, and then apply 1-1/4 circumferences of appropriate PVDC tape around overlapped butt joint.

3. Continuous jacket can be spiral wrapped around a length of pipe insulation. Apply adhesive or PVDC tape at overlapped spiral edge. When electing to use adhesives, refer to manufacturer's written instructions for application of adhesives along this spiral edge to maintain a permanent bond.
4. Jacket can be wrapped in cigarette fashion along length of roll for insulation systems with an outer circumference of 33-1/2 inches or less. The 33-1/2-inch- circumference limit allows for 2-inch- overlap seal. Using the length of roll allows for longer sections of jacket to be installed at one time. Use adhesive on the lap seal. Visually inspect lap seal for "fish mouthing," and use PVDC tape along lap seal to secure joint.
5. Repair holes or tears in PVDC jacket by placing PVDC tape over the hole or tear and wrapping a minimum of 1-1/4 circumferences to avoid damage to tape edges.

### **3.10 FINISHES**

- A. Equipment and Pipe 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.

### **3.11 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 field-insulated equipment, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.

2. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.
- D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

### **3.12 EQUIPMENT INSULATION SCHEDULE**

- A. Retain "one of" option in paragraphs in this article to allow Contractor to select piping materials from those retained.
- B. Insulation materials and thicknesses are identified below. If more than one material is listed for a type of equipment, selection from materials listed is Contractor's option.
- C. Insulate indoor and outdoor equipment in paragraphs below that is not factory insulated.
- D. Heat-exchanger (water-to-water for domestic water heating service) insulation shall be one of the following:
  1. Calcium Silicate: 3 inches thick.
  2. Cellular Glass: 3 inches thick.
  3. Mineral-Fiber Board: 2 inches thick and 3-lb/cu. ft. nominal density.
  4. Mineral-Fiber Pipe and Tank: 2 inches thick.
- E. Steam-to-hot-water heat exchanger insulation shall be one of the following:
  1. Calcium Silicate: 3 inches thick.
  2. Cellular Glass: 3 inches thick.
  3. Mineral-Fiber Board: 2 inches thick and 3-lb/cu. ft. nominal density.
  4. Mineral-Fiber Pipe and Tank: 2 inches thick.
- F. Domestic hot-water hydro-pneumatic tank insulation shall be one of the following:
  1. Cellular Glass: 1-1/2 inches thick.
  2. Flexible Elastomeric: 1 inch thick.
  3. Mineral-Fiber Board: 1 inch thick and 3-lb/cu. ft. nominal density.
  4. Mineral-Fiber Pipe and Tank: 1 inch thick.
- G. Domestic hot-water storage tank insulation shall be one of the following, of thickness to provide an R-value of 12.5:
  1. Cellular glass.
  2. Mineral-Fiber Board: 3-lb/cu. ft. nominal density.

3. Mineral-fiber pipe and tank.

H. Domestic water storage tank insulation shall be one of the following:

1. Cellular Glass: 2 inches thick.
2. Flexible Elastomeric: 1 inch thick.
3. Mineral-Fiber Board: 1 inch thick and 3-lb/cu. ft. nominal density.
4. Mineral-Fiber Pipe and Tank: 1 inch thick.

### **3.13 PIPING INSULATION SCHEDULE, GENERAL**

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:

1. Drainage piping located in crawl spaces.
2. Underground piping.
3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

### **3.14 INDOOR PIPING INSULATION SCHEDULE**

A. Domestic Cold Water: As required by project location. Refer to drawings for additional information.

1. NPS 1 and Smaller: Insulation shall be one of the following:

- a. Cellular Glass: 1-1/2 inches thick.
- b. Flexible Elastomeric: 1 inch thick.
- c. 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: 1-1/2 inches thick.
- b. Flexible Elastomeric: 1 inch thick.
- c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

B. Domestic Hot and Recirculated Hot Water:

1. NPS 1-1/4 and Smaller: Insulation shall be one of the following:

- a. Cellular Glass: 1-1/2 inches thick.
- b. Flexible Elastomeric: 1 inch thick.
- c. 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. Flexible Elastomeric: 1 inch thick.
  - c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
- C. 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. Flexible Elastomeric: 1 inch thick.
    - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
- D. Sanitary Waste Piping Where Heat Tracing Is Installed:
1. All Pipe Sizes: Insulation shall be one of the following:
    - a. Cellular Glass: 2 inches thick.
    - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inches thick.
- E. 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. Flexible Elastomeric: 1 inch thick.
    - c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
- 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. Flexible Elastomeric: 1 inch thick.
    - c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

**END OF SECTION 22 07 00**

## **SECTION 22 11 16 - DOMESTIC WATER PIPING**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Refer to Section 22 05 00 – Common Work Results for Plumbing.

#### **1.2 SUMMARY**

- A. Section Includes
  - 1. Under-building slab and aboveground domestic water pipes, tubes, fittings, and specialties inside the building.
  - 2. Encasement for piping.
  - 3. Specialty valves.
  - 4. Flexible connectors.
  - 5. Water meters.
  - 6. Escutcheons.
  - 7. Sleeves
  - 8. Sleeve seals.
  - 9. Wall penetration systems.
- B. Related Section
- C. General: Refer to Section 22 05 00 - COMMON WORK RESULTS FOR PLUMBING.
  - 1. PERFORMANCE REQUIREMENTS
- D. Seismic Performance: Domestic water piping and support and installation shall withstand effects of earthquake motions determined according to ASCE/SEI 7.

#### **1.3 SUBMITTALS**

- A. Product Data: For the following products:
  - 1. Specialty valves.
  - 2. Flexible connectors.
  - 3. Backflow preventers and vacuum breakers.

#### **1.4 QUALITY ASSURANCE**

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 14 for plastic, potable domestic water piping and components. Include marking "NSF-pw" on piping.
- C. Comply with NSF 61 for potable domestic water piping and components.

#### **1.5 PROJECT CONDITIONS**

- A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:
  - 1. Notify Construction Manager no fewer than two days in advance of proposed interruption of water service.
  - 2. Do not proceed with interruption of water service without Construction Manager's written permission.
- B. Adequate volume and pressure of water must be available at all times. On-site pressurization should be considered if the city supply is not reliable. Prior to the start of design work, contact the City of Corvallis Water Department to determine their requirements and pressures.
- C. System capacity shall be based on peak flow demand rates of the plumbing system, make-up to HVAC equipment, and process water requirements.

#### **1.6 COORDINATION**

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

#### **1.7 LEAD FREE INSTALLATION**

- A. The contractor shall install only products that comply with the requirements as described in State Assembly Bill AB-1953 for lead free products. Submit all lead free products to be installed to the engineer for review.

### **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 COPPER TUBE AND FITTINGS

- A. Hard Copper Tube: ASTM B 88, drawn temper, Type L for domestic water and ASTM B 88, Type M water tube for condensate drains.
1. Cast-Copper Solder-Joint Fittings: ASME B16.18, pressure fittings.
  2. Wrought-Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
  3. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
  4. 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.
    - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - 1) Elkhart Products Corporation; Industrial Division
      - 2) NIBCO INC.
    5. Grooved-Joint Copper-Tube Appurtenances
      - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
        - 1) Anvil International
        - 2) Shurjoint Piping Products
        - 3) Victaulic Company
      - b. Copper Grooved-End Fittings: ASTM B 75 copper tube or ASTM B 584 bronze castings.
      - c. Grooved-End-Tube Couplings: Copper-tube dimensions and design similar to AWWA C606. Include ferrous housing sections, EPDM-rubber gaskets suitable for hot and cold water, and bolts and nuts.
- B. Soft Copper Tube: ASTM B 88, Type K and ASTM B 88, Type L water tube, annealed temper.
1. Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.

## 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, unless otherwise indicated; full-face or ring type unless otherwise indicated.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

- D. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.
- E. Solvent Cements for Joining CPVC Piping and Tubing: ASTM F 493.
  - 1. Use CPVC 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 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- F. Plastic, Pipe-Flange Gaskets, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

## **2.4 SPECIALTY VALVES**

- A. Comply with requirements in Section 22 05 23 – General Duty Valves for Plumbing Piping for general-duty metal valves.
- B. Comply with requirements in Section 22 11 19 – Domestic Water Piping Specialties for balancing valves, drain valves, backflow preventers, and vacuum breakers.

## **2.5 TRANSITION FITTINGS**

- A. General: Refer to Section 22 05 00 – Common Work Results for Plumbing.

## **2.6 DIELECTRIC FITTINGS**

- A. General: Refer to Section 22 05 00 – Common Work Results for Plumbing.

## **2.7 FLEXIBLE CONNECTORS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Flex-Hose Co., Inc.
  - 2. Flexicraft Industries
  - 3. Flex Pression, Ltd.
  - 4. Flex-Weld, Inc.
  - 5. Hyspan Precision Products, Inc.
  - 6. Mercer Rubber Co.
  - 7. Metraflex, Inc.
  - 8. Proco Products, Inc.
  - 9. Tozen Corporation
  - 10. Unaflex, Inc.
  - 11. Universal Metal Hose; a Hyspan company



- B. Stainless-Steel-Hose Flexible Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.
  - 1. Working-Pressure Rating: Minimum 200 psig.
  - 2. End Connections NPS 2 and Smaller: Threaded steel-pipe nipple.
  - 3. End Connections NPS 2-1/2 and Larger: Flanged steel nipple.

## **2.8 ESCUTCHEONS**

- A. General: Refer to Section 22 05 00 – Common Work Results for Plumbing.

## **2.9 SLEEVES**

- A. General: Refer to Section 22 05 00 – Common Work Results for Plumbing.

## **2.10 SLEEVE SEALS**

- A. General: Refer to Section 22 05 00 – Common Work Results for Plumbing.

## **2.11 WALL PENETRATION SYSTEMS**

- A. General: Refer to Section 22 05 00 – Common Work Results for Plumbing.

## **2.12 GROUT**

- A. General: Refer to Section 22 05 00 – Common Work Results for Plumbing.

## **PART 3 - EXECUTION**

### **3.1 EARTHWORK**

- A. Comply with requirements in Section 31 20 00 – 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 underground copper tube and ductile-iron pipe in PE encasement according to ASTM A 674 or AWWA C105.
- E. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve, inside the building at each domestic water service entrance. Comply with requirements in Section 22 05 19 – Meters and Gages for Plumbing Piping for pressure gages and Section 22 11 19 – Domestic Water Piping Specialties for drain valves and strainers.
- F. Install shutoff valve immediately upstream of each dielectric fitting.
- G. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements in Section 22 11 19 – Domestic Water Piping Specialties for pressure-reducing valves.
- H. Install domestic water piping level and plumb.
- I. Rough-in domestic water piping for water-meter installation according to utility company's requirements.
- J. Install seismic restraints on piping. Comply with requirements in Section 22 05 48 – Vibration and Seismic Controls for Plumbing Piping and Equipment for seismic-restraint devices.
- K. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- L. 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.
- M. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- N. Install piping adjacent to equipment and specialties to allow service and maintenance.
- O. Install piping to permit valve servicing.
- P. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than system pressure rating used in applications below unless otherwise indicated.
- Q. Install piping free of sags and bends.
- R. Install fittings for changes in direction and branch connections.
- S. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

- T. Install pressure gages on suction and discharge piping from each plumbing pump and packaged booster pump. Comply with requirements in Section 22 05 19 – Meters and Gages for Plumbing Piping for pressure gages.
- U. Install thermostats in hot-water circulation piping. Comply with requirements in Section 22 11 23 – Domestic Water Pumps for thermostats.
- V. Install thermometers on inlet and outlet piping from each water heater. Comply with requirements in Section 22 05 19 – Meters and Gages for Plumbing Piping for thermometers.

### **3.3 JOINT CONSTRUCTION**

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  - 1. Apply appropriate tape or thread compound to external pipe threads.
  - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- D. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Braze Joints" Chapter.
- E. Soldered Joints: 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."
- F. Copper-Tubing Grooved Joints: Roll groove end of tube. Assemble coupling with housing, gasket, lubricant, and bolts. Join copper tube and grooved-end fittings according to AWWA C606 for roll-grooved joints.
- G. 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.
- H. 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.
- I. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

### **3.4 VALVE INSTALLATION**

- A. General-Duty Valves: Comply with requirements in Section 22 05 23 – General Duty Valves for Plumbing Piping for valve installations.
- B. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment, and on each water supply to plumbing fixtures that do not have supply stops. Use ball or gate valves for piping NPS 2 and smaller. Use butterfly or gate valves for piping NPS 2-1/2 and larger.
- C. Install drain valves for equipment at base of each water riser, at low points in horizontal piping, and where required to drain water piping. Drain valves are specified in Section 22 11 19 – Domestic Water Piping Specialties.
  - 1. Hose-End Drain Valves: At low points in water mains, risers, and branches.
  - 2. Stop-and-Waste Drain Valves: Instead of hose-end drain valves where indicated.
- D. Install calibrated balancing valves in each hot-water circulation return branch and discharge side of each pump and circulator. Set calibrated balancing valves partly open to restrict but not stop flow. Comply with requirements in Section 22 11 19 – Domestic Water Piping Specialties for calibrated balancing valves.

### **3.5 TRANSITION FITTING INSTALLATION**

- A. General: Refer to Section 22 05 00 – Common Work Results for Plumbing.

### **3.6 DIELECTRIC FITTING INSTALLATION**

- A. General: Refer to Section 22 05 00 – Common Work Results for Plumbing.

### **3.7 FLEXIBLE CONNECTOR INSTALLATION**

- A. Install flexible connectors in suction and discharge piping connections to each domestic water pump and in suction and discharge manifold connections to each domestic water booster pump.
- B. Install bronze-hose flexible connectors in copper domestic water tubing.
- C. Install stainless-steel-hose flexible connectors in steel domestic water piping.

### **3.8 HANGER AND SUPPORT INSTALLATION**

- A. Comply with requirements in Section 22 05 48 – Vibration and Seismic Controls for Plumbing Piping and Equipment for seismic restraint devices.
- B. Comply with requirements Section 22 05 29 – Hangers and Supports for Plumbing Piping and Equipment for pipe hanger and support products and installation.

1. Vertical Piping: MSS Type 8 or 42, clamps.
  2. Individual, Straight, Horizontal Piping Runs:
    - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
    - b. Longer than 100 Feet: MSS Type 43, adjustable roller hangers.
    - c. Longer than 100 Feet If Indicated: MSS Type 49, spring cushion rolls.
  3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
  4. Base of Vertical Piping: MSS Type 52, spring hangers.
- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8-inch.
- E. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
  2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
  3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
  4. NPS 2-1/2: 108 inches with 1/2-inch rod.
  5. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
  6. NPS 6: 10 feet with 5/8-inch rod.
- F. Install supports for vertical copper tubing every 10 feet.
- G. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 1-1/4 and Smaller: 84 inches with 3/8-inch rod.
  2. NPS 1-1/2: 108 inches with 3/8-inch rod.
  3. NPS 2: 10 feet with 3/8-inch rod.
  4. NPS 2-1/2: 11 feet with 1/2-inch rod.
  5. NPS 3 and NPS 3-1/2: 12 feet with 1/2-inch rod.
  6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.
  7. NPS 6: 12 feet with 3/4-inch rod
- H. Install supports for vertical steel piping every 15 feet.
- I. 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.
  2. NPS 1-1/4 to NPS 2: 48 inches with 3/8-inch rod.
  3. NPS 2-1/2 to NPS 3-1/2: 48 inches with 1/2-inch rod.
  4. NPS 4 and NPS 5: 48 inches with 5/8-inch rod.
  5. NPS 6: 48 inches with 3/4-inch rod.

- J. 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.
- K. Install vinyl-coated hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:
  - 1. NPS 2 and Smaller: 48 inches with 3/8-inch rod.
  - 2. NPS 2-1/2 to NPS 3-1/2: 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.
- L. Install supports for vertical PVC piping every 48 inches.
- M. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

### **3.9 CONNECTIONS**

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment and machines to allow 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 required by plumbing code. Comply with requirements in Division 22 plumbing fixture Sections for connection sizes.
  - 4. Equipment: Cold- and hot-water supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

### **3.10 ESCUTCHEON INSTALLATION**

- A. General: Refer to Section 22 05 00 – Common Work Results for Plumbing.

### **3.11 SLEEVE INSTALLATION**

- A. General: Refer to Section 22 05 00 – Common Work Results for Plumbing.

### **3.12 SLEEVE SEAL INSTALLATION**

- A. General: Refer to Section 22 05 00 – Common Work Results for Plumbing.

### **3.13 WALL PENETRATION SYSTEM INSTALLATION**

- A. General: Refer to Section 22 05 00 – Common Work Results for Plumbing.

### **3.14 IDENTIFICATION**

- A. Identify system components. Comply with requirements in Section 22 05 53 – Identification for Plumbing Piping and Equipment for identification materials and installation.
- B. Label pressure piping with system operating pressure.

### **3.15 FIELD QUALITY CONTROL**

- A. Perform tests and inspections.
- B. Piping Inspections
  - 1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
  - 2. 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:
    - a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
    - b. Final Inspection: Arrange final inspection for authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
  - 3. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
  - 4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- C. Piping Tests
  - 1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
  - 2. 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.
  - 3. 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.

4. 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.
  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 for corrective action required.
- D. Domestic water piping will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

### **3.16 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 flow of hot water 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.

### **3.17 CLEANING**

- A. Clean and disinfect potable and non-potable domestic water piping as follows:
1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
  2. Use purging 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.
  3. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
  4. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.
- B. Clean non-potable domestic water piping as follows:
1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
  2. Use purging procedures prescribed by authorities having jurisdiction or; if methods are not prescribed, follow procedures described below:
    - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
    - b. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.
- C. Prepare and submit reports of purging and disinfecting activities.
- D. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

### **3.18 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 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 ball valves with flanged ends for piping NPS 2-1/2 and larger.
  3. Hot-Water Circulation Piping, Balancing Duty: Calibrated with Memory stop.
  4. Drain Duty: Hose-end drain valves.
- B. Use check valves to maintain correct direction of domestic water flow to and from equipment.
- C. Iron grooved-end valves may be used with grooved-end piping.
- D. CPVC valves matching piping materials may be used.

**END OF SECTION 22 11 16**

## **SECTION 22 11 19 - DOMESTIC WATER PIPING SPECIALTIES**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Refer to Section 22 05 00 – Common Work Results for Plumbing.

#### **1.2 SUMMARY**

- A. This Section includes the following domestic water piping specialties:
  - 1. Vacuum breakers.
  - 2. Backflow preventers.
  - 3. Water pressure-reducing valves.
  - 4. Temperature-actuated water mixing valves.
  - 5. Strainers.
  - 6. Outlet boxes.
  - 7. Hose bibbs.
  - 8. Wall hydrants.
  - 9. Water hammer arresters.
  - 10. Air vents.
  - 11. Trap-seal primer valves.
  - 12. Trap-seal primer systems.
- B. Related Sections include the following:
  - 1. Section 22 05 19 – Meters and Gages for Plumbing Piping for thermometers, pressure gages, and flow meters in domestic water piping.
  - 2. Section 22 11 16 – Domestic Water Piping for water meters.
  - 3. Section 22 45 00 – Emergency Plumbing Fixtures for water tempering equipment.

4. Section 22 47 00 – Drinking Fountains and Water Coolers for water filters for water coolers.

### **1.3 PERFORMANCE REQUIREMENTS**

- A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig, unless otherwise indicated.

### **1.4 SUBMITTALS**

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For domestic water piping specialties 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, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. NSF Compliance
  1. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic domestic water piping components.
  2. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."

## **PART 2 - PRODUCTS**

### **2.1 VACUUM BREAKERS**

- A. Pipe-Applied, Atmospheric-Type Vacuum Breakers
  1. Manufacturers: Subject to compliance with requirements, provide Watts Industries, Inc.; Water Products Div. or equal product by one of the following:
    - a. Ames Co.
    - b. Cash Acme
    - c. ConBraCo Industries, Inc.
    - d. FEBCO; SPX Valves & Controls

- e. Zurn Plumbing Products Group; Wilkins Div.
  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 Watts Industries, Inc.; Water Products Div. or equal product by one of the following:
    - a. Arrowhead Brass Products, Inc.
    - b. Cash Acme
    - c. ConBraCo Industries, Inc.
    - d. Legend Valve
    - e. MIFAB, Inc.
    - f. Prier Products, Inc
    - g. Woodford Manufacturing Company
    - h. Wilkins Valve Div.
  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: Chrome or nickel plated.
- C. Spill-Resistant Vacuum Breakers
1. Manufacturers: Subject to compliance with requirements, provide Watts Industries, Inc.; Water Products Div. or equal product by one of the following:
    - a. ConBraCo Industries, Inc.
  2. Standard: ASSE 1056.
  3. Operation: Continuous-pressure applications.
  4. Size: Refer to floor plans
  5. Accessories
    - a. Valves: Ball type, on inlet and outlet.

## 2.2 BACKFLOW PREVENTERS

- A. Intermediate Atmospheric-Vent Backflow Preventers. Refer to equipment schedule for equipment type:
1. Manufacturers: Subject to compliance with requirements, provide Watts Industries, Inc.; Water Products Div. or equal product by one of the following:
    - a. Cash Acme
    - b. ConBraCo Industries, Inc.
    - c. FEBCO; SPX Valves & Controls
    - d. Wilkins Valve Div.
  2. Standard: ASSE 1012.
  3. Operation: Continuous-pressure applications.
  4. Size: Refer to equipment schedule
  5. Body: Bronze.
  6. End Connections: Union, solder joint.
  7. Finish: Chrome plated.
- B. Reduced-Pressure-Principle Backflow Preventers. Refer to equipment schedule for equipment type:
1. Manufacturers: Subject to compliance with requirements, provide Watts Industries, Inc.; Water Products Div. or equal product by one of the following:
    - a. Ames Co.
    - b. ConBraCo Industries, Inc.
    - c. FEBCO; SPX Valves & Controls
    - d. Flomatic Corporation
    - e. Wilkins Valve Div.
  2. Standard: ASSE 1013.
  3. Operation: Continuous-pressure applications.
  4. Pressure Loss: 12 psig maximum, through middle 1/3 of flow range.
  5. Size: Refer to equipment schedule
  6. Design Flow Rate: Refer to equipment schedule
  7. Body: lead free brass.
  8. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
  9. Configuration: Designed for horizontal, straight through flow.

10. Accessories
  - a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 and smaller; outside screw and yoke 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.
  
- C. Beverage-Dispensing-Equipment Backflow Preventers: Refer to equipment schedule for equipment type:
  1. Manufacturers: Subject to compliance with requirements, provide Watts Industries, Inc.; Water Products Div. or equal product by one of the following:
    - a. ConBraCo Industries, Inc.
    - b. Zurn Plumbing Products Group; Wilkins Div.
  2. Standard: ASSE 1022.
  3. Operation: Continuous-pressure applications.
  4. Size: NPS 1/4 or NPS 3/8.
  5. Body: Stainless steel.
  6. End Connections: Threaded.
  
- D. Hose-Connection Backflow Preventers: Refer to equipment schedule for equipment type.
  1. Manufacturers: Subject to compliance with requirements, provide Watts Industries, Inc.; Water Products Div. or equal product by one of the following:
    - a. ConBraCo Industries, Inc.
    - b. Woodford Manufacturing Company
  2. Standard: ASSE 1052.
  3. Operation: Up to 10-foot head of water back pressure.
  4. Inlet Size: NPS 1/2 or NPS 3/4.
  5. Outlet Size: Garden-hose thread complying with ASME B1.20.7.
  6. Capacity: At least 3 gpm flow.
  
- E. Backflow-Preventer Test Kits
  1. Manufacturers: Subject to compliance with requirements, provide ConBraCo Industries, Inc. or equal product by one of the following:
    - a. FEBCO; SPX Valves & Controls
    - b. Flomatic Corporation
    - c. Watts Industries, Inc.; Water Products Div.

- d. Zurn Plumbing Products Group; Wilkins Div.
- 2. Description: Factory calibrated, with gages, fittings, hoses, and carrying case with test-procedure instructions.

### **2.3 TEMPERATURE-ACTUATED WATER MIXING VALVES**

- A. Water-Temperature Limiting Devices Refer to equipment schedule for equipment type.
  - 1. Manufacturers: Subject to compliance with requirements, provide Powers; a Watts Industries Co or equal product by one of the following:
    - a. Leonard Valve Company
    - b. Symmons Industries, Inc.
    - c. Watts Industries, Inc.; Water Products Div.
    - d. Zurn Plumbing Products Group; Wilkins Div.
  - 2. Standard: ASSE 1017.
  - 3. Pressure Rating: 125 psig.
  - 4. Type: Thermostatically controlled water mixing valve.
  - 5. Material: Bronze body with corrosion-resistant interior components.
  - 6. Connections: Threaded with unions on inlets and outlet.
  - 7. Accessories: Check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
  - 8. Tempered-Water Setting: Refer to equipment schedule.
  - 9. Tempered-Water Design Flow Rate: Refer to equipment schedule.
  - 10. Valve Finish: Rough bronze.
- B. Primary, Thermostatic, Water Mixing Valves: Refer to equipment schedule for equipment type.
  - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 3. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
    - a. Armstrong International, Inc.
    - b. Lawler Manufacturing Company, Inc.
    - c. Leonard Valve Company

- d. Powers; a Watts Industries Co.
  - e. Symmons Industries, Inc.
- 4. Standard: ASSE 1017.
  - 5. Pressure Rating: 125 psig.
  - 6. Type: Exposed-mounting, thermostatically controlled water mixing valve.
  - 7. Material: Bronze body with corrosion-resistant interior components.
  - 8. Connections: Threaded with unions on inlets and outlet.
  - 9. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
  - 10. Valve Pressure Rating: 125 psig minimum, unless otherwise indicated.
  - 11. Tempered-Water Setting: Refer to equipment schedule.
  - 12. Tempered-Water Design Flow Rate: Refer to equipment schedule.
  - 13. Valve Finish: Rough bronze.
  - 14. Piping Finish: Copper.

## **2.4 STRAINERS FOR DOMESTIC WATER PIPING**

- A. Y-Pattern Strainers Refer to equipment schedule for equipment type.
  - 1. Pressure Rating: 125 psig minimum, unless otherwise indicated.
  - 2. Body: Bronze for NPS 2 and smaller; cast iron for NPS 2-1/2 and larger.
  - 3. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
  - 4. Screen: Stainless steel with round perforations, unless otherwise indicated.
  - 5. Perforation Size
    - a. Strainers NPS 2 and Smaller: 0.020-inch.
    - b. Strainers NPS 2-1/2 to NPS 4: 0.045-inch.
  - 6. Drain: Pipe plug.

## **2.5 HOSE BIBBS**

- A. Hose Bibbs Refer to equipment schedule for equipment type:
  - 1. Standard: ASME A112.18.1 for sediment faucets.



2. Body Material: Bronze.
3. Seat: Bronze, replaceable.
4. Supply Connections: NPS 1/2 or 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 non-removable, 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: Chrome or nickel plated.
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: Operating key.
14. Include operating key with each operating-key hose bibb.
15. Include integral wall flange with each chrome- or nickel-plated hose bibb.

## 2.6 WALL HYDRANTS

- A. Moderate-Climate Wall Hydrants: Refer to equipment schedule for equipment type.
1. Manufacturers: Subject to compliance with requirements, provide Woodford Manufacturing Company or equal product by one of the following:
    - a. Josam Company
    - b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    - c. Tyler Pipe; Wade Div.
    - d. Watts Drainage Products Inc.
    - e. Zurn Plumbing Products Group; Specification Drainage Operation
  2. Standard: ASME A112.21.3M for concealed-outlet, self-draining wall hydrants.
  3. Pressure Rating: 125 psig.
  4. Operation: Loose key.
  5. Inlet: NPS 3/4 or NPS 1.

6. Outlet: Concealed, with integral vacuum breaker or non removable hose-connection vacuum breaker complying with ASSE 1011; and garden-hose thread complying with ASME B1.20.7.
7. Box: Deep, flush mounting with cover.
8. Box and Cover Finish: Rough Chrome plated.
9. Outlet: Exposed, with integral vacuum breaker or nonremovable hose-connection vacuum breaker complying with ASSE 1011; and garden-hose thread complying with ASME B1.20.7.
10. Operating Keys(s): Two with each wall hydrant.

## **2.7 WATER HAMMER ARRESTERS**

- A. Water Hammer Arresters: Refer to equipment schedule for equipment type.
  1. Manufacturers: Subject to compliance with requirements, provide Precision Plumbing Products Inc. or equal product by one of the following:
    - a. Josam Company
    - b. Sioux Chief Manufacturing Company, Inc.
    - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    - d. Tyler Pipe; Wade Div.
    - e. Watts Drainage Products Inc.
  2. Standard: ASSE 1010 or PDI-WH 201.
  3. Type: Metal bellows.
  4. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

## **2.8 AIR VENTS**

- A. Bolted-Construction Automatic Air Vents: Refer to equipment schedule for equipment type.
  1. Body: Bronze.
  2. Pressure Rating: 125 psig minimum pressure rating at 140 degrees F.
  3. Float: Replaceable, corrosion-resistant metal.
  4. Mechanism and Seat: Stainless steel.
  5. Size: NPS 1/2 minimum inlet.
  6. Inlet and Vent Outlet End Connections: Threaded.

- B. Welded-Construction Automatic Air Vents: Refer to equipment schedule for equipment type.

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.

## **2.9 TRAP-SEAL PRIMER VALVES**

- A. Supply-Type, Trap-Seal Primer Valves: Refer to equipment schedule for equipment type.
  1. Manufacturers: Subject to compliance with requirements, provide Precision Plumbing Products Inc. or equal product by one of the following:
    - a. Sioux Chief Manufacturing Company, Inc.
    - b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    - c. Watts Industries, Inc.; Water Products Div.
  2. Standard: ASSE 1018.
  3. Pressure Rating: 125 psig minimum.
  4. Body: Bronze.
  5. Inlet and Outlet Connections: NPS 1/2 threaded, union, or solder joint.
  6. Gravity Drain Outlet Connection: NPS 1/2 threaded or solder joint.
  7. Finish: Rough bronze.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Refer to Section 22 05 00 – Common Work Results for Plumbing for piping joining materials, joint construction, and basic installation requirements.
- B. 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 not acceptable for this application.
  3. Do not install bypass piping around backflow preventers.
- C. Install water regulators with inlet and outlet shutoff valves. Install pressure gages on inlet and outlet.
- D. Install water control valves with inlet and outlet shutoff valves. Install pressure gages on inlet and outlet.
- E. Install balancing valves in locations where they can easily be adjusted.
- F. Install temperature-actuated water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.
1. Install thermometers and water regulators if specified.
  2. Install cabinet-type units recessed in or surface mounted on wall as specified.
- G. Install Y-pattern strainers for water on supply side of each control valve, water pressure-reducing valve, solenoid valve, and pump.
- H. Install outlet boxes recessed in wall. Install 2-inch by-4-inch fire retardant treated wood blocking wall reinforcement between studs. Fire-retardant-treated-wood blocking is specified in Section 06 10 00 – Rough Carpentry.
- I. Install hose stations with check stops or shutoff valves on inlets and with thermometer on outlet.
1. Install shutoff valve on outlet if specified.
  2. Install cabinet-type units recessed in or surface mounted on wall as specified. Install 2-inch by-4-inch fire retardant treated wood blocking wall reinforcement between studs. Fire-retardant-treated-wood blocking is specified in Section 06 10 00 – Rough Carpentry.
- J. Install water hammer arresters in water piping according to PDI-WH 201.
- K. Install air vents at high points of water piping. Install drain piping and discharge onto floor drain.
- L. 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.
- M. 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. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping and specialties.
- B. Ground equipment according to Section 26 05 26 – Grounding and Bonding for Electrical Systems.
- C. Connect wiring according to Section 26 05 19 – Low Voltage Electrical Power Conductors and Cables.

### **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. Pressure vacuum breakers.
  - 2. Intermediate atmospheric-vent backflow preventers.
  - 3. Reduced-pressure-principle backflow preventers.
  - 4. Double-check backflow-prevention assemblies.
  - 5. Water pressure-reducing valves.
  - 6. Calibrated balancing valves.
  - 7. Primary, thermostatic, water mixing valves.
  - 8. Primary water tempering valves.
  - 9. Outlet boxes.
  - 10. Hose stations.
  - 11. Supply-type, trap-seal primer valves.
  - 12. 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 22 05 53 – Identification for Plumbing Piping and Equipment.

### **3.4 FIELD QUALITY CONTROL**

- A. Perform the following tests and prepare test reports:

1. Test each vacuum breaker reduced-pressure-principle backflow preventer double-check backflow-prevention assembly according to authorities having jurisdiction and the device's reference standard.
- B. Remove and replace malfunctioning domestic water piping specialties and retest as specified above.

### **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.

**END OF SECTION 22 11 19**

## **SECTION 22 13 16 SANITARY WASTE AND VENT PIPING**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Refer to Section 22 05 00 – Common Work Results for Plumbing.

#### **1.2 SUMMARY**

- A. This Section includes the following piping inside the building:
  - 1. Sanitary Waste and Vent
  - 2. Pipe, tube, and fittings.
  - 3. Special pipe fittings.
  - 4. Sanitary Sewer, Force-Main Piping
  - 5. Encasement for underground metal piping.
- B. Related Sections include the following:
  - 1. Section 22 13 29 – Sanitary Sewerage Pumps
  - 2. Section 22 66 00 – Chemical Waste Systems for Laboratory and Healthcare Facilities for chemical-waste and vent piping systems.

#### **1.3 DEFINITIONS**

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. EPDM: Ethylene-propylene-diene terpolymer rubber.
- C. LLDPE: Linear, low-density polyethylene plastic.
- D. NBR: Acrylonitrile-butadiene rubber.
- E. PE: Polyethylene plastic.
- F. PVC: Polyvinyl chloride plastic.
- G. TPE: Thermoplastic elastomer.

#### **1.4 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 for a period of 4 hours with no visible loss of water.
  - 2. Sanitary Sewer, Force-Main Piping: 100 psig.
- B. Seismic Performance: Soil, waste, and vent piping and support and installation shall be capable of withstanding the effects of seismic events determined according to ASCE 7, "Minimum Design Loads for Buildings and Other Structures."

#### **1.5 SUBMITTALS**

- A. Product Data: For pipe, tube, fittings, and couplings.
- B. LEED Submittal
  - 1. Product Data for Credit EQ 4.1: For solvent cements and adhesive primers, including printed statement of VOC content.
- C. Shop Drawings
  - 1. Design Calculations: Signed and sealed by a qualified professional engineer for selecting seismic restraints.
- D. Field quality-control inspection and test reports.

#### **1.6 QUALITY ASSURANCE**

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping; "NSF-drain" for plastic drain piping; "NSF-tubular" for plastic continuous waste piping; and "NSF-sewer" for plastic sewer piping.
- C. All cast iron pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute (CISPI) and be listed by NSF International.
- D. Pipe capacity shall be based on the current Plumbing Code.



## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

### **2.2 PIPING MATERIALS**

- A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

### **2.3 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS**

- A. Pipe and Fittings: ASTM A 888 or CISPI 301.
- B. Shielded Couplings: ASTM C 1277 assembly of metal shield or housing, corrosion-resistant fasteners, and rubber sleeve with integral, center pipe stop.
  - 1. Standard, Shielded, Stainless-Steel Couplings: CISPI 310, with stainless-steel corrugated shield; stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve.
    - a. Manufacturers
      - 1) ANACO.
      - 2) Ideal Div.; Stant Corp.
      - 3) Mission Rubber Co.
      - 4) Tyler Pipe; Soil Pipe Div.
    - 2. Heavy-Duty, Shielded, Stainless-Steel Couplings: With stainless-steel shield, stainless-steel bands and tightening devices, and ASTM C 564, rubber sleeve.
      - a. Manufacturers
        - 1) ANACO.
        - 2) Clamp-All Corp.
        - 3) Ideal Div.; Stant Corp.
        - 4) Mission Rubber Co.
        - 5) Tyler Pipe; Soil Pipe Div.
      - 3. Heavy-Duty, Shielded, Cast-Iron Couplings: ASTM A 48/A 48M, two-piece, cast-iron housing; stainless-steel bolts and nuts; and ASTM C 564, rubber sleeve.
        - a. Manufacturers

1) MG Piping Products Co.

- C. Rigid, Unshielded Couplings: ASTM C 1461, sleeve-type, reducing- or transition-type mechanical coupling molded from ASTM C 1440, TPE material with corrosion-resistant-metal tension band and tightening mechanism on each end.

1. Manufacturers
  - a. ANACO.

## 2.4 SPECIAL PIPE FITTINGS

- A. Flexible, Non pressure Pipe Couplings: Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition pattern. Include shear ring, ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.

1. Manufacturers
  - a. Dallas Specialty & Mfg. Co.
  - b. Fernco, Inc.
  - c. Logan Clay Products Company (The).
  - d. Mission Rubber Co.
  - e. NDS, Inc.

2. Sleeve Materials
  - a. For Cast-Iron Soil Pipes: ASTM C 564, rubber.

- B. Shielded Nonpressure Pipe Couplings: ASTM C 1460, elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

1. Manufacturers
  - a. Cascade Waterworks Mfg. Co.
  - b. Mission Rubber Co.

- C. Rigid, Unshielded, Nonpressure Pipe Couplings: ASTM C 1461, sleeve-type reducing- or transition-type mechanical coupling molded from ASTM C 1440, TPE material with corrosion-resistant-metal tension band and tightening mechanism on each end.

1. Manufacturers
  - a. ANACO.

- D. Flexible Ball Joints: Ductile-iron fitting with combination of flanged and mechanical-joint ends complying with AWWA C110 or AWWA C153. Include gasketed ball-joint section and ductile-iron gland, rubber gasket, and steel bolts.

1. Manufacturers

- a. EBAA Iron Sales, Inc.
- E. Expansion Joints: Two or three-piece, ductile-iron assembly consisting of telescoping sleeve(s) with gaskets and restrained-type, ductile-iron, bell-and-spigot end sections complying with AWWA C110 or AWWA C153. Select and assemble components for expansion indicated. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.
  - 1. Manufacturers
    - a. EBAA Iron Sales, Inc.
    - b. Romac Industries, Inc.
    - c. Star Pipe Products; Star Fittings Div.
  - F. Wall-Penetration Fittings: Compound, ductile-iron coupling fitting with sleeve and flexing sections for up to 20-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.
    - 1. Manufacturers
      - a. SIGMA Corp.

## **2.5 ENCASEMENT FOR UNDERGROUND METAL PIPING**

- A. Description: ASTM A 674 or AWWA C105, high-density, cross laminated PE film of 0.004-inch minimum thickness.
- B. Form: tube.
- C. Color: Black.

## **PART 3 - EXECUTION**

### **3.1 EXCAVATION**

- A. Refer to Section 31 20 00 – Earth Moving for excavating, trenching, and backfilling.

### **3.2 PIPING APPLICATIONS**

- A. Flanges and unions may be used on aboveground pressure piping, unless otherwise indicated.
- B. Aboveground, soil, waste and vent piping shall be any of the following:
  - 1. Hubless cast-iron soil pipe and fittings; heavy-duty shielded, stainless-steel couplings; and hubless-coupling joints.
  - 2. Steel pipe, drainage fittings, and threaded joints.
  - 3. Copper DWV tube, copper drainage fittings, and soldered joints.

4. Dissimilar Pipe-Material Couplings: Shielded, non pressure pipe couplings for joining dissimilar pipe materials with small difference in OD.
- C. Underground, soil, waste, and vent piping shall be any of the following:
1. Service class, cast-iron soil piping; gaskets; and gasketed joints.
  2. Solid wall ABS pipe, ABS socket fittings, and solvent-cemented joints.
  3. Dissimilar Pipe-Material Couplings: Shielded, non pressure pipe couplings for joining dissimilar pipe materials with small difference in OD.
  4. Hubless plain-end cast iron piping to a point five feet beyond the exterior face of the building.
- D. Aboveground sanitary-sewage force mains shall be any of the following:
1. Hard copper tube, Type L; copper pressure fittings; and soldered joints.
  2. Steel pipe, pressure fittings, and threaded joints.
- E. Underground sanitary-sewage force mains shall be any of the following:
1. Hard copper tube, Type L; wrought-copper pressure fittings; and soldered joints.
  2. Steel pipe, pressure fittings, and threaded joints.
  3. Pressure pipe couplings, if dissimilar pipe materials or piping with small difference in OD must be joined.

### **3.3 PIPING INSTALLATION**

- A. Sanitary sewer piping outside the building is specified in Section 22 13 13 – Facility Sanitary Sewers.
- B. Basic piping installation requirements are specified in Section 22 05 00 – Common Work Results for Plumbing.
- C. Install seismic restraints on piping. Seismic-restraint devices are specified in Section 22 05 48 – Vibration and Seismic Controls for Plumbing Piping and Equipment.
- D. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.
- E. Install cleanout fitting with closure plug inside the building in sanitary force-main piping.
- F. Cleanouts shall be two-way except at dead-end lines.
- G. Install underground, steel, force-main piping. Install encasement on piping according to ASTM A 674 or AWWA C105.
  1. Install encasement on piping according to ASTM A 674 or AWWA C105.
- H. Install underground, copper, force-main tubing according to CDA's "Copper Tube Handbook."
  1. Install encasement on piping according to ASTM A 674 or AWWA C105.

- I. Install underground, ductile-iron, special pipe fittings according to AWWA C600.
  - 1. Install encasement on piping according to ASTM A 674 or AWWA C105.
- J. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Section 22 05 00 – Common Work Results for Plumbing.
- K. Install wall-penetration fitting at each service pipe penetration through foundation wall. Make installation watertight.
- 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.
- M. 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 2 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.
- N. 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.
- O. 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 unless otherwise indicated on drawings.
  - 2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow unless otherwise indicated on drawings.
  - 3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.
- P. Install engineered soil and waste drainage and vent piping systems as follows:
  - 1. Combination Waste and Vent: Comply with standards of authorities having jurisdiction.
- Q. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.
- R. Install ABS soil and waste drainage and vent piping according to ASTM D 2661.
- S. Install underground ABS soil and waste drainage piping according to ASTM D 2321.

- T. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

### **3.4 JOINT CONSTRUCTION**

- A. Basic piping joint construction requirements are specified in Section 22 05 00 – Common Work Results for Plumbing.
- B. 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.
- C. Join hubless cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.
- D. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.

### **3.5 VALVE INSTALLATION**

- A. General valve installation requirements are specified in Section 22 05 23 – General Duty Valves for Plumbing Piping.
- B. Shutoff Valves: Install shutoff valve on each sewage pump discharge.
  - 1. Install full-port ball valve for piping NPS 2 and smaller.
  - 2. Install gate valve for piping NPS 2-1/2 and larger.
- C. Check Valves: Install swing check valve, between pump and shutoff valve, on each sewage pump discharge.

### **3.6 HANGER AND SUPPORT INSTALLATION**

- A. Seismic-restraint devices are specified in Section 22 05 48 – Vibration and Seismic Controls for Plumbing Piping and Equipment.
- B. Pipe hangers and supports are specified in Section 22 05 29 – Hangers and Supports for Plumbing Piping and Equipment. Install the following:
  - 1. Vertical Piping: MSS Type 8 or Type 42, clamps.
  - 2. Install individual, straight, horizontal piping runs according to the following:
    - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
    - b. Longer than 100 Feet: MSS Type 43, adjustable roller hangers.
    - c. Longer than 100 Feet, if Indicated: MSS Type 49, spring cushion rolls.
  - 3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
  - 4. Base of Vertical Piping: MSS Type 52, spring hangers.

- C. Install supports according to Section 22 05 29 – Hangers and Supports for Plumbing Piping and Equipment.
- D. Support vertical piping and tubing at base and at each floor.
- E. Rod diameter may be reduced 1 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. NPS 8 to NPS 12: 60 inches with 7/8-inch rod.
- G. Install supports for vertical cast-iron soil piping every 15 feet.
- H. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
  - 1. NPS 1-1/4: 84 inches with 3/8-inch rod.
  - 2. NPS 1-1/2: 108 inches with 3/8-inch rod.
  - 3. NPS 2: 10 feet with 3/8-inch rod.
  - 4. NPS 2-1/2: 11 feet with 1/2-inch rod.
  - 5. NPS 3: 12 feet with 1/2-inch rod.
  - 6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.
  - 7. NPS 6: 12 feet with 3/4-inch rod.
- I. Install supports for vertical steel piping every 15 feet.
- J. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
  - 1. NPS 1-1/4: 72 inches with 3/8-inch rod.
  - 2. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
  - 3. NPS 2-1/2: 108 inches with 1/2-inch rod.
  - 4. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
  - 5. NPS 6: 10 feet with 5/8-inch rod.
  - 6. NPS 8: 10 feet with 3/4-inch rod.
- K. Install supports for vertical copper tubing every 10 feet.
- L. 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. 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 force-main piping to the following:
  - 1. Sanitary Sewer: To exterior force main or sanitary manhole.
  - 2. Sewage Pumps: To sewage pump discharge.

### **3.8 FIELD QUALITY CONTROL**

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
  - 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
  - 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Re-inspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for re-inspection.
- 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:
1. 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.
  2. 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.
  3. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
  4. Prepare reports for tests and required corrective action.

### **3.9 CLEANING**

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.

### **3.10 PROTECTION**

- A. Exposed ABS Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.

**END OF SECTION 22 13 16**

## SECTION 22 13 19 - SANITARY WASTE PIPING SPECIALTIES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Refer to Section 22 05 00 – Common Work Results for Plumbing.

#### 1.2 SUMMARY

- A. This Section includes the following sanitary drainage piping specialties:
  - 1. Floor drains.
  - 2. Clean Outs.
  - 3. Through-penetration firestop assemblies.
  - 4. Miscellaneous sanitary drainage piping specialties.
  - 5. Flashing materials.
- B. Related Sections include the following:
  - 1. Section 22 14 23 – Storm Drainage Piping Specialties for trench drains for storm water, channel drainage systems for storm water, roof drains, and catch basins.

#### 1.3 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.

#### 1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and accessories for the following:
  - 1. Cleanouts.

2. Floor drains.
  3. Floor Sinks.
  4. Indirect Waste Receptors
  5. Through-penetration firestop assemblies.
  6. Miscellaneous sanitary drainage piping specialties.
  7. Flashing materials.
- B. Shop Drawings: Show fabrication and installation details for frost-resistant vent terminals.
1. Wiring Diagrams: Power, signal, and control wiring.
- C. Field quality-control test reports.
- D. 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 concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- B. Coordinate size and location of roof penetrations.

## **1.7 EXTRA MATERIALS**

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

## **PART 2 - PRODUCTS**

### **2.1 FLOOR DRAINS**

- A. Manufacturers: Subject to compliance with requirements, provide Zurn Industries or equal product by one of the following:
- B. Provide Zurn Plumbing Products or equal product by one of the following:

1. Commercial Enameling Co.
2. Josam Company
3. MIFAB, Inc.
4. Smith, Jay R. Mfg. Co.
5. Tyler Pipe; Wade Div.
6. Watts Drainage Products Inc.

C. Floor Drain: FD-1

1. Make and Model: Zurn Industries Model Z-415-2NH-5S-P
2. Description: Dura Coated Cast Iron body, bottom outlet, combination membrane clamp with adjustable collar and trap primer connection.
3. Strainer type: 5" nickel bronze square secured top.
4. Connection Type: 2" no hub connection.

## 2.2 CLEANOUTS

A. Manufacturers: Subject to compliance with requirements, provide Zurn Plumbing Products or equal product by one of the following:

1. Josam Company
2. MIFAB, Inc.
3. Smith, Jay R. Mfg. Co.
4. Tyler Pipe; Wade Div.
5. Watts Drainage Products Inc.

B. Floor Cleanout: FCO-1

1. Make and Model: Zurn industries Model Z-1400-NH
2. Description: Dura coated Cast Iron body, adjustable top, no hub connection, round top, brass tapered threaded plug.
3. Pipe size connection as indicated on floor plans.

C. Wall Cleanout: WCO-1

1. Make and Model: Zurn industries Model Z-1441-NH
2. Description: Dura coated Cast Iron body, adjustable top, no hub connection, smooth stainless steel cover plate with securing screw and brass tapered threaded plug.
3. Pipe size connection as indicated on floor plans.

## 2.3 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

A. Through-Penetration Fire stop 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 fire stopping 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. 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.
6. Special Coating: Corrosion resistant on interior of fittings.

## **2.4 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES**

### **A. 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.

### **B. Air-Gap Fittings**

1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
2. Body: Bronze or cast iron.
3. Inlet: Opening in top of body.
4. Outlet: Larger than inlet.
5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

### **C. Sleeve Flashing Device**

1. Description: Manufactured, cast-iron fitting, with clamping device, that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 1 inch above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
2. Size: As required for close fit to riser or stack piping.

### **D. Stack Flashing Fittings**

1. Description: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
2. Size: Same as connected stack vent or vent stack.

### **E. 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.

### **F. Expansion Joints**

1. Standard: ASME A112.21.2M.
2. Body: Cast iron with bronze sleeve, packing, and gland.
3. End Connections: Matching connected piping.
4. Size: Same as connected soil, waste, or vent piping.

## **2.5 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. Refer to Section 22 05 00 – Common Work Results for Plumbing for piping joining materials, joint construction, and basic installation requirements.
- B. Install backwater valves in building drain piping. For interior installation, provide cleanout deck plate flush with floor and centered over backwater valve cover, and of adequate size to remove valve cover for servicing.

- C. 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.
- 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 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.
    - a. Every floor drain shall be equipped with a ProSet trap guard to prevent the trap from drying out and to prevent sewer gas from entering the occupied space.
  5. Floor drains in mechanical rooms shall have perforated sediment bucket with integral auxiliary drainage rim so designed that grate cannot be set in place until bucket is in position.
  6. Sterilizers and autoclaves shall have a fixed air gap between the equipment and the sewer.
- G. Floor drains and floor sinks are generally cast iron with a polished bronze heel proof grating.
- H. Install trench drains at low points of surface areas to be drained. Set grates of drains flush with finished surface, unless otherwise indicated.
- I. 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.
- J. Install fixture air-admittance valves on fixture drain piping.

- K. Install stack air-admittance valves at top of stack vent and vent stack piping.
- L. Install air-admittance-valve wall boxes recessed in wall.
- M. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.
- N. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.
- O. Install through-penetration fire stop assemblies for stacks at floor penetrations.
- P. Assemble open drain fittings and install with top of hub 36 inches above floor.
- Q. Install floor-drain and floor sink, trap-seal primer fittings on inlet to floor drains and floor sinks that require trap-seal primer connection.
  - 1. Size: Same as floor drain inlet. Refer to floor plans for location.
- 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 frost-resistant vent terminals on each vent pipe passing through roof. Maintain 1-inch clearance between vent pipe and roof substrate.
- V. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.
- W. Install frost-proof vent caps on each vent pipe passing through roof. Maintain 1-inch clearance between vent pipe and roof substrate.

### **3.2 CONNECTIONS**

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.
- C. Ground equipment according to Section 26 05 26 – Grounding and Bonding for Electrical Systems.
- D. Connect wiring according to Section 26 05 19 – Low Voltage Electrical Power Conductors and Cables.



### **3.3 FLASHING INSTALLATION**

- A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:
  - 1. Lead Sheets: Burn joints of lead sheets 6.0-lb/sq. ft., 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 07 62 00 – Sheet Metal Flashing and Trim.
- F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.
- G. Fabricate and install flashing and pans, sumps, and other drainage shapes.

### **3.4 LABELING AND IDENTIFYING**

- A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign next to equipment.
- 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 22 05 53 – Identification for Plumbing Piping and Equipment.

### **3.5 FIELD QUALITY CONTROL**

- A. Perform tests and inspections and prepare test reports.
  - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled equipment and their installation, including piping and electrical connections, and to assist in testing.
- B. Tests and Inspections

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

### **3.6 PROTECTION**

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

### **3.7 DEMONSTRATION**

- A. Engage a factory-authorized service representative to train the Owner's maintenance personnel to adjust, operate, and maintain all installed equipment. Refer to Section 01 79 00 – Demonstration and Training.

**END OF SECTION 22 13 19**

## **SECTION 22 40 00 - PLUMBING FIXTURES**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Refer to Section 22 05 00 – Common Work Results for Plumbing.

#### **1.2 SUMMARY**

- A. This Section includes the following conventional plumbing fixtures and related components:
  - 1. Faucets for lavatories, bathtubs, bathtub / showers, showers and sinks.
  - 2. Flushometers.
  - 3. Toilet seats.
  - 4. Protective shielding guards.
  - 5. Fixture supports.
  - 6. Water closets.
  - 7. Lavatories.
  - 8. Commercial sinks.
  - 9. Shower Faucets
- B. Related Sections include the following:
  - 1. Section 22 11 19 – Domestic Water Piping Specialties for backflow preventers, floor drains, and specialty fixtures not included in this Section.

#### **1.3 DEFINITIONS**

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.

- C. Fitting: Device that controls the flow of water into or out of the plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, shower heads and tub spouts, drains and tailpieces, and traps and waste pipes. Piping and general-duty valves are included where indicated.
- D. FRP: Fiberglass-reinforced plastic.
- E. PMMA: Polymethyl methacrylate (acrylic) plastic.
- F. PVC: Polyvinyl chloride plastic.

#### **1.4 SUBMITTALS**

- A. Product Data: For each type of plumbing fixture indicated. Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports. Indicate materials and finishes, dimensions, construction details, and flow-control rates.
- B. Operation and Maintenance Data: For plumbing fixtures to include in emergency, operation, and maintenance manuals.
- C. Warranty: Special warranty specified in this Section.

#### **1.5 QUALITY ASSURANCE**

- A. Source Limitations
  - 2. Obtain plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer.
  - 3. Exception: If fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; for plumbing fixtures for people with disabilities.
- D. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.
- E. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.
- F. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.

- G. Comply with the following applicable standards and other requirements specified for plumbing fixtures:
4. Porcelain-Enameled, Formed-Steel Fixtures: ASME A112.19.4M.
  5. Vitreous-China Fixtures: ASME A112.19.2M.
  6. Provide fixtures in accordance with the Construction Standards 01 10 02 Accessibility Best Practices for OSU and the 2010 Americans with Disabilities Act Standards for Accessible Design. Where applicable requirements are more stringent, those requirements shall be followed.
- H. Comply with the following applicable standards and other requirements specified for lavatory and sink faucets:
7. Faucets: ASME A112.18.1.
  8. NSF Potable-Water Materials: NSF 61.
  9. Pipe Threads: ASME B1.20.1.
  10. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
  11. Supply Fittings: ASME A112.18.1.
  12. Brass Waste Fittings: ASME A112.18.2.
- I. Comply with the following applicable standards and other requirements specified for miscellaneous components:
13. Sensor-Operation Flushometers: ASSE 1037 and UL 1951.
  14. Flexible Water Connectors: ASME A112.18.6.
  15. Floor Drains: ASME A112.6.3.
  16. Off-Floor Fixture Supports: ASME A112.6.1M.
  17. Pipe Threads: ASME B1.20.1.
  18. Supply and Drain Protective Shielding Guards: ICC A117.1.

## 1.6 WARRANTY

- A. Special Warranties: Manufacturer's standard form in which manufacturer agrees to repair or replace components of whirlpools that fail in materials or workmanship within specified warranty period.
19. Failures include, but are not limited to, the following:
- a. Structural failures of unit shell.
  - b. Faulty operation of controls, blowers, pumps, heaters, and timers.
  - c. Deterioration of metals, metal finishes, and other materials beyond normal use.

20. Warranty Period for Commercial Applications: One year(s) from date of Substantial Completion.
21. Warranty Period for Residential Applications: Five years from date of Substantial Completion.

## **1.7 EXTRA MATERIALS**

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  22. Faucet Washers and O-Rings: Equal to 10 percent of amount of each type and size installed.
  23. Faucet Cartridges and O-Rings: Equal to 5 percent of amount of each type and size installed.
  24. Flushometer Valve, Repair Kits: Equal to 10 percent of amount of each type installed, but no fewer than 12 of each type.
  25. Provide hinged-top wood or metal box, or individual metal boxes, with separate compartments for each type and size of extra materials listed above.

## **PART 2 - PRODUCTS**

### **2.1 FLUSHOMETERS**

- A. Flushometers: Refer to plumbing fixture schedule for fixture type:
  1. Manufacturers: Subject to compliance with requirements, provide product by one of the following:
    - a. Moen Commercial – No substitutions.
  2. Description: Flushometer for water-closet-type fixture. Include brass body with corrosion-resistant internal components, non-hold-open feature, control stop with check valve, vacuum breaker, copper or brass tubing, and polished chrome-plated finish on exposed parts.
    - a. Internal Design: Piston type actuation.
    - b. Style: Exposed.
    - c. Inlet Size: NPS 3/4 for urinals and NPS 1 for water closets.
    - d. Trip Mechanism: Battery-operated sensor actuator.
    - e. Consumption: 1.6 gpf maximum.

## 2.2 TOILET SEATS

### A. Toilet Seats

1. Manufacturers: Subject to compliance with requirements, provide Olsonite Corp. or equal product by one of the following:
  - a. Bemis Manufacturing Company
  - b. Centoco Manufacturing Corp.
  - c. Church Seats
  - d. Eljer
  - e. Kohler Co.
  - f. Beneke Div.
  - g. Sperzel
2. Description: Toilet seat for water-closet-type fixture.
  - a. Material: Molded, solid plastic with antimicrobial agent.
  - b. Configuration: Open front without cover.
  - c. Size: Elongated.
  - d. Hinge Type: SS, self-sustaining.
  - e. Class: Heavy-duty commercial.
  - f. Color: White.

## 2.3 PROTECTIVE SHIELDING GUARDS

### A. Protective Shielding Pipe Covers, Refer to plumbing fixture schedule:

1. Manufacturers: Subject to compliance with requirements, provide TRUBRO Inc or equal product by one of the following:
  - a. Engineered Brass Co.
  - b. Insul-Tect Products Co.; a Subsidiary of MVG Molded Products.
  - c. McGuire Manufacturing Co., Inc.
  - d. Plumberex Specialty Products Inc.
  - e. Zurn Plumbing Products Group; Tubular Brass Plumbing Products Operation.

2. Description: Manufactured plastic wraps for covering plumbing fixture hot-water supply and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

## **2.4 FIXTURE SUPPORTS**

- A. Manufacturers: Subject to compliance with requirements, provide Smith, Jay R. Mfg. Co. or equal product by one of the following:
  1. Josam Company.
  2. MIFAB Manufacturing Inc.
  3. Zurn Industries

## **2.5 WATER CLOSETS**

1. Manufacturers: Subject to compliance with requirements, provide American Standard or equal product by one of the following:
  - a. Briggs Plumbing Products, Inc.
  - b. Crane Plumbing, L.L.C./Fiat Products
  - c. Commercial Enameling Company
  - d. Eljer
  - e. Kohler Co.
  - f. TOTO USA, Inc.
2. Water Closet WC-1
  - a. Manufacturer and model number: American Standard AFWall #3351.101
  - b. Description type: Water saving toilet, wall mounted, back outlet, elongated bowl, vitreous-china fixture designed for flush valve operation.
  - c. Color: White
  - d. Design Consumption: 1.6 gallons per flush.
  - e. Supply: NPS 1 1/4 chrome-plated brass with loose-key stop.
  - f. Fixture Support: Water-closet support combination carrier. Provide Zurn Industries 1200 series carrier for horizontal or vertical mounting. Refer to floor plans. Provide bolting to slab for rear anchor lug.



## 2.6 LAVATORIES

### A. Lavatories, Wall Mounted:

1. Manufacturers: Subject to compliance with requirements, provide Sloan or equal product by one of the following:
  - a. Briggs Plumbing Products, Inc.
  - b. American Standard
  - c. Crane Plumbing, L.L.C./Fiat Products
  - d. Commercial Enameling Company
  - e. Eljer
  - f. Kohler Co.
  - g. TOTO USA, Inc.
2. Description: Wall-mounting, vitreous-china fixture.
  - a. Type: With back.
  - b. Size: 20 by 18 inches rectangular.
  - c. Faucet Hole Punching: One hole.
  - d. Faucet Hole Location: Top.
  - e. Color: White.
  - f. Supplies: NPS 3/8 chrome-plated copper with stops.
  - g. Drain: Grid.
  - h. Protective Shielding Guard(s): Yes
  - i. Fixture Support: Wall type

### B. Lavatories, Counter Mounted:

1. Manufacturers: Subject to compliance with requirements, provide Sloan or equal product by one of the following:
  - a. Briggs Plumbing Products, Inc.
  - b. American Standard
  - c. Crane Plumbing, L.L.C./Fiat Products
  - d. Commercial Enameling Company
  - e. Eljer

- f. Kohler Co.
- g. TOTO USA, Inc.
  
- 2. Description: Under counter mounted.
  - a. Type: Under Counter
  - b. Size: 21 by 15 inches rectangular.
  - c. Faucet Hole Punching: One hole (counter).
  - d. Color: White.
  - e. Supplies: NPS 3/8 chrome-plated copper with stops.
  - f. Drain: Grid.
  - g. Fixture Support: Counter attachment.

## 2.7 COMMERCIAL SINKS

- A. Commercial Sinks, Refer to plumbing fixture schedule for fixture type:
  - 1. Manufacturers: Subject to compliance with requirements, provide Just Manufacturing or equal product by one of the following:
    - a. Advance Tabco.
    - b. Elkay Manufacturing Co.
  - 2. Description: One-compartment, counter-mounting, stainless-steel commercial sink with backsplash.
    - a. Overall Dimensions: 19" x 18" x 5.5" deep
    - b. Metal Thickness: 18 gauge.
    - c. Compartment:
      - 1) Dimensions: 16 x 11.5 x 5.4
      - 2) Drain: Grid with NPS 2 tailpiece and twist drain.
    - d. Faucet(s): See drawing schedule.
      - 1) Mounting: Deck.
    - e. Supplies: NPS 1/2 chrome-plated copper with stops or shutoff valves.
    - f. Drain Piping: NPS 2 chrome-plated, cast-brass P-trap; 0.045-inch- thick tubular brass waste to wall; continuous waste; and wall escutcheon(s).

## 2.8 INDIVIDUAL SHOWERS

- A. Individual Showers and enclosures, Refer to architects drawings and specifications.

## 2.9 SHOWER FAUCETS

- A. Shower Faucets, ADA Compliant:

1. Manufacturers: Subject to compliance with requirements, provide American Standard or equal product by one of the following:
  - a. Chicago Faucet
  - b. Central Brass Manufacturing Company.
  - c. Delta Faucet Company.
  - d. Eljer.
  - e. Gerber Plumbing Fixtures LLC.
  - f. Kohler Co.
  - g. Moen, Inc.
  - h. Powers; a Watts Industries Co.
  - i. Symmons Industries, Inc.
2. Description: Single-handle pressure-balance valve. Include hot- and cold-water indicators; check stops; and shower head, arm, and flange. Coordinate faucet inlets with supplies and outlet with diverter valve.
  - a. Body Material: Solid brass.
  - b. Finish: Polished chrome plate.
  - c. Maximum Flow Rate: 1.5 gpm, unless otherwise indicated.
  - d. Diverter Valve: Not required.
  - e. Mounting: Concealed.
  - f. Operation: Compression, manual.
  - g. Antiscald Device: Integral with mixing valve.
  - h. Check Stops: Check-valve type, integral with or attached to body; on hot- and cold-water supply connections.
  - i. Supply Connections: NPS 1/2.
  - j. Shower Head Type: Ball joint.

- k. Shower Head Material: Metallic with chrome-plated finish. Mounted on adjustable height bar with flexible hose.
- l. Spray Pattern: Fixed.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before plumbing fixture installation.
- B. Examine cabinets, counters, floors, and walls for suitable conditions where fixtures will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 INSTALLATION**

- A. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.
- B. Install off-floor supports, affixed to building substrate, for wall-mounting fixtures.
  - 1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
  - 2. Use carrier supports without waste fitting for fixtures with tubular waste piping.
  - 3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.
- C. Install back-outlet, wall-mounting fixtures onto waste fitting seals and attach to supports.
- D. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.
- B. Install wall-mounting fixtures with tubular waste piping attached to supports.
- E. Install counter-mounting fixtures in and attached to casework.
- F. Install fixtures level and plumb according to roughing-in drawings.
- G. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.

1. Exception: Use ball, gate, or globe valves if supply stops are not specified with fixture. Valves are specified in Section 22 05 23 – General Duty Valves for Plumbing Piping.
- H. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.
- I. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.
- J. Install toilet seats on water closets.
- K. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
- L. Install water-supply flow-control fittings with specified flow rates in fixture supplies at stop valves.
- M. 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.
- N. Install shower flow-control fittings with specified maximum flow rates in shower arms.
- O. Install traps on fixture outlets.
  1. Exception: Omit trap on fixtures with integral traps.
  2. Exception: Omit trap on indirect wastes, unless otherwise indicated.
- P. Install escutcheons at piping wall ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Escutcheons are specified in Section 22 05 00 – Common Work Results for Plumbing.
- Q. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color.

### **3.3 CONNECTIONS**

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- C. Connect wiring according to Section 26 05 19 – Low Voltage Electrical Power Conductors and Cables.

### **3.4 FIELD QUALITY CONTROL**

- A. Verify that installed plumbing fixtures are categories and types specified for locations where installed.
- B. Check that plumbing fixtures are complete with trim, faucets, fittings, and other specified components.
- C. Inspect installed plumbing fixtures for damage. Replace damaged fixtures and components.
- D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.
- E. Install fresh batteries in sensor-operated mechanisms.

### **3.5 ADJUSTING**

- A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.
- B. Adjust water pressure at faucets and flushometer valves to produce proper flow and stream.
- C. Replace washers and seals of leaking and dripping faucets and stops.

### **3.6 CLEANING**

- A. Clean fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Do the following:
  - 1. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts.
  - 2. Remove sediment and debris from drains.
- B. After completing installation of exposed, factory-finished fixtures, faucets, and fittings, inspect exposed finishes and repair damaged finishes.

### **3.7 PROTECTION**

- A. Provide protective covering for installed fixtures and fittings.
- B. Do not allow use of plumbing fixtures prior to substantial completion unless approved in writing by Owner.

## **SECTION 23 00 00 - GENERAL HVAC REQUIREMENTS**

### **PART 1 GENERAL**

#### **1.1 SCOPE OF WORK**

- A. It is intended for the Division 23 scope of work to include complete and functional mechanical systems - including all required materials, labor, equipment, and services necessary to achieve the desired final product. It is further intended for the Division 23 scope of work to include coordination with Divisions 21 and 22 and all work required by Division 23 for complete Fire Protection and Plumbing systems.

#### **1.2 REVISION TO DIVISION NUMBERING**

- A. These documents have been revised to reflect new numbering standards. All Mechanical documents were previously contained within Division 15. These documents have now been divided into Fire Protection, Plumbing and HVAC and renumbered as Divisions 21, 22 and 23, respectively.

#### **1.3 COORDINATION OF DIVISIONS 21, 22 AND 23.**

- A. Divisions 21, 22 and 23 are used to communicate the requirements for the total Mechanical scope of work. It is intended for these three Divisions to serve as a single document, communicating the Mechanical scope of work.

#### **1.4 REFERENCES**

- A. Division 00 and Division 01 of these specifications shall govern Division 23 work, including Bidding Requirements, Conditions of the Contract, and Supplementary Conditions. It is the Division 23 Contractor's responsibility to be aware of all information and requirements included in these locations, and to include those requirements as part of the Division 23 scope of work.
- B. It shall be understood by the Division 23 Contractor that the Division 23 scope of work is intended to involve a coordinated effort with all other Divisions of work. Refer to other sections of the documents for additional related requirements and to ensure a coordinated effort.
- C. References to industry standards, testing procedures, etc. are noted in individual sections of these specifications. The requirements and standards from the referenced documents shall be considered part of the requirements of these specifications.
- D. This section applies to all Division 23 work. The Division 23 Contractor shall ensure that all Division 23 work described throughout other specification sections and on the drawings is in accordance with this section.

- E. It shall be understood by the Contractor that the Division 21, 22 and 23 information is intended to serve as a single document, and each section of these specifications directly or indirectly relates to all other sections. As such, each section does not attempt to identify every other Division 21, 22 and/or 23 section that is related. Significant references to information outside of Division 21, 22 and 23 are, however, occasionally provided for informational purposes. This information is provided to assist in coordination, but the lack of a reference to another portion of the Contract Documents does not relieve the Contractor of the responsibility for coordination with other sections of Divisions 21, 22 and 23 and all other trades.

## 1.5 DEFINITIONS

- A. The following definitions shall apply to the use of these words when used in Division 23. These definitions are not intended to define use of these words outside of Division 23.
- B. Acceptance: The Owner's assumption of ownership of the mechanical system.
- C. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.
- E. Contractor (The Contractor, This Contractor, Division 23 Contractor, etc.): The contractor responsible for the Division 23 scope of work.
- F. Date of Acceptance: The official date when Acceptance occurs. This will coincide with the granting of Substantial Completion unless noted otherwise by the Owner's Representative. It shall not be assumed that the Date of Acceptance has deviated from Substantial Completion unless written documentation is provided by the Owner's Representative indicating differently.
- G. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- H. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- I. 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, crawlspace, and tunnels.
- J. Mechanical: Shall be considered interchangeable with "Division 23".
- K. Owner's Representative: The Architect or his designated representative, as outlined in the General Conditions.
- L. Provide: Furnish and install.



## 1.6 ABBREVIATIONS

- A. The following are industry abbreviations used in these specifications: ABS: Acrylonitrile-butadiene-styrene plastic; ASJ: All-service jacket; BR: Butyl rubber; Buna-N: Nitrile rubber; CPVC: Chlorinated polyvinyl chloride plastic; CR: Chlorosulfonated polyethylene synthetic rubber; CSM: Chlorosulfonyl-polyethylene rubber; CWP: Cold working pressure; DDC: Direct digital control; DOP: Dioctyl phthalate or bis-(2-ethylhexyl) phthalate; EMCS: Energy Management and Control System; EPDM: Ethylene-propylene-diene terpolymer rubber; FOG: Fats, oils, and greases; FRP: Fiberglass-reinforced plastic; FSK: Foil, scrim, kraft paper; FSP: Foil, scrim, polyethylene; HDPE: High-density polyethylene plastic; HEPA: High-efficiency particulate air; I/O: Input/output; LLDPE: Linear, low-density polyethylene plastic; MS/TP: Master slave/token passing; MSS: Manufacturers Standardization Society for The Valve and Fittings Industry Inc; NBR: Acrylonitrile-butadiene rubber; NC: Noise criteria; NR: Natural rubber; NUSIG: National Uniform Seismic Installation Guidelines; PE: Polyethylene plastic; PEX: Crosslinked polyethylene plastic; PC: Personal computer; PID: Proportional plus integral plus derivative; PMMA: Polymethyl methacrylate (acrylic) plastic; PP: Polypropylene plastic; PTFE: Polytetrafluoroethylene plastic; PUR: Polyurethane plastic; PVC: Polyvinyl chloride plastic; PVDC: Polyvinylidene chloride; RC: Room criteria; RTD: Resistance temperature detector; SSL: Self-sealing lap; SWP: Steam working pressure; TFE: Tetrafluoroethylene plastic; TPE: Thermoplastic elastomer; ULPA: Ultra low penetration air.

## 1.7 APPLICABLE CODES

- A. Division 23 work shall be performed in accordance with applicable codes and standards as adopted by the authorities having jurisdiction including amendments. Following is a listing of major codes and standards, the requirements of which shall be considered part of the scope of this project. This list should not be considered comprehensive, and codes or standards not included in this list should not be considered to be excluded from the scope of the project.
1. Americans with Disabilities Act (ADA)
  2. Applicable State and Local Codes and Ordinances
  3. National Electrical Code
  4. International Building Code
  5. International Fire Code
  6. International Mechanical Code
  7. Uniform Plumbing Code

## **1.8 PERMITS AND FEES**

- A. All permits and inspections required to complete the Division 23 scope of work shall be included in the Division 23 bid price. All certifications provided as part of the permit and inspection process shall be provided to the Owner as part of the Division 23 scope of work as specified in these documents.
- B. All fees required by utility providers shall be included in the Division 23 bid price, including water, gas, sanitary sewer, and storm sewer connections. This shall include all charges to the project by these agencies, including but not limited to general fees, equipment charges (meters, vaults, etc.), tap fees, and utility main installation charges.

## **1.9 ALTERNATES (REFER TO DIVISION 01)**

- A. The bid price for the scope of work shall be separated into base bid and alternate values when indicated. Both base bid and alternate bid prices shall reflect a complete and working mechanical system, with specific features and/or portions of the systems designated as base bid or alternate as described.

## **1.10 SCOPE AND APPROPRIATE USE OF BID DOCUMENTS**

- A. These specifications and accompanying drawings are intended to communicate the design concept for this project and outline the scope of work. They should not be viewed as a comprehensive document that details every specific task, item, or piece of equipment required to complete the project. It is understood that industry knowledge and experience is required to establish an accurate and complete scope of work from these documents, and it is assumed that the Division 23 Contractor possesses that knowledge and experience. Work not specifically noted in these specifications or the accompanying drawings, but which is required to complete the project, shall be included by the Division 23 Contractor as part of his scope of work.
- B. These specifications and the accompanying drawings are intended to supplement each other. Information included in either one shall be incorporated into the project as if included in both. In the event of any conflicts, the most stringent requirements shall be considered the governing scope of work until and unless clarification can be obtained by the Contractor.
- C. In the event of dimensional discrepancies between Division 23 documents and other disciplines, Architectural and Structural documents take precedence over Division 23. Refer to this information for sufficient understanding to the extent that it impacts the Division 23 scope of work.

- D. Drawings are intended to indicate the general arrangement of piping, ductwork, equipment and other components of Division 23 systems. They shall be followed as closely as possible, but shall be considered diagrammatic in nature. They are not intended to show every component, fitting, offset, etc. Components, fittings, offsets, etc. as required to meet the intent of the documents and to achieve coordination with other trades shall be included in the Division 23 scope of work. Note that more detailed information about routing may be provided for certain areas of the project where special constraints exist. It is the intent of this detailed information to better communicate the constraints, but these drawings and details shall still be considered diagrammatic in nature as outlined above.

### **1.11 ROUTING AND LOCATIONS**

- A. It is the Contractor's responsibility to coordinate equipment locations and system routing with available space and with all other trades.
- B. It is the Contractor's responsibility to coordinate and verify the exact locations and routing of equipment and systems prior to fabrication and installation. If discrepancies become apparent as part of the verification process, the Contractor shall ask for written clarification/direction. Alteration, removal and/or replacement of work already installed as a result of failure to verify and/or coordinate locations and routing prior to fabrication and/or installation shall be at the Contractor's expense.
- C. Locations of equipment shown on the drawings are approximate unless specifically dimensioned.
- D. All ductwork, piping, tubing, conduit, etc. shall be concealed within building construction unless noted otherwise. Mechanical rooms are considered to be within building construction for the purposes of this requirement.
- E. Existing utilities, piping, and ductwork have been indicated as closely as possible. The Contractor can assume that points of connection to existing utilities have been shown within 10 feet (3 meters) of the actual location. When actual points of connection are more than 10 feet (3 meters) from the location shown on the drawings, the Contractor shall notify the Owner's Representative prior to commencing this portion of the work.
- F. The Contractor is responsible for any remedial work required from failure to locate and preserve underground utilities. This shall include all work necessary to repair any damaged utilities to their original condition.

### **1.12 SCHEDULING**

- A. It is understood that while drawings are to be followed as closely as circumstances permit, the Contractor shall be responsible for installation of systems according to the true intent and meaning of Contract Documents. Anything not clear or in conflict will be explained by making application to Owner's Representative. The Contractor shall familiarize himself with his scope of work as well as the required coordination with other trades and the scheduling of other trades sufficiently to address coordination issues in a timely manner such that they do not result in remedial work for other trades.

- B. Should conditions arise where certain changes would be advisable, secure approval from Owner's Representative for those changes before proceeding with work. Proceeding without written approval is at the Contractor's risk and at the Contractor's expense.
- C. The contractor shall coordinate with the work of various trades when installing interrelated work. Before installation of mechanical items, proper provisions shall be made to avoid interferences. Changes required in work specified in Division 23 caused by neglect to do so shall be made at no cost to Owner.
- D. Inserts and supports required by Division 23 shall be furnished and installed unless otherwise noted. Furnish sleeves, inserts, supports, and equipment that are an integral part of other Divisions of the Work to those involved in sufficient time to be built into construction as the Work proceeds. Locate these items and see that they are properly installed. Expense resulting from improper location or installation of items above shall be borne under Division 23.

### **1.13 CUTTING AND PATCHING**

- A. The Division 23 Contractor shall be responsible for all cutting and patching required to complete the Division 23 scope of work.
- B. All patching shall be performed such that it matches existing finishes.
- C. The Contractor shall not cut any structural members without first getting approval from the Owner's Representative to do so.
- D. All cutting and patching required to correct defective or otherwise unacceptable work shall be the responsibility of the Division 23 Contractor.

### **1.14 GUARANTEE (REFER TO DIVISION 01)**

- A. All Division 23 systems and equipment shall be guaranteed for a minimum period of one year.
- B. Specific equipment and/or systems requiring warranties beyond one year are indicated in the table at the end of this section.
- C. The guarantee shall begin at the Date of Acceptance, unless written documentation is provided noting otherwise. When more than one Date of Acceptance is indicated for various portions or specific equipment, the guarantee shall begin at the Date of Acceptance independently for each portion of the system or piece of equipment.
- D. Permission to use Division 23 systems or equipment for temporary heating or other contractor use prior to the Date of Acceptance, as outlined elsewhere in these specifications, shall not constitute the beginning of the guarantee period. The contractor shall make any necessary arrangements to extend equipment and/or system warranties sufficient to maintain the designated guarantee period from the Date of Acceptance.

1. Exception: When temporary heating and or other system use is requested by the Owner for the Owner's benefit prior to the Date of Acceptance, the guarantee period for the portions of the system or specific equipment requested for use may begin at the time it is put into service. This can only be assumed to have occurred if written documentation is provided indicating such.

## **1.15 QUALITY ASSURANCE**

### **A. Material and Equipment Qualifications**

1. Provide materials and equipment that are standard products of manufacturers regularly engaged in the manufacture of such products, which are of a similar material, design and workmanship. Standard products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year use shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been for sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2 year period.
2. Alternative Qualifications: Products having less than a two-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturer's factory or laboratory tests, can be shown.

**B. Service Support:** The equipment items shall be supported by service organizations. When requested to gain approval, submit a certified list of qualified permanent service organizations for support of the equipment which includes their addresses and qualifications. These service organizations shall be reasonably convenient to the equipment installation and able to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

**C. Manufacturer's Nameplate:** Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

**D. UL Listings:** All equipment shall be provided with a UL or approved equivalent label when labeling is available for that type of equipment.

**E. Fuel-fired equipment** shall be labeled by the appropriate nationally recognized label for the fuel type (i.e. AGA).

**F. All control panels** shall be UL listed (or equivalent approved label).

**G. Pressure vessels** shall be provided in accordance with applicable pressure vessel ordinances.

**H. All mechanical equipment** shall have an AIC rating of 100,000 or otherwise specified on electrical one-line diagrams fault current for each piece of equipment.

### **1.16 SUBSTITUTIONS (REFER TO DIVISION 01)**

- A. When multiple manufacturers are listed in these specifications, equipment can be used from those manufacturers providing they can meet the requirements of the specifications and drawings. This shall include meeting capacity requirements, efficiencies, space and weight limitations, electrical provisions, etc. The detailed information in the specifications, scheduled equipment information, additional drawing information and any specific references to a particular manufacturer and/or model of equipment shall be considered the basis of design. Other listed manufacturers, even when listed in these specifications, will only be allowed if they meet or exceed that basis of design.
- B. Substitutions involving manufacturers not listed in these specifications will not be allowed without written approval. When written approval is requested, information will be reviewed in preliminary fashion for general conformance only. Any approved manufacturers will still be required to meet the requirements of these specifications and the drawings, and final approval during submittal review will only be granted if the equipment meets or exceeds the requirements of the documents.
- C. It is the Contractor's responsibility when utilizing approved substituted equipment to ensure the equipment will fit within the constraints of the project as detailed using the basis of design equipment (space, weight, power, etc.). Any required alterations by Division 23 or any other Division of work to accommodate differences between the substituted equipment and the basis of design equipment shall be the responsibility of the Division 23 Contractor, including the cost of design for the required changes.
- D. If the changes required by substituted equipment cannot be accommodated, the Contractor shall be responsible for replacing the substituted equipment with the basis of design equipment.
- E. Proposed substituted equipment will not be considered equal if it requires an increase of more than 5% in power usage at design conditions.

### **1.17 MECHANICAL COST BREAKDOWN (REFER TO DIVISION 01)**

- A. Provide a breakdown of construction costs within 30 days of Notice to Proceed, with separate costs for each of the items listed in the table at the end of this section.

### **1.18 PAYMENT REQUESTS**

- A. Submittals and operation and maintenance data must be received and approved before payment requests will be considered for materials and equipment.
- B. EMCS submittals must be received before payment requests will be reviewed for this portion of the work. Only payment requests for programming and submittals will be reviewed until submittals are approved.
- C. Fire sprinkler system submittals, including code-approved shop drawings, must be received before payment requests will be reviewed for this portion of the work. Only payment requests for design and submittals will be reviewed until submittals are approved.

### **1.19 TEMPORARY HEATING (REFER TO DIVISION 01)**

- A. Temporary heating shall not be provided by the permanent mechanical system.
  - 1. Exception: The Owner's Representative may choose to allow the Contractor to use the permanent mechanical system. In such cases, the Contractor shall obtain written authorization from the Owner's Representative. In no case shall the permanent system be used until and unless this written authorization is granted.
- B. If allowed to use the permanent systems for temporary heating, the following constraints shall apply:
  - 1. The contractor shall be responsible for providing a clean system at substantial completion, to include pressure cleaning of coils and vacuum cleaning of ductwork if required to negate the effects of use during construction.
  - 2. Granting the use of equipment and systems for temporary heat will not constitute Acceptance of equipment, and will not start the warranty or guarantee period for the Owner.
  - 3. System guarantee and equipment warranties shall be extended to maintain the guarantee and warranty periods from the Date of Acceptance. Any costs associated with extension of warranties shall be at the Contractor's expense.
  - 4. Filters shall be installed meeting the requirements of these documents. When multiple stages of filtration are provided on a system, filters meeting the requirements of the first stage of filtration shall be provided and maintained during use. A minimum of MERV 13 filtration filters shall be used during this time, even if this requirement is more stringent than the requirements for permanent filtration. New filters shall be provided prior to system balancing.
  - 5. Filter fabric shall be provided at all return grilles, and shall be replaced as appropriate to maintain a clean system.

### **1.20 SUBMITTALS (REFER TO DIVISION 01)**

- A. Submittal information shall be provided and approved on all materials and equipment prior to ordering.
- B. Provide indication of which options and accessories are to be included.
- C. Include all scheduled information for equipment listed in schedules on the drawings.
- D. Review will be for general conformance only, and shall not relieve the Contractor for any deviations from the requirements of the documents unless clear written reference is made by the Contractor in the submittal to proposed deviations.
- E. All Division 23 information shall be provided in one complete submittal, indexed by specification section.

1. Exceptions: Fire protection and EMCS submittals can be provided separately. At the discretion of the Owner's Representative, partial submittals may be provided. If allowed, provide a table indicating submittal status with each submittal, and provide an initial submittal with all required tabs and space for all current and future submittals.
- F. Provide operation and maintenance data for individual equipment after initial submittals have been reviewed.
- G. Efficiency Standards
1. Units requiring more than a 5% increase in power input beyond the scheduled equipment to meet design capacities will not be considered equal.
  2. Units requiring more than a 15% increase in fan brake horsepower over the scheduled equipment to meet the design flow and external static pressure requirements will not be considered equal and will not be accepted.

### **1.21 DELIVERY, STORAGE, AND HANDLING**

- A. Follow manufacturer's directions in delivery, storage, protection, and installation of equipment and materials.
- B. Promptly notify Owner's Representative in writing of conflicts between requirements of Contract Documents and Manufacturer's directions and obtain written instructions from Owner's Representative before proceeding with work. The Contractor shall bear expenses arising from correcting deficiencies of work that do not comply with manufacturer's directions or such written instructions from Owner's Representative.
- C. Handle, store, and protect equipment and materials to prevent damage before and during installation in accordance with the manufacturer's recommendations, and as approved by the Contracting Officer. Replace damaged or defective items.
- D. Store ductwork in a clean, dry location. If the location of storage cannot be protected from moisture, keep ductwork above grade level to protect from standing water.

### **1.22 OPERATION AND MAINTENANCE MANUALS**

- A. Operation and Maintenance Manuals shall be provided in three post binders capable of having materials added or removed. Standard clasp-type binders are not acceptable. Binders with overlapping, telescoping posts shall be used.
- B. Provide a title page at the beginning of the manual with the project title, date, Architect, Engineer, and Contractor. Also provide a master index. The title page and index shall be provided at the beginning of each volume when multiple volumes are required.
- C. Organize the manual into five divisions: Contacts, Equipment, Maintenance Schedule and Extra Materials, Energy Management and Controls System, Warranties and Certifications.



1. Contacts division: Division shall consist of name, address, and phone number of the following parties: Architect, Mechanical Engineer, Electrical Engineer, General Contractor, Mechanical Contractor, Plumbing Contractor, Sheet Metal Contractor, EMCS Contractor, Electrical Contractor and major equipment suppliers.
  2. Equipment division: Provide a separate section for each section of the specifications. Each section shall include, at a minimum, the following for each item of Division 23 equipment.
    - a. Performance curves or tables showing the specified operating points and the operating points after final testing and balancing
    - b. Manufacturer's maintenance instructions: Instructions shall include name of vendor, installation instructions, parts numbers and lists, operating instructions for equipment, maintenance and lubrication instructions, troubleshooting guides, and overhaul specifications for major equipment.
    - c. Wiring diagrams
    - d. Step-by-step procedures for putting each piece of mechanical equipment into operation
    - e. Refer to individual specification sections for additional information required to be incorporated into the Operation and Maintenance Manual.
  3. Maintenance Summary and Extra Materials division: Division shall include two sections.
    - a. The first section shall consist of a preventative maintenance schedule summary table (or list). The table shall be organized by specification section and include equipment name and designation as it appears on the equipment schedule, equipment location, and type and frequency of preventative maintenance requirements (including lubrication).
    - b. The second section shall consist of a list of extra materials furnished under this contract. The list shall be organized by specification section and include equipment name and designation as it appears on the equipment schedule, extra material(s) furnished, and verification by an owner's representative that material(s) have been provided. List shall be similar to that included at the end of this section.
  4. Energy Management and Controls System division: Division shall be as specified in 230900.
  5. Warranties and Certificates division: Division shall include
    - a. Test and balance reports
    - b. Test records of piping, tanks, ductwork, etc
    - c. Signed checklist of Instruction Period
    - d. Certificate from Health Department indicating acceptance of domestic water quality
    - e. Copies of specific product Warranties
    - f. Copies of certified factory start-up reports
    - g. Valve tag identification schedules
    - h. Fire sprinkler system certification
- D. Prior to binding, submit one copy of Operation and Maintenance Manual to Owner's Representative for review. After this review and final approval of the manuals, prepare two (2) copies of approved manuals for use during the instruction period. Following instruction period, turn over both copies to the Owner.
- E. Manuals may be compiled in multiple volumes if necessary for ease of use.

## 1.23 OPERATION AND MAINTENANCE TRAINING

### A. General

1. Provide two training sessions for the Owner. The first training session shall occur prior to substantial completion. The second training session shall occur prior to completion of the warranty period. The content below is required for the first training session. The content for the second training session shall be as requested by the Owner, up to an including all information included in the first training session.
2. Operation and maintenance of mechanical systems utilizing Operation and Maintenance Manual. During the training session, each piece of equipment shall be located, and all information included in the O&M manuals shall be demonstrated to the satisfaction of the Owner's Representative.
3. Individuals present shall include the mechanical contractors, subcontractors and equipment factory representatives as appropriate. Certified factory representatives shall be present for all equipment requiring certified factory start-up.
4. Provide a video tape of the training sessions conducted and furnish copies of the tape to the Owner. Video tapes shall be of sufficient quality to allow training of future employees or refresher training of personnel. Turn over to the Owner in DVD format.
5. The two training sessions shall each occur in one consolidated session for all mechanical equipment.
  - a. Exceptions:
    - 1) Training for equipment requiring certified factory start-up shall be conducted at the time of start-up.
    - 2) Multiple sessions shall be scheduled as required to maintain a maximum allowable duration of any single session of four hours.
    - 3) When separate training sessions are warranted to achieve proper training on all equipment and systems, as determined by the owner's representative, multiple sessions shall be scheduled as required.
    - 4) EMCS system training shall occur independently, and shall be in accordance with the requirements of Section 230900.
    - 5) Training session shall include all equipment included in the table at the end of this section. A table similar to this one shall be used to verify owner training has been completed on all equipment, and shall be included in the Operation and Maintenance Manual.
6. Extra Materials
  - a. A list of extra materials to be provided under this contract has been included at the end of this section. Refer to individual specification sections for specific requirements of extra materials to be furnished under this contract.
  - b. Turn extra materials over to Owner.
    - 1) Provide summarized list of extra materials that have been furnished. List shall include verification by Owner's Representative that parts have been furnished. Incorporate into O&M Manual. Extra materials list shall be similar to that provided at the end of this section.

7. Cleaning
    - a. Leave all equipment and systems in a clean and new condition at the completion of the project. Clean all piping and ductwork exposed in finished spaces. Remove all stickers from equipment in finished spaces (plumbing fixtures, etc.). Repair all scratched and damaged equipment to new condition, to include touch-up painting.
  8. Record Drawings
    - a. Maintain a set of Contract Documents dedicated for record drawings. These documents shall incorporate all clarifications and changes provided by the Owner's Representative, as well as field changes made by the Contractor. All markings shall be neat and legible. Turn over documents to the Owner's Representative at the completion of the project.
  9. Punch Lists
    - a. Notify the Owner's Representative in writing when the project is ready for punch lists.
    - b. When all punch list items have been addressed, notify the Owner's Representative in writing that the project is ready for a backcheck of completed punch list items. Include a copy of the original punch list with each completed item initialed and any required notation indicating if something was not completed and why.
    - c. If, at the time of the backcheck, items are found that continue to be in nonconformance with the project documents, these items will be forwarded to the Contractor. Completion of these items shall be required to achieve substantial completion. All site visits required beyond the initial punch list and initial back check visits, including visits required to verify completion of these remaining outstanding items, shall be charged to the Contractor at normal billing rates.
  10. Visiting the Project Site
    - a. The premises shall be examined and conditions shall be understood which may affect performance of work of this Division before submitting proposals for this work.
    - b. No subsequent allowance for time or money will be considered for any consequence related to failure to examine existing site conditions.
- B. Products (Not Used)
- C. Execution (Not Used)
- D. Tables

1. Cost Breakdown Table

<b>Cost Breakdown Table</b>		
<b>Category</b>	<b>Material Cost</b>	<b>Labor / Installation Cost</b>
Mobilization		
Supervision		
Site Utilities		
HVAC Piping Insulation		
Duct External Insulation		
Air and Water Balance		
EMCS Programming and Submittals		
EMCS Installation		
Hydronic Piping Systems		
Hydronic Pumps		
Steam and Condensate Piping Systems		
Steam Condensate Pumps		
Refrigerant Piping Systems		
HVAC Water Treatment		
Ductwork Fabrication		
Ductwork Installation		
Power Ventilators		
Air Terminal Units		
Grilles, Registers, and Diffusers		
Intake and Relief Ventilators		
Breechings, Chimneys, and Stacks		
Boilers		
Heat Exchangers		
Condensing Units		
Water Chillers		
Cooling Towers		
Air Handling Units		
Terminal Heat Transfer Units		
Fan Coil Units		
Commissioning Assistance		

2. Submittal Table

<b>Submittal Table</b>				
	<b>Submittal Data Included</b>	<b>Submittal Previously Approved</b>	<b>O&amp;M Data Included</b>	<b>O&amp;M Previously Approved</b>
<b>230500 – Basic HVAC Materials and Methods</b>				
Access Doors				
Dielectric Fittings				
Escutcheons				
Mechanical Sleeve Seals				
Welding Certificates				
<b>230529 – HVAC Hangers and Supports</b>				
Fastener Systems				
Metal Framing Systems				
Welding Certificates				
<b>230553 – Mechanical Identification</b>				
Access Panel and Door Markers				
Ceiling Tacks				
Nameplates				
Pipe Markers				
Tags				
Valve Schedules - A preliminary chart shall be submitted at submittal time, and shall be updated as part of the as-built documentation process.				
List of all equipment/items to receive nameplates indicating designation to be printed on nameplate.				
<b>230593 – HVAC Testing, Adjusting, and Balancing</b>				
Firm Qualifications and Certifications				
Construction Documents Examination Report				
Strategies and Procedures Plan				
Sample Report Forms				
Certified TAB Report				
<b>230700 – HVAC Insulation</b>				
Pipe Insulation – Cellular Foam				
Pipe Insulation – Glass Fiber				
Pipe Insulation – Cellular Glass				
Pipe Jacketing				
Duct Insulation - Glass Fiber, Flexible Blanket (Duct Wrap)				
Duct Insulation - Glass Fiber, Flexible (Duct Liner)				
Duct Insulation - Glass Fiber, Rigid				
Equipment Insulation – Glass Fiber				
Schedule Including Piping Systems,				

<b>Submittal Table</b>				
	<b>Submittal Data Included</b>	<b>Submittal Previously Approved</b>	<b>O&amp;M Data Included</b>	<b>O&amp;M Previously Approved</b>
Insulation Type, Insulation Thickness Relative To Pipe Size				
Schedule Including Equipment, Insulation Type, Insulation Thickness				
Schedule Including Duct Systems, Insulation Type, Insulation Thickness				
<b>233100- Ductwork</b>				
Table indicating sheet metal materials to be used for each system type.				
Low Velocity Ductwork and Fittings				
Medium Velocity Ductwork and Fittings				
Chemical Fume Hood Exhaust Ductwork				
Clothes Dryer Exhaust Ductwork				
Flexible Ducts				
Kitchen Exhaust Ductwork				
Sealants				
<b>233300 – Duct Accessories</b>				
Access Doors				
Backdraft Dampers				
Duct-Mounted Access Doors				
Duct Silencers				
Fire and Smoke Dampers				
Flexible Duct Connectors				
Flexible Ducts				
Turning Vanes				
Volume Balancing Dampers				
<b>233710 – Grilles, Registers, and Diffusers</b>				
Sidewall Supply Grilles (Double Deflection)				
Return Grilles				
Modular Core Ceiling Diffusers				

3. Operation and Maintenance Training Table

<b>Operation and Maintenance Training Table</b>	
<b>System</b>	<b>O&amp;M Training Complete</b>
230900 – Energy Management and Control System	
232100 – Hydronic Piping Systems	
232120 – Hydronic Pumps	
232200 – Steam and Condensate Piping Systems	
232220 – Steam Condensate Pumps	
232300 – Refrigerant Piping Systems	
232500 – HVAC Water Treatment	
233400 – Power Ventilators	
233600 – Air Terminal Units	
234100 – Air Filters	
235200 – Boilers and Accessories	
235700 – Heat Exchangers	
236200 – Condensing Units	
236400 – Water Chillers	
236500 – Cooling Towers	
237400 – Air Handling Units	
237400 – Terminal Heat Transfer Units	
<p>The Contractor, associated factory representatives and subcontractors, have started each system and the total system and have proved their normal operation to the Owner's representative and have instructed him in the operation and maintenance thereof.</p>	
_____	_____
Owner's Representative	Contractor

4. Extra Materials List

<b>Extra Materials List</b>				
<b>Specification Section</b>	<b>Mechanical Equipment</b>	<b>Extra Materials</b>	<b>Verified By</b>	<b>Date</b>
230519	HVAC Meters and Guages	Test Kit		
232120	Hydronic Pumps	One (1) Set of Mechanical Seals for Each Pump		
233400	Power Ventilators	One (1) Set of Fan Belts for Each Fan		
237400	Air Handling Units	One (1) Set of Fan Belts for Each Different Size and/or Type of Belt		
237400	Air Handling Units	One (1) Fan Bearing For Each Different Size and/or Type of Bearing		
237400	Air Handling Units	One (1) Set of Filters for Each Air Handling Unit		
233300	Duct Accessories	Fusible Links Equal to 10% of the Amount Installed		
233400	Power Ventilators	One (1) Spare Set of Belts and Bearings for Each Belt Driven Unit		
234100	Air Filters	One (1) Complete Set of Filters for Each Filter Bank		
234100	Air Filters	One (1) Container of Red Oil for Inclined Manometer Filter Guage		

5. Extended Warranty List

<b>Extended Warranty List</b>		
<b>Specification Section</b>	<b>Mechanical Equipment</b>	<b>Warranty Description</b>
230900	Actuators	3 year unlimited warranty
232115	Ground Loop Piping	50 Year Limited Warranty
235200	Boilers	Heat Exchangers: 10 year warranty



6. Pre-Balance Checklist

<b>Pre-Balance Checklist</b>	
<b>Item</b>	<b>Complete</b>
General Contractor	
All doors and closures, windows and ceiling tile shall be installed	
96-hour run test complete	
Plumbing Contractor	
All valves, flow meters, temperature/pressure taps installed correctly, functional and accessible.	
Strainers and piping, clean, flushed, and free of debris	
Construction strainer baskets replaced with permanent baskets	
System filled to proper level and pressure reducing valve set	
Automatic and manual air vents properly installed and functional	
All air purged from system	
Water in expansion tanks at proper level	
All coils piped correctly and accessible	
Correct pump rotation	
Pumps properly aligned, grouted, and anchored	
Vibration isolators properly installed and adjusted	
Service and balance valves are open	
Sheet Metal Contractor	
Ductwork is intact and properly sealed	
Ductwork leak tested and repaired as required	
Access doors installed and properly secured	
Ductwork end caps installed	
Ductwork installed according to drawings and specifications	
Ductwork is free of debris	
All dampers, fire, volume, mixing, splitters are installed, accessible and open	
All terminal boxes, reheat coils, operators and dampers are installed, accessible and operable	
Return air has unobstructed path from each conditioned space back to the unit	
All grilles, registers, diffusers and other devices are installed and functional	
Filters are clean and correctly installed	
Filter frames correctly installed and sealed	
Coils clean, properly installed and sealed	
Drive components installed	
Sheaves properly aligned and tight on their shaft	
Belts adjusted for correct tension	
Belt guard properly installed	
Automatic control dampers installed and functional	
Fan rotation correct	
Fan housing installed and sealed	
All flex connections and vibration isolators are installed correctly	
Fan wheel aligned with adequate clearance	
Fan bearings lubricated	

<b>Pre-Balance Checklist</b>	
<b>Item</b>	<b>Complete</b>
Controls Contractor	
Controls complete and functional	
Thermostats and sensors calibrated	
Program correct and functional	
Electrical Contractor	
Motors wired and energized	
Proper starter and overload protection installed	
Correct fuses installed	
Motor secured to frame	
Motor bearings lubricated	
Fire alarms and duct smoke detectors are fully operational	
General Contractor Sign-Off: _____	Date: _____
Plumbing Contractor Sign-Off: _____	Date: _____
Sheet Metal Contractor Sign-Off: _____	Date: _____
Controls Contractor Sign-Off: _____	Date: _____
Electrical Contractor Sign-Off: _____	Date: _____

**END OF SECTION**

## **SECTION 23 05 00 - BASIC HVAC MATERIALS AND METHODS**

### **PART 1 GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Section 230000 – General HVAC Requirements

#### **1.2 SUBMITTALS**

- A. General
  - 1. Product data for specified materials.
  - 2. Welding certificates

#### **1.3 QUALITY ASSURANCE**

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
  - 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
  - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- C. Electrical Characteristics for Mechanical Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

#### **1.4 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver ductwork, pipes, and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent ductwork and pipe end damage and to prevent entrance of dirt, debris, and moisture.
- B. Store ductwork out of weather at all times.

- C. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

## **1.5 COORDINATION**

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for mechanical installations.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Coordinate requirements for access panels and doors for mechanical items requiring access that are concealed behind finished surfaces. Access panels and doors shall be provided as required for Division 23 systems and equipment by Division 23 in accordance with Division 08.

## **PART 2 PRODUCTS**

### **2.1 ACCESS DOORS**

- A. Access doors shall be provided by Division 23 when serving Division 23 systems and equipment in accordance with the requirements of Division 08.

### **2.2 DIELECTRIC FITTINGS**

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

### **2.3 ESCUTCHEONS**

- A. Description: Chrome plated steel manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

### **2.4 HOUSEKEEPING PADS**

- A. Housekeeping pads shall be provided by Division 23 when serving Division 23 systems and equipment and shall be made of concrete in accordance with the requirements of Division 03.

### **2.5 JOINING MATERIALS**

- A. Refer to individual Division 23 piping Sections for special joining materials not listed below. Joining material requirements listed in individual Sections shall supersede the requirements in this section.

- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
  - 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.
    - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
    - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
  - 2. AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick, unless otherwise indicated; full-face or ring type, unless otherwise indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; AWS A5.8, BAgl, silver alloy for refrigerant piping, unless otherwise indicated.
- G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- H. Solvent Cements for Joining Plastic Piping
  - 1. ABS Piping: ASTM D 2235.
  - 2. CPVC Piping: ASTM F 493.
  - 3. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
  - 4. PVC to ABS Piping Transition: ASTM D 3138.
- I. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

## 2.6 MECHANICAL SLEEVE SEALS

- A. Manufacturers:
  - 1. Advance Products & Systems, Inc.
  - 2. Calpico, Inc.
  - 3. Metraflex Co.

4. Pipeline Seal and Insulator, Inc.

- B. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
- C. Construction: Sealing element - EPDM interlocking links shaped to fit surface of pipe, type and number required for pipe material and size of pipe; pressure plates - stainless steel, include two for each sealing element; connecting bolts and nuts - stainless steel of length required to secure pressure plates to sealing elements, include one for each sealing element.

## 2.7 PAINT

- A. When painting is noted in Division 22 as required, paint shall be provided by Division 22 in accordance with the requirements of Division 09.

## 2.8 SLEEVES

- A. Sleeves for Pipes Through Non-fire Rated Floors: 18 gauge (1.2 mm) thick galvanized steel.
- B. Sleeves for Pipes Through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 gauge (1.2 mm) thick galvanized steel.
- C. Sleeves for Pipes Through Fire Rated and Fire Resistive Floors and Walls, and Fire Proofing: Prefabricated fire rated sleeves including seals, UL listed, refer to Section 07270.
- D. Sleeves for below grade piping passing under footings: Class 52; ductile iron.
- E. Sleeves for below grade piping passing through exterior walls - Mechanical Sleeve Seals.
- F. Sleeves for Ductwork: Galvanized steel.
- G. Miscellaneous
  - 1. Stuffing Insulation: Glass fiber type; non-combustible; 3 lb. density.
  - 2. Fire Safeing Sealant: Intumescent material capable of expanding up to 8 to 10 times when exposed to temperatures beginning at 250°F. It shall have ICBO, BOCA I approved ratings to 3 hours per ASTM E814 (UL 1479). 3M Fire Barrier Caulk, Putty, strip and sheet forms.

## 2.9 SUPPORTS AND ANCHORAGES

- A. Metal supports for Division 23 systems and equipment shall be provided in accordance with the requirements of Division 05.

## **PART 3 EXECUTION**

### **3.1 GENERAL**

#### **A. Mechanical Demolition**

1. Refer to Division 1 and Section 220000 for general demolition requirements and procedures.
2. Disconnect, demolish, and remove mechanical systems, equipment, and components indicated to be removed.
  - a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
  - b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
  - c. Ducts to Be Removed: Remove portion of ducts indicated to be removed and cap and seal remaining ducts with same or compatible ductwork material.
  - d. Ducts to Be Abandoned in Place: Cap and seal ducts with same or compatible ductwork material. Provide duct supports as required to ensure proper support of abandoned ducts.
  - e. Equipment to Be Removed: Disconnect and cap services and remove equipment.
  - f. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
  - g. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
3. If pipe, duct, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.
4. Patch all building penetrations for systems and equipment that are removed.

#### **B. Cutting And Patching**

1. All cutting and patching of new and existing construction required for the installation of systems and equipment specified in Division 23 shall be the responsibility of the Division 23 Contractor. All cutting shall be accomplished with masonry saws, drills or similar equipment to provide neat uniform openings.

2. Patch and repair walls, floors, ceilings and roof with materials of same quality and appearance as adjacent surfaces unless otherwise shown. Surface finishes shall exactly match existing finishes of same materials. All patching shall meet the approval of the Owner's Representative.
3. All cutting and patching made necessary to repair defective equipment, defective workmanship or be neglect of this Contractor to properly anticipate his requirements shall be included in Division 23.
4. Cut carefully to minimize necessity for repairs to existing work. Do not cut beams, columns, or trusses or other structural members without the Owner Representative's written approval.
5. Cutting, patching, repairing, and replacing pavement, sidewalks, roads, and curbs to permit installation of work specified or indicated under this Division is responsibility of Division 23.

### **3.2 ACCESS DOORS**

- A. Provide access doors where specialties are not exposed unless indicated to be provided under other Divisions. Access doors shall comply with Division 08. Coordinate size and location with access requirements.
- B. Access door locations may occasionally be shown on the drawings, to indicate specific location and/or installation requirements in certain instances. This shall not be construed to indicate that all required access doors have been shown on the drawings. It is the Contractor's responsibility to provide access doors as required.

### **3.3 DIELECTRIC FITTINGS**

- A. Provide dielectric fittings whenever connecting piping of dissimilar metals.

### **3.4 ESCUTCHEONS**

- A. Install escutcheons for penetrations of walls, ceilings, and floors in finished spaces.

### **3.5 HOUSEKEEPING PADS**

- A. Refer to individual specification Sections for equipment requiring housekeeping pads.
- B. Construct housekeeping pads of dimensions not less than 4 inches (100 mm) larger in both directions than supported unit. Also ensure minimum concrete coverage around anchor bolts is maintained to meet both anchor bolt manufacturer's requirements and seismic codes.
- C. 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 the base.



- D. Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes.
- E. Anchor Bolts
  - 1. Install anchor bolts according to anchor-bolt manufacturer's written instructions and according to seismic codes.
  - 2. Extend anchor bolts through concrete base, and anchor into structural concrete floor.
  - 3. Install anchor bolts to elevations required for proper attachment to supported equipment.

### **3.6 MECHANICAL SLEEVE SEALS**

- A. Provide mechanical sleeve seals at the following locations:
  - 1. Below grade wall piping penetrations
  - 2. Slab on grade floor and basement floor piping penetrations.
  - 3. Penetrations of all separations where separation serves as a moisture barrier.

### **3.7 PAINTING**

- A. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.
- B. Refer to individual specifications Sections for additional paint scope requirements.

### **3.8 SLEEVES**

- A. Provide sleeves for above grade duct and piping penetrations of walls, roofs and floors.
  - 1. Exception: Sleeves are not required for core drilled holes.
- B. Set sleeves in position in formwork. Provide reinforcing around sleeves. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping, where duct or pipe is to be insulated. Where piping or ductwork penetrates a roof, floor or wall, close off space between pipe or duct and sleeve with fiberglass insulation and sealant (air tight). This applies to all roofs, walls or floors regardless of fire rating. Refer to Division 07 for additional information. Note: 3 lb. insulation not required at roof penetrations. Use fire safeing sealant at penetrations of fire rated floors and walls.
- E. Furnish and install waterproof sleeves on all piping and duct penetrations through the floor slabs in mechanical room and any area where pipes and ducts pass through slabs where water spillage could cause damage to ceilings below. Top of sleeve shall extend 2" (51 mm) above floor.

### **3.9 SUPPORTS AND ANCHORAGES**

A. Metal

1. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.
2. Field Welding: Comply with AWS D1.1.

B. Wood

1. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor mechanical materials and equipment.
2. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.
3. Attach to substrates as required to support applied loads.

**End of Section 23 05 00**

## **SECTION 23 05 53 - HVAC IDENTIFICATION**

### **PART 1 GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Section 230000 – General HVAC Requirements

#### **1.2 REFERENCES**

- A. General
  - 1. ASME A13.1 - Scheme for the Identification of Piping Systems

#### **1.3 SUBMITTALS**

- A. General
  - 1. Product data for specified materials.
  - 2. Samples: For color, letter style, and graphic representation required for each identification material and device.
  - 3. Valve numbering scheme.
- B. Valve Schedules:
  - 1. For each piping system. Furnish extra copies (in addition to mounted copies) to include in maintenance manuals.

#### **1.4 OPERATION AND MAINTENANCE MATERIALS**

- A. General: Include valve tag identification schedule.

#### **1.5 QUALITY ASSURANCE**

- A. ASME Compliance: Comply with ASME A13.1, "Scheme for the Identification of Piping Systems," for letter size, length of color field, colors, and viewing angles of identification devices for piping.

## **1.6 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 location of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

## **PART 2 PRODUCTS**

### **2.1 ACCESS PANEL AND DOOR MARKERS:**

- A. 1/16-inch- (1.6-mm-) thick, engraved laminated plastic, with abbreviated terms and numbers corresponding to identification. Provide 1/8-inch (3.2-mm) center hole for attachment.
- B. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive.

### **2.2 CEILING TACKS**

- A. Description: Steel with 3/4-inch (19-mm) diameter color coded head.
- B. Color code as follows:
  - 1. HVAC equipment: Blue
  - 2. Fire dampers/smoke dampers: Red
  - 3. Plumbing valves: Green
  - 4. Heating/cooling valves: Blue

### **2.3 NAMEPLATES**

- A. Description: Laminated three-layer plastic with engraved white letters 3/16" high or larger on black background.
- B. Nameplates shall include the following minimum information:
  - 1. Plan identification.
  - 2. Capacity specified at designed operating conditions.
  - 3. Actual capacity as balanced at site operating conditions.
  - 4. Area or zone served.

## 2.4 PIPE MARKERS

Do not use pipe markers or plastic tapes for bare pipes conveying fluids at temperatures of 125 deg F (52 deg C) or higher.

- A. General: Preprinted, color-coded, with lettering indicating service, and showing direction of flow.
  - 1. Colors: Comply with ASME A13.1, unless otherwise indicated.
  - 2. Lettering: Use piping system terms indicated and abbreviate only as necessary for each application length.
  - 3. Pipes with OD, Including Insulation, Less Than 6 Inches (150 mm): Full-band pipe markers extending 360 degrees around pipe at each location.
  - 4. Pipes with OD, Including Insulation, 6 Inches (150 mm) and Larger: Either full-band or strip-type pipe markers at least three times letter height and of length required for label.
  - 5. Arrows: Integral with piping system service lettering to accommodate both directions or as separate unit on each pipe marker to indicate direction of flow.
- B. Pretensioned Pipe Markers: Precoiled semirigid plastic formed to cover full circumference of pipe and to attach to pipe without adhesive.
- C. Shaped Pipe Markers: Preformed semirigid plastic formed to partially cover circumference of pipe and to attach to pipe with mechanical fasteners that do not penetrate insulation vapor barrier.
- D. Self-Adhesive Pipe Markers: Plastic with pressure-sensitive, permanent-type, self-adhesive back.
- E. Plastic Tape: Continuously printed, vinyl tape at least 3 mils (0.08 mm) thick with pressure-sensitive, permanent-type, self-adhesive back.
  - 1. Width for Markers on Pipes with OD, Including Insulation, Less Than 6 Inches (150 mm): 3/4 inch (19 mm) minimum.
  - 2. Width for Markers on Pipes with OD, Including Insulation, 6 Inches (150 mm) or Larger: 1-1/2 inches (38 mm) minimum.

## 2.5 TAGS

- A. Stamped or engraved with 3/16-inch (6.4-mm) letters for piping system abbreviation and 1/2-inch (13-mm) numbers, with numbering scheme as approved. Provide 5/32-inch (4-mm) hole for fastener.
  - 1. Material: 0.051-inch- (1.3-mm-) thick brass.
  - 2. Size: At least 1-inch by 3-inch or 2-inch diameter.

3. Valve-Tag Fasteners: Steel rings connected to valve stems.
4. Valve Tags shall include the following minimum information:
  - a. Plan Identification
  - b. Normal Position
  - c. Duty
  - d. Area Served
  - e. Valve Type

## **2.6 VALVE SCHEDULES**

- A. Valve Schedules: For each piping system, on standard-size 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-Schedule Frames: Glazed display frame for removable mounting on masonry walls for each page of valve schedule. Include mounting screws.
  2. Frame: Extruded aluminum.
  3. Glazing: ASTM C 1036, Type I, Class 1, Glazing Quality B, 2.5-mm, single-thickness glass.

## **PART 3 EXECUTION**

### **3.1 GENERAL**

- A. Preparation
  1. Degrease and clean surfaces to receive adhesive for identification materials.
  2. Provide identifying devices after completion of coverings and painting.
- B. Adjusting
  1. Relocate mechanical identification materials and devices that have become visually blocked by other work.
- C. Cleaning
  1. Clean faces of mechanical identification devices and glass frames of valve schedules.

### 3.2 NAMEPLATES

- A. For unfinished canvas covering, apply paint primer before applying labels.
- B. Install equipment markers with permanent adhesive on or near each major item of mechanical equipment. Data required for markers may be included on signs, and markers may be omitted if both are indicated.
- C. Stenciled Equipment Marker Option: Stenciled markers may be provided instead of laminated-plastic equipment markers, at Installer's option, if lettering larger than 1 inch (25 mm) high is needed for proper identification because of distance from normal location of required identification.

### 3.3 IDENTIFICATION SCHEDULE

- A. Identify all scheduled equipment (air handling units, fans, pumps, heat transfer equipment, tanks, etc.) and water treatment devices with plastic nameplates.
- B. Identify control panels and major control components outside panels with plastic nameplates.
- C. Identify valves in main and branch piping with tags.
- D. Identify air terminal units and valves with numbered tags.
- E. Tag automatic controls, instruments, and relays. Key to control schematic.
- F. Identify piping, concealed or exposed, with plastic pipe markers or plastic tape pipe markers. Identify service, flow direction, and pressure (when applicable). Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet (6 m) on straight runs including risers and drops, adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction.
- G. Provide ceiling tacks to locate valves, terminal boxes or dampers above T-bar type panel ceilings. Locate in corner of panel closest to equipment.

END OF SECTION 230553

## **SECTION 23 05 93 - HVAC TESTING, ADJUSTING, AND BALANCING**

### **PART 1 GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Section 230000 – General HVAC Requirements

#### **1.2 REFERENCES**

- A. General
  - 1. AABC - National Standards for Total System Balance
  - 2. ADC - Test Code for Grilles, Registers, and Diffusers
  - 3. ASHRAE 111 - Practices for Measurement, Testing, Adjusting, and Balancing of Building Heating, Ventilation, Air-conditioning, and Refrigeration Systems
  - 4. NEBB - Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems
  - 5. SMACNA - HVAC Systems Testing, Adjusting, and Balancing

#### **1.3 SUBMITTALS**

- A. Contract Documents Examination Report: Submit copies of the Contract Documents review report as specified in Part 3.
- B. Strategies and Procedures Plan: Submit copies of TAB strategies and step-by-step procedures as specified in Part 3 "Preparation" Article. Include a complete set of report forms intended for use on this Project.
- C. Certified TAB Reports: Submit two copies of reports prepared, as specified in this Section, on approved forms certified by TAB firm.
- D. Sample Report Forms: Submit two sets of sample TAB report forms.
- E. Warranties specified in this Section.



## 1.4 QUALITY ASSURANCE

- A. TAB Firm Qualifications: Engage a TAB firm certified by AABC or NEBB.
- B. TAB Conference: Meet with Owner's and Architect's representatives on approval of TAB strategies and procedures plan to develop a mutual understanding of the details. Ensure the participation of TAB team members, equipment manufacturers' authorized service representatives, HVAC controls installers, and other support personnel. Provide seven days' advance notice of scheduled meeting time and location.
  - 1. Agenda Items: Include at least the following:
    - a. Submittal distribution requirements.
    - b. The Contract Documents examination report.
    - c. TAB plan.
    - d. Work schedule and Project-site access requirements.
    - e. Coordination and cooperation of trades and subcontractors.
    - f. Coordination of documentation and communication flow.
- C. Certification of TAB Reports: Certify TAB field data reports. This certification includes the following:
  - 1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
  - 2. Certify that TAB team complied with approved TAB plan and the procedures specified and referenced in this Specification.
- D. TAB Report Forms: Use standard forms NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems."
- E. Instrumentation Type, Quantity, and Accuracy: As described in NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems," Section II, "Required Instrumentation for NEBB Certification."
- F. Instrumentation Calibration: Calibrate instruments at least every six months or more frequently if required by instrument manufacturer.
  - 1. Keep an updated record of instrument calibration that indicates date of calibration and the name of party performing instrument calibration.

## 1.5 PROJECT CONDITIONS

- A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

- B. 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.

## **1.6 COORDINATION**

- A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist TAB activities.
- B. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.
- C. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

## **PART 2 PRODUCTS (NOT APPLICABLE)**

## **PART 3 EXECUTION**

### **3.1 TAB SPECIALISTS**

- A. Approved TAB Specialists
  - 1. Neodorfer Engineers

### **3.2 EXAMINATION**

- A. General
  - 1. Verify that systems are complete and operable before commencing work. Ensure that the items on the pre-balance checklist are completed.
  - 2. 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.
  - 3. 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.
  - 4. Examine the approved submittals for HVAC systems and equipment.

5. 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.
6. When used for HVAC distribution, examine ceiling plenums and underfloor air plenums used for supply, return, or relief air to verify that they meet the leakage class of connected ducts as specified in Section 233100 and are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.
7. Examine equipment performance data including fan and pump curves.
  - a. 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.
  - b. 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.
8. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
9. Examine test reports specified in individual system and equipment Sections.
10. 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.
11. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.
12. Examine strainers. Verify that startup screens are replaced by permanent screens with indicated perforations.
13. When used, examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.
14. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
15. Examine system pumps to ensure absence of entrained air in the suction piping.
16. Examine operating safety interlocks and controls on HVAC equipment.
17. 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.

**B. Test and Verification of Control System**

1. The Air Balance and Testing Agency, with the aid of the Control Contractor, shall verify that the control systems are performing in accordance to the specified criteria.
2. Operation of all components and system sequence shall be verified. Letter of certification shall be forwarded to the Owner's Representative with copies enclosed in the O&M Manual.
3. This procedure shall not relieve the control contractor of any responsibilities. This paragraph is intended to insure that the control system is completely operational and adjusted at the time the air systems testing and balancing is being accomplished.

### **3.3 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. Hydronic systems are filled, clean, and free of air.
  3. Automatic temperature-control systems are operational.
  4. Equipment and duct access doors are securely closed.
  5. Balance, smoke, and fire dampers are open.
  6. Isolating and balancing valves are open and control valves are operational.
  7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
  8. Windows and doors can be closed so indicated conditions for system operations can be met.
- C. Provide instruments required for testing, adjusting, and balancing operations.

### **3.4 PROCEDURES**

- A. General
  1. All procedures shall be in accordance with and meet all the requirements of either AABC or NEBB procedural standards for all equipment and systems included in the project. The requirements listed in this section are intended to be supplementary to the requirements of these standards.
  2. Comply with requirements in ASHRAE 62.1-2004, Section 7.2.2, "Air Balancing."

3. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.
  - a. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
  - b. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Division 23 Section "HVAC Insulation."
4. 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.
5. Take and report testing and balancing measurements in inch-pound (IP) units.

B. Air Systems

1. General

- 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."

2. Constant Volume Systems

- a. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
- b. Measure total airflow.
  - 1) Where sufficient space in ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow.
- c. Measure fan static pressures as follows to determine actual static pressure:
  - 1) Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.
  - 2) Measure static pressure directly at the fan outlet or through the flexible connection.
  - 3) 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.
  - 4) Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
  - d. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
    - 1) Report the cleanliness status of filters and the time static pressures are measured.
  - e. Measure static pressures entering and leaving other devices, such as sound traps, heat-recovery equipment, and air washers, under final balanced conditions.
  - f. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors.
  - g. Make required fan speed adjustments. Make all required system alterations to achieve fan speed adjustments, including sheave adjustment and replacement.
    - 1) 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.
3. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.
- a. Measure airflow of submain and branch ducts.
    - 1) 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.
  - b. Measure static pressure at a point downstream from the balancing damper, and adjust volume dampers until the proper static pressure is achieved.
  - c. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.
4. Measure air outlets and inlets without making adjustments.
- a. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.
5. 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.
- a. 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.
  - b. Adjust patterns of adjustable outlets for proper distribution without drafts.
6. Constant Flow Systems
- a. Measure water flow at pumps. Use the following procedures except for positive-displacement pumps:
    - 1) Verify impeller size by operating the pump with the discharge valve closed. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on manufacturer's

- pump curve at zero flow and verify that the pump has the intended impeller size.
- 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.
  - 3) Monitor motor performance during procedures and do not operate motors in overload conditions.
  - 4) 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.
  - 5) 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 presettings.
  - 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.
7. Variable Flow Systems
- a. Balance systems with automatic two- and three-way control valves by setting systems at maximum flow through heat-exchange terminals and proceed as specified above for hydronic systems.
8. Supplemental Requirements
- a. Primary-Secondary Systems
    - 1) Balance the primary circuit flow first and then balance the secondary circuits.

9. Condensing Units

- a. Verify proper rotation of fans.
- b. Measure entering- and leaving-air temperatures.
- c. Record compressor data.

C. Existing Systems

1. Perform a preconstruction inspection of existing equipment that is to remain and be reused.
2. Measure and record the operating speed, airflow, and static pressure of each fan.
  - a. Measure motor voltage and amperage. Compare the values to motor nameplate information.
  - b. Check the refrigerant charge.
  - c. Check the condition of filters.
  - d. Check the condition of coils.
  - e. Check the operation of the drain pan and condensate-drain trap.
  - f. Check bearings and other lubricated parts for proper lubrication.
  - g. Report on the operating condition of the equipment and the results of the measurements taken. Report deficiencies.
3. Before performing testing and balancing of existing systems, inspect existing equipment that is to remain and be reused to verify that existing equipment has been cleaned and refurbished. Verify the following:
  - a. New filters are installed.
  - b. Coils are clean and fins combed.
  - c. Drain pans are clean.
  - d. Fans are clean.
  - e. Bearings and other parts are properly lubricated.
  - f. Deficiencies noted in the preconstruction report are corrected.
4. Perform testing and balancing of existing systems to the extent that existing systems are affected by the renovation work.
  - a. Compare the indicated airflow of the renovated work to the measured fan airflows, and determine the new fan speed and the face velocity of filters and coils.
  - b. Verify that the indicated airflows of the renovated work result in filter and coil face velocities and fan speeds that are within the acceptable limits defined by equipment manufacturer.
  - c. If calculations increase or decrease the air flow rates and water flow rates by more than 5 percent, make equipment adjustments to achieve the calculated rates. If increase or decrease is 5 percent or less, equipment adjustments are not required.
  - d. Balance each air outlet.



### 3.5 TOLERANCES

- A. Balance all systems to within plus or minus 10% of design parameters. When system performance (available fan and pump flow and pressure, etc.) allows, balance systems so that total system flows are at a minimum of 100% of design parameters, without causing any individual flow location to be more than 10% in excess of design parameters.

### 3.6 REPORTING

- A. Initial Construction-Phase Report
  - 1. 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. Final Report
  - 1. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
    - a. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
    - b. Include a list of instruments used for procedures, along with proof of calibration.
  - 2. Final Report Contents: In addition to certified field-report data, include the following:
    - a. Pump curves.
    - b. Fan curves.
    - c. Manufacturers' test data.
    - d. Field test reports prepared by system and equipment installers.
    - e. Other information relative to equipment performance; do not include Shop Drawings and product data.
  - 3. General Report Data: In addition to form titles and entries, include the following data:
    - a. Title page.
    - b. Name and address of the TAB contractor.
    - c. Project name.
    - d. Project location.
    - e. Architect's name and address.
    - f. Engineer's name and address.
    - g. Contractor's name and address.
    - h. Report date.
    - i. Signature of TAB supervisor who certifies the report.
    - j. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
    - k. Summary of contents including the following:
      - 1) Indicated versus final performance.

- 2) Notable characteristics of systems.
  - 3) Description of system operation sequence if it varies from the Contract Documents.
- l. Nomenclature sheets for each item of equipment.
- m. Data for terminal units, including manufacturer's name, type, size, and fittings.
  - n. Notes to explain why certain final data in the body of reports vary from indicated values.
  - o. Test conditions for fans and pump performance forms including the following:
    - 1) Settings for outdoor-, return-, and exhaust-air dampers.
    - 2) Conditions of filters.
    - 3) Cooling coil, wet- and dry-bulb conditions.
    - 4) Face and bypass damper settings at coils.
    - 5) Fan drive settings including settings and percentage of maximum pitch diameter.
    - 6) Inlet vane settings for variable-air-volume systems.
    - 7) Settings for supply-air, static-pressure controller.
    - 8) Other system operating conditions that affect performance.
  - p. Test Data (Indicated and Actual Values):
    - 1) Total air flow rate in cfm (L/s).
    - 2) Entering-air temperature in deg F (deg C).
    - 3) Leaving-air temperature in deg F (deg C).
    - 4) Air temperature differential in deg F (deg C).
    - 5) Entering-air static pressure in inches wg (Pa).
    - 6) Leaving-air static pressure in inches wg (Pa).
    - 7) Air static-pressure differential in inches wg (Pa).
    - 8) Low-fire fuel input in Btu/h (kW).
    - 9) High-fire fuel input in Btu/h (kW).
    - 10) Manifold pressure in psig (kPa).
    - 11) High-temperature-limit setting in deg F (deg C).
    - 12) Operating set point in Btu/h (kW).
    - 13) Motor voltage at each connection.
    - 14) Motor amperage for each phase.
    - 15) Heating value of fuel in Btu/h (kW).
4. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:
- a. Report Data:
    - 1) System and air-handling-unit number.
    - 2) Location and zone.
    - 3) Traverse air temperature in deg F (deg C).
    - 4) Duct static pressure in inches wg (Pa).
    - 5) Duct size in inches (mm).
    - 6) Duct area in sq. ft. (sq. m).
    - 7) Indicated air flow rate in cfm (L/s).
    - 8) Indicated velocity in fpm (m/s).
    - 9) Actual air flow rate in cfm (L/s).
    - 10) Actual average velocity in fpm (m/s).

11) Barometric pressure in psig (Pa).

5. Instrument Calibration Reports:

- a. Report Data:
  - 1) Instrument type and make.
  - 2) Serial number.
  - 3) Application.
  - 4) Dates of use.
  - 5) Dates of calibration.

### 3.7 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.

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.
- 2. The TAB contractor's test and balance engineer shall conduct the inspection in the presence of the designated Owner's Representative.
- 3. The Owner's Representative 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.

END OF SECTION 230593

## SECTION 23 07 00 - HVAC INSULATION

### PART 1 GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Section 230000 – General HVAC Requirements

#### 1.2 REFERENCES

- A. General
  - 1. ASTM C518 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus
  - 2. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation
  - 3. ASTM C665
  - 4. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials
  - 5. ASTM E162 - Standard Test Method for Surface Flammability of Materials Using a Radiant Heat Energy Source
  - 6. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi
  - 7. ASTM G22
  - 8. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials
  - 9. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials
  - 10. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials
  - 11. SMACNA - HVAC Duct Construction Standards - Metal and Flexible
  - 12. Oregon State Energy Code
- B. Glass fiber, Flexible Blanket (Duct Wrap)

1. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
- C. Glass Fiber, Flexible (Duct Liner)
1. ASTM C1071 - Standard Specification for Thermal and Acoustical Insulation (Glass Fiber, Duct Lining Material)

### 1.3 SUBMITTALS

A. General

1. For each insulation type, provide material characteristics, minimum and maximum service temperatures, moisture absorption characteristics, thermal and vapor transmission characteristics.
2. Provide a schedule indicating insulation type and thickness for all duct sizes of all duct systems.
3. Provide a schedule indicating insulation type and thickness for all pipe sizes of all piping systems.
4. Provide a schedule indicating insulation type and thickness for all equipment to receive insulation.
5. Product Data: For each type of product indicated, identify thermal conductivity, thickness, and jackets (both factory and field applied, if any).
6. Shop Drawings: Show details for the following:
  - a. Application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
  - b. Attachment and covering of heat tracing inside insulation.
  - c. Insulation application at pipe expansion joints for each type of insulation.
  - d. Insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
  - e. Removable insulation at piping specialties, equipment connections, and access panels.
  - f. Application of field-applied jackets.
  - g. Application at linkages of control devices.
  - h. Field application for each equipment type.

### 1.4 QUALITY ASSURANCE

A. General

1. Conform to maximum flame spread/smoke developed rating of 25/50 in accordance with ASTM E84, NFPA 255, and UL 723.

2. Insulation and jacketing shall be resistant to moisture and mold and shall be resistant to damage or deterioration under the service intended.
3. Closed cell plastic insulation is preferred on refrigerant piping and cold equipment.

## 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 size and location of supports, hangers, and insulation shields specified in Division 23 Section "HVAC Hangers and Supports."
- B. Coordinate clearance requirements with piping Installer for piping insulation application, duct Installer for duct insulation application, and equipment Installer for equipment insulation application. Before preparing piping and ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heat tracing.

## 1.7 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 GENERAL

- A. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- B. 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.
- C. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

- D. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- E. For indoor applications, use adhesives that have a VOC content of 50 g/L or less when calculated according to 40 DFR 59, Subpart D (EPA method 24).

## 2.2 DUCT INSULATION

- A. Glass Fiber, Flexible Blanket (Duct Wrap)
  - 1. Manufacturers
    - a. Certainteed; Standard Ductwrap
    - b. Knauf; Ductwrap
    - c. Owens Corning; All Service Ductwrap
    - d. Schuller; R-Series Microlite
  - 2. Insulation: ASTM C553; flexible, noncombustible blanket; 'K' ('Ksi') value: ASTM C518, 0.29 at 75 deg F; maximum service temperature: 250 deg F; maximum moisture absorption: 0.20 percent by volume; density: 0.75 lbs/cu ft; resistance to microbial growth: ASTM C665; shall not support mold, bacteria, or fungus growth.
  - 3. Vapor Barrier Jacket: Foil Scrim Kraft (FSK); foil thickness: 0.00035 inches; moisture vapor transmission: ASTM E96; 0.02 perm; Class I vinyl; vinyl thickness: 0.0032 inches; moisture vapor transmission: ASTM E96; 1.3 perm; vapor barrier tape: same material as vapor barrier jacket as recommended by the insulation manufacturer.
- B. Glass Fiber, Flexible (Duct Liner)
  - 1. Manufacturers
    - a. Certainteed - Toughgard
    - b. Knauf - Duct Liner E-M
    - c. Schuller - Permacote Linacoustic
  - 2. Insulation: ASTM C1071; flexible, noncombustible bonded glass fiber blanket with a black matt faced surface for damage resistance; 'K' ('Ksi') Value: ASTM C1071, maximum 0.28 at 75 deg F maximum service temperature: 250 deg F; maximum rated air velocity on coated air side: 4,000 fpm; surface coating with EPA registered anti-microbial agent that will not support growth of fungus or bacteria; anti-microbial agent shall be tested in accordance with: fungi test ASTM C665, fungi test ASTM G21, bacterial test ASTM G22.
  - 3. Adhesive:
    - a. Waterproof, ASTM E162 fire-retardant type
  - 4. Mechanical Fasteners:
    - a. Conform to SMACNA Mechanical Fastener Standard MF-1-1975
    - b. Manufacturers
      - 1) DuroDyne
      - 2) Omark dished head "Insul-Pins"



- c. Grip nails may be used if nail is installed by “Grip Nail Air Hammer” or by “Automatic Fastener Equipment” in accordance with Manufacturer’s recommendations.

C. Glass Fiber, Rigid

1. Manufacturers
  - a. Schuller, Spin-Glas type 814
2. Insulation: ASTM C612; rigid, noncombustible blanket; 'K' ('Ksi') value : ASTM C518, 0.23 at 75 deg F; maximum service temperature: 450 degrees F; maximum moisture absorption: 1 percent by volume; density: 3.0 lb/cu ft.

## 2.3 EQUIPMENT INSULATION

A. Manufacturers

1. CertainTeed Corp.; CrimpWrap
2. Johns Manville; MicroFlex
3. Knauf Insulation; Pipe and Tank Insulation
4. Manson Insulation Inc.; AK Flex
5. Owens Corning; Fiberglas Pipe and Tank Insulation

- B. Glass Fiber 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. (40 kg/cu. m) or more. Thermal conductivity (k-value) at 100 deg F (55 deg C) is 0.29 Btu x in./h x sq. ft. x deg F (0.042 W/m x K) or less. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.

## 2.4 LACE-ON BLANKETS

A. Manufacturers (Refer to Section 230000):

1. Insulation
  - a. Kaowool Cerablanket
2. Fabric
  - a. JP Stevens Glass-Tex Fabric Style 9987
  - b. Alpha Maritex Style 3200-SA

- B. Materials: 0.008 inch thick type 304 stainless steel knitted wire mesh inner liner 8 lb/cu.ft. density insulation, ½ inch (13mm) thick; oil and water resistant exterior protective fabric.

- C. Construction: Blankets shall be sewn together. Lacing anchors shall be 2½ inch (65 mm) stainless steel secured with 12 gauge (2.5 mm) stainless steel washers. Blankets shall have stainless steel wire installed for draw cords.

## 2.5 JACKETS AND FITTING COVERS

A. PVC Plastic Jacket and Fitting Covers (Interior Applications):

1. Manufacturers (Refer to Section 230000):
  - a. Zeston 2000
2. Jackets and fitting covers: ASTM D1784; one piece molded type fitting covers and sheet material; off-white color; minimum service temperature: 0 °F -18 °C; maximum service temperature: 450 °F 230° C; thickness: 20 mil 0.50 mm
3. Jackets and fitting covers (vapor barrier jackets): ASTM D1784; one piece molded type fitting covers and sheet material; off-white color; minimum service temperature: 0 °F -18 °C; maximum service temperature: 450 °F 230 °C; moisture vapor transmission - ASTM E96 - 0.002 perm-inches 0.0029 ng/(s×m×Pa); thickness: 20 mil 0.50 mm.
4. Connections: Pressure sensitive color matching vinyl tape

B. Inserts and Shields

1. Inserts: Heavy density insulation which will not crush from weight of pipe. Locate between shield and pipe. Inserts are furnished in this Section and installed in Section 15140.
2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and insulation. Shields are furnished and installed under Section 230901.

## PART 3 EXECUTION

### 3.1 GENERAL

A. Examination

1. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
2. Verify that systems and equipment to be insulated have been tested and are free of defects.
3. Verify that surfaces to be insulated are clean and dry.
4. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Preparation

1. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
2. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
3. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

C. Installation

1. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment, ducts and fittings, and piping including fittings, valves, and specialties.
2. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and pipe system as specified in insulation system schedules.
3. 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.
4. Install insulation with longitudinal seams at top and bottom of horizontal runs.
5. Install multiple layers of insulation with longitudinal and end seams staggered.
6. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
7. Keep insulation materials dry during application and finishing.
8. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
9. Install insulation with least number of joints practical.
10. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
  - a. Install insulation continuously through hangers and around anchor attachments.
  - b. 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.
  - c. 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.

- d. 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.
  11. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
  12. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
  13. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
  14. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches (100 mm) beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
  15. For above ambient services, do not install insulation to the following:
    - a. Vibration-control devices.
    - b. Testing agency labels and stamps.
    - c. Nameplates and data plates.
    - d. Manholes.
    - e. Handholes.
    - f. Cleanouts.
- D. Application
1. Insulation shall be applied in accordance with the requirements of the applicable energy code. Refer to code for minimum required thicknesses.
  2. Additional information has been provided in the schedules at the end of this section. It is the intent of this information to help communicate the requirements of the energy code, and to provide supplemental information.
  3. Where insulation requirements at the end of this section are more stringent than energy code requirements, the more stringent requirements shall be met.
  4. Where insulation requirements at the end of this section are less stringent than the energy code requirements, the more stringent energy code requirements shall be met.
  5. For systems that have not been specifically noted in the schedule at the end of this section, energy code requirements shall dictate insulation requirements.
  6. Provide lace-on blankets at all valves, unions, strainers and flanges.
  7. Provide equipment insulation at all equipment connected to systems requiring insulation that receive fluids at system operating temperature and are not factory insulated to system requirements. This shall include pumps.

E. Penetrations

1. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
  - a. Seal penetrations with flashing sealant.
  - b. 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.
  - c. Extend jacket of outdoor insulation outside roof flashing at least 2 inches (50 mm) below top of roof flashing.
  - d. Seal jacket to roof flashing with flashing sealant.
2. Insulation Installation at Below-Grade Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
3. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
  - a. Seal penetrations with flashing sealant.
  - b. 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.
  - c. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches (50 mm).
  - d. Seal jacket to wall flashing with flashing sealant.
4. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
5. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions. 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 (50 mm).
  - a. Firestopping and fire-resistive joint sealers are specified in Division 7 Section "Through-Penetration Firestop Systems."
6. Insulation Installation at Floor Penetrations:
  - a. Pipe: Install insulation continuously through floor penetrations.
  - b. Seal penetrations through fire-rated assemblies according to Division 7.
7. Insulation Installation on Pipe Flanges:
  - a. Install preformed pipe insulation to outer diameter of pipe flange.
  - b. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
  - c. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of block insulation of same material and thickness as pipe insulation.
  - d. Finish flange insulation same as pipe insulation.
8. Insulation Installation on Pipe Fittings and Elbows:

- a. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
- b. When preformed insulation sections of insulation are not available, install mitered sections of calcium silicate insulation. Secure insulation materials with wire or bands.
- c. Finish fittings insulation same as pipe insulation.

### 3.2 DUCT AND PLENUM INSULATION

#### A. Glass Fiber, Flexible Blanket (Duct Wrap)

1. Secure with adhesive and insulation pins.
2. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
3. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
4. 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 (450 mm) and smaller, place pins along longitudinal centerline of duct. Space 3 inches (75 mm) maximum from insulation end joints, and 16 inches (400 mm) o.c.
  - b. On duct sides with dimensions larger than 18 inches (450 mm), place pins 16 inches (400 mm) o.c. each way, and 3 inches (75 mm) 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.
5. 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 (50 mm) from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch (13-mm) outward-clinching staples, 1 inch (25 mm) 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 (10 deg C) at 18-foot (5.5-m) 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 2 times the insulation thickness but not less than 3 inches (75 mm).

6. Overlap unfaced blankets a minimum of 2 inches (50 mm) on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches (450 mm) o.c.
7. 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.
8. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- (150-mm-) wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches (150 mm) o.c.

B. Glass Fiber, Flexible (Duct Liner)

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 (450 mm) and smaller, place pins along longitudinal centerline of duct. Space 3 inches (75 mm) maximum from insulation end joints, and 16 inches (400 mm) o.c.
  - b. On duct sides with dimensions larger than 18 inches (450 mm), space pins 16 inches (400 mm) o.c. each way, and 3 inches (75 mm) 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 (50 mm) from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch (13-mm) outward-clinching staples, 1 inch (25 mm) 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 (10 deg C) at 18-foot (5.5-m) 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 2 times the insulation thickness but not less than 3 inches (75 mm).

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- (150-mm-) wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches (150 mm) o.c.

C. Application

1. Refer to General Application requirements earlier in this section, and the schedule information at the end of this section.

### 3.3 LACE-ON BLANKETS

- A. Provide lace-on blankets at all components requiring maintenance access, including but not limited to valves, strainers, flanges, and unions.

### 3.4 JACKETS AND FITTING COVERS

- A. Provide PVC jackets for interior applications, and aluminum jackets for exterior applications.
- B. Where PVC jackets are indicated, install with 1-inch (25-mm) 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.
- C. Where metal jackets are indicated, install with 2-inch (50-mm) 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 (300 mm) o.c. and at end joints.

### 3.5 EQUIPMENT INSULATION

- A. Secure insulation with adhesive and anchor pins and speed washers.
  1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of tank and vessel surfaces.
  2. Groove and score insulation materials to fit as closely as possible to equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joints. Stagger end joints.
  3. Protect exposed corners with secured corner angles.
  4. Install adhesively attached or self-sticking insulation hangers and speed washers on sides of tanks and vessels as follows:



- a. Do not weld anchor pins to ASME-labeled pressure vessels.
  - b. Select insulation hangers and adhesive that are compatible with service temperature and with substrate.
  - c. On tanks and vessels, maximum anchor-pin spacing is 3 inches (75 mm) from insulation end joints, and 16 inches (400 mm) o.c. in both directions.
  - d. Do not overcompress insulation during installation.
5. Secure each layer of insulation with stainless-steel or aluminum bands. Select band material compatible with insulation materials.
    - a. Secure aluminum jackets with aluminum bands on 12 inch centers with longitudinal seams lapped and turned down shall be installed on all piping exposed to weather.
  6. Install insulation in removable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection.
  7. For equipment with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.

## PART 4 SCHEDULES

### 4.1 DUCT INSULATION SCHEDULE

DUCTWORK INSULATION SCHEDULE			
SERVICE	INSULATION TYPE	THICKNESS (inches)	NOTES
Lined Supply Ductwork - Building Interior	Glass Fiber, Flexible (Duct Liner)	1	3, 4
Wrapped Supply Ductwork - Building Interior	Glass Fiber, Flexible Blanket (Duct Wrap)	1½	1
Lined Supply Ductwork - Building Exterior (including ventilated attic spaces)	Glass Fiber, Flexible (Duct Liner)	2½	3, 4
Wrapped Supply Ductwork - Building Exterior (including ventilated attic spaces)	Glass Fiber, Rigid	2½	1
Lined Return Ductwork - Building Interior	Glass Fiber, Flexible (duct liner)	1	3, 4
Lined Return Ductwork - Building Exterior (including ventilated attic spaces)	Glass Fiber, Flexible (duct liner)	2½	3, 4
Wrapped Return Ductwork - Building Exterior (including ventilated attic spaces)	Glass Fiber, Rigid	2½	2
Combustion Air Ductwork	Glass Fiber, Flexible Blanket (Duct Wrap)	1½	
Lined Outside / Exhaust / Economizer Relief Air Ductwork between insulated	Glass Fiber, Flexible (Duct Liner) And	1 And 3	6

<b>DUCTWORK INSULATION SCHEDULE</b>			
<b>SERVICE</b>	<b>INSULATION TYPE</b>	<b>THICKNESS (inches)</b>	<b>NOTES</b>
wall or roof and indoor equipment or motorized damper	Glass Fiber, Flexible Blanket (Ductwrap)		
Un-lined Outside / Exhaust / Economizer Relief Air Ductwork (Systems 2800 cfm and greater) between insulated wall or roof and indoor equipment or motorized damper	Glass Fiber, Flexible Blanket (Ductwrap)	4½	6
Lined Outside Air Ductwork (All Systems) between motorized damper and indoor equipment	Glass Fiber, Flexible (Duct liner)	1	
Un-lined Outside Air Ductwork (All Systems) between motorized damper and indoor equipment	Glass Fiber, Flexible Blanket (Ductwrap)	1½	
<p>Notes:</p> <ol style="list-style-type: none"> <li>1. All supply ductwork not indicated to be lined shall be wrapped. Exception: exposed ductwork serving only the area in which it is located.</li> <li>2. All return ductwork exterior to the building (including ventilated attic spaces) not indicated to be lined shall be wrapped.</li> <li>3. In some areas on the Drawings, duct liner may be indicated to be greater than 1 inch for acoustical purposes. Provide thickness indicated.</li> <li>4. Where round or flat oval duct is indicated to be lined, see Section 233110 – Ductwork.</li> <li>5. Insulate systems noted with an installed R-7 insulation system with insulation types and thicknesses indicated.</li> <li>6. Insulate systems noted with an installed R-11 insulation system with insulation types and thicknesses indicated.</li> </ol>			

END OF SECTION 230700

## SECTION 23 09 00 - INSTRUMENTATION AND CONTROL DEVICES FOR HVAC SYSTEMS

### PART 1 GENERAL

#### 1.1 MECHANICAL GENERAL PROVISIONS

- A. This contractor shall conform to the General and Supplementary Conditions Provisions under Division 1 of the Specifications.
- B. This contractor shall conform to the Specifications Section 23 05 00: Mechanical General Provisions.

#### 1.2 SUMMARY

- A. Scope: Furnish all labor, materials and equipment necessary to modify the existing Siemens Building Management System (digital controls system), utilizing Direct Digital Controls as shown on the drawings and as described herein. Drawings are diagrammatic only.
  - 1. The intent of this specification is to furnish and install two new wall mounted room temperature sensors and connect the two new sensors to the existing Siemens PXXCM controller located in the NE Basement Mechanical Room 4, in the Gill Coliseum basement. Integrate the two new sensors into the existing digital controls system and add the spaces and sensors to the existing graphics already present. The new temperature sensors shall be advisory only and have no control input to the mechanical systems serving the space. Furnish and install all necessary conduit, wiring, connections to existing controllers, configuration, calibration and integration into the existing controls system.
- B. Approved Manufacturers: Siemens Building Technologies. No Substitutions
- A. Approved Installation Contractors: Siemens Building Technologies.

#### 1.3 SUBMITTALS:

- A. Submit documentation of contractor qualifications, including those indicated in paragraph 1.9 "Quality Assurance" if requested by the A-E.
- B. Product data for the room sensors shall be submitted including manufacturers' catalog data sheets and installation instructions.
- C. Shop drawings shall also contain complete wiring and schematic diagrams, sequences of operation, control system bus layout and any other details required to demonstrate that the system has been coordinated and will properly function as a system. Terminal identification for all control wiring shall be shown on the shop drawings.
- D. Any deviations from these specifications or the work indicated on the drawings shall be clearly identified in the Submittals.

#### **1.4 DELIVERY, STORAGE AND HANDLING**

- A. Maintain integrity of shipping cartons for each piece of equipment and control device through shipping, storage, and handling as required to prevent equipment damage. Store equipment and materials inside and protected from weather.

#### **1.5 JOB CONDITIONS**

- A. Cooperation with Other Trades: Coordinate the Work of this section with that of other sections to insure that the Work will be carried out in an orderly fashion. It shall be this Contractor's responsibility to check the Contract Documents for possible conflicts between his Work and that of other crafts in equipment location, pipe, duct and conduit runs, electrical outlets and fixtures, air diffusers, and structural and architectural features.

### **PART 2 MATERIALS**

#### **2.1 GENERAL**

- A. The Building Management System (digital controls system) is existing in this portion of the building.

#### **2.2 TEMPERATURE SENSORS**

- A. Wall Mounted Room Temperature sensors: Each room temperature sensor shall provide temperature indication to the existing digital controller and overall existing digital controls system. The sensor shall be non-adjustable and have no display to indicate the room temperature and no occupant set point adjustment or occupancy over-ride button. The sensor is advisory only, reporting the room temperature to the existing digital controls system. The sensor shall be complete with a decorative cover and suitable for mounting over a standard electrical utility box. These devices shall have an accuracy of 0.5 degrees, F., over the entire range.
- B. Sensors shall be suitable for use with an existing Siemens PXXM controller.
- C. Space Temperature Sensor Foam Insulation Pad: Ensure all space temperature sensors are isolated from the wall surface with a minimum ¼ inch foam pad.

### **PART 3 EXECUTION**

#### **3.1 INSTALLATION**

- A. GENERAL

1. Install room temperature sensors in accordance with manufacturer's instructions, and as detailed on the project drawing set.
2. Mount on the wall 54" above the finished floor.
3. Line and low voltage electrical connections to control equipment shown specified or shown on the control diagrams shall be furnished and installed by the Control System Contractor in accordance with these specifications.
4. Equipment furnished by the Mechanical Contractor that is normally wired before installation shall be furnished completely wired. Control wiring normally performed in the field will be furnished and installed by the Control System Contractor.

**B. WIRING**

1. All electrical control wiring to the control panels shall be the responsibility of the Control System Contractor.
2. All wiring shall be in accordance with the Project Electrical Specifications, the National Electrical Code and any applicable local codes. All control wiring shall be installed in raceways.
3. All Lon bus wire shall be orange in color.

**C. INTEGRATION AND PROGRAMMING**

1. Add the room temperature sensors to the existing digital controls system.
2. Route wiring for sensors to an existing Siemens PXXM controller located in .NE Basement Mechanical Room 4. The existing controller has sufficient spare capacity for two additional room temperature sensors.
3. Add floor plan graphics to the existing digital controls system floor plan graphics with color indication of room temperature similar to existing systems nearby.
4. Label rooms where temperature sensors are located using room names from architectural plans.
5. Coordinate with owners digital controls system personnel for device naming and other site related standards and preferences.

### 3.2 PROJECT CLOSEOUT

#### A. ACCEPTANCE TESTING

2. The Control System Contractor shall perform tests to verify proper performance of components, routines, and points. Repeat tests until proper performance results. This testing shall include a point-by-point log to validate 100% of the input and output points of the DDC system operation.
3. System Acceptance: Satisfactory completion is when the Control System Contractor has performed successfully all the required testing to show performance compliance with the requirements of the Contract Documents to the satisfaction of the Owner's Representative. System acceptance shall be contingent upon completion and review of all corrected deficiencies.

#### B. WARRANTY PERIOD SERVICES

4. Equipment, materials and workmanship incorporated into the work shall be warranted for a period of one year from the time of system acceptance.
5. Within this period, upon notice by the Owner, any defects in the digital controls system due to faulty materials, methods of installation or workmanship shall be promptly repaired or replaced by the Control System Contractor at no expense to the Owner
6. Service Period: Calls for service by the Owner shall be honored within 24 hours and are not to be considered as part of routine maintenance.
7. Service Documentation: A copy of the service report associated with each owner-initiated service call shall be provided to the owner.

#### C. OPERATION & MAINTENANCE MANUALS

8. See Division 1 for requirements. O&M manuals shall include the following elements, as a minimum:
9. As-built control drawings for all equipment.
10. General description and specifications for all components.
  - a.

**END OF SECTION 23 09 00**

## **SECTION 23 31 00 - METAL DUCTS**

### **PART 1 GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Section 230000 – General HVAC Requirements

#### **1.2 REFERENCES**

- A. General
  - 1. ASTM A 36 - Structural Steel
  - 2. ASTM A 90 - Weight of Coating on Zinc-Coated (Galvanized) Iron or Steel Articles
  - 3. ASTM A 366 - Steel, Sheet, Carbon, Cold Rolled, Commercial Quality
  - 4. ASTM A 525 - General Requirements for Steel Sheet, Zinc- Coated (Galvanized) by the Hot-Dip Process
  - 5. ASTM A 527 - Steel Sheet, Zinc-Coated (Galvanized) by Hot-Dip Process, Lock Forming Quality
  - 6. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Material
  - 7. NFPA 90A - Installation of Air Conditioning and Ventilating systems
  - 8. SMACNA - HVAC Air Duct Leakage Test Manual
  - 9. SMACNA - HVAC Duct Construction Standards - Metal and Flexible
  - 10. UL 181 - Factory-Made Air Ducts and Connectors

#### **1.3 SUBMITTALS**

- A. General
  - 1. Welding certificates.
  - 2. Field quality-control test reports.

#### **1.4 QUALITY ASSURANCE**

- A. Construct ductwork to the 1997 Uniform Mechanical Code, and SMACNA, HVAC Duct Construction Standards - Metal and Flexible, Latest Edition
- B. In addition to the above standards, construct kitchen ductwork serving type I hoods to NFPA 96 and 1997 UMC standards.
- C. In addition to the above standards, construct ductwork from product conveying exhaust systems to

NFPA 91 standards.

- D. Where more than one standard is referenced, the most restrictive shall apply.
- E. Welding: Qualify procedures and personnel according to [AWS D1.1, "Structural Welding Code--Steel," for hangers and supports] [AWS D1.2, "Structural Welding Code--Aluminum," for aluminum supporting members] [and] [AWS D9.1, "Sheet Metal Welding Code," for duct joint and seam welding].
- F. NFPA Compliance:
  - 1. NFPA 90A, "Installation of Air Conditioning and Ventilating Systems."
  - 2. NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- G. Comply with NFPA 96, "Ventilation Control and Fire Protection of Commercial Cooking Operations," Ch. 3, "Duct System," for range hood ducts, unless otherwise indicated.

## **PRODUCTS**

### **1.1 SHEET METAL MATERIALS**

- A. 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: Lock-forming quality; complying with ASTM A 653/A 653M and having G60 (Z180) coating designation; ducts shall have mill-phosphatized finish for surfaces exposed to view.
- C. Stainless Steel: ASTM A 480/A 480M, Type 316 or 304, as specified (use type 316 if not otherwise specified) and having a No. 2D finish.
- D. Aluminum Sheets: ASTM B 209 (ASTM B 209M), alloy 3003, temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.
- E. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts.
- F. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for lengths 36 inches (900 mm) or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

## 1.2 LOW VELOCITY DUCTWORK AND FITTINGS

- A. General
  - 1. Low velocity ductwork shall be defined as all ductwork not specifically defined as medium velocity ductwork.
  - 2. Fabricate, install, and support in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, the Uniform Mechanical Code, and as indicated. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.
  - 3. Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Provide turning vanes in all rectangular elbows greater than 45 degrees (unless utilized for return duct stub-outs into return air plenums - no vanes required).
  - 4. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.
  - 5. Maximum pressure drop: 0.10 inches w.c per 100 feet.
  - 6. Maximum velocity: 1200 fpm
    - a. Supply Diffuser run out: 500 fpm.
    - b. Return run out: 600 fpm.
    - c. Branch duct above ceiling: 1750 fpm.
    - d. Mains in mechanical rooms or shafts: 2,000 fpm.
    - e. Exposed mains: 1,450 fpm.
- B. Low velocity plenums
  - 1. Plenums shall be at least two gages heavier than specified ductwork of equal size.
  - 2. Provide access doors to service equipment. Fabricate with 16 gage steel double wall construction with 1 inch (25 mm) thick fiberglass insulation in core. Openings shall be reinforced with welded angle bar frames. Doors shall be pulled airtight on neoprene gaskets.

C. Rectangular Duct and Fitting Fabrication

1. Fabricate ducts, elbows, transitions, offsets, branch connections, and other construction according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" and complying with requirements for metal thickness, reinforcing types and intervals, tie-rod applications, and joint types and intervals.
  - a. Lengths: Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure class.
  - b. Deflection: Duct systems shall not exceed deflection limits according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."
2. Transverse Joints: Prefabricated slide-on joints and components constructed using manufacturer's guidelines for material thickness, reinforcement size and spacing, and joint reinforcement.
3. Formed-On Flanges: Construct according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," Figure 1-4, using corner, bolt, cleat, and gasket details.
  - a. Duct Size: Maximum 30 inches (750 mm) wide and up to 2-inch wg (500-Pa) pressure class.
  - b. Longitudinal Seams: Pittsburgh lock sealed with noncuring polymer sealant.
4. Cross Breaking or Cross Beading: Cross break or cross bead duct sides 19 inches (480 mm) and larger and 0.0359 inch (0.9 mm) thick or less, with more than 10 sq. ft. (0.93 sq. m) of nonbraced panel area unless ducts are lined.

D. Round and Flat-Oval Duct and Fitting Fabrication

1. General
  - a. Diameter as applied to flat-oval ducts in this Article is the diameter of a round duct with a circumference equal to the perimeter of a given size of flat-oval duct.

- b. Round, Longitudinal- and Spiral Lock-Seam Ducts: Fabricate supply ducts of galvanized steel according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."
  - c. Flat-Oval, Spiral Lock-Seam Ducts: Fabricate supply ducts according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible." Fabricate ducts larger than 72 inches (1830 mm) in diameter with continuously butt-welded longitudinal seams.
2. Duct Joints
- a. Ducts up to 20 Inches (500 mm) in Diameter: Interior, center-beaded slip coupling, sealed before and after fastening, attached with sheet metal screws.
  - b. Ducts 21 to 72 Inches (535 to 1830 mm) in Diameter: Three-piece, gasketed, flanged joint consisting of two internal flanges with sealant and one external closure band with gasket.
  - c. Ducts Larger Than 72 Inches (1830 mm) in Diameter: Companion angle flanged joints per SMACNA "HVAC Duct Construction Standards--Metal and Flexible," Figure 3-2.
  - d. Round Ducts: Prefabricated connection system consisting of double-lipped, EPDM rubber gasket. Manufacture ducts according to connection system manufacturer's tolerances.
  - e. Flat-Oval Ducts: Prefabricated connection system consisting of two flanges and one synthetic rubber gasket.
3. 90-Degree Tees and Laterals and Conical Tees: Fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," with metal thicknesses specified for longitudinal-seam straight ducts.
4. Diverging-Flow Fittings: Fabricate with reduced entrance to branch taps and with no excess material projecting from fitting onto branch tap entrance.
5. Fabricate elbows using die-formed, gored, pleated, or mitered construction. Unless elbow construction type is indicated, fabricate elbows as follows:
- a. Mitered-Elbow Radius and Number of Pieces: Continuously welded construction complying with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," unless otherwise indicated.
  - b. Round Mitered Elbows: Continuously welded construction with the following metal thickness for pressure classes from minus 2- to plus 2-inch wg (minus 500 to plus 500 Pa):
    - 1) Ducts 3 to 36 Inches (75 to 915 mm) in Diameter: 0.034 inch (0.85 mm).
    - 2) Ducts 37 to 50 Inches (940 to 1270 mm) in Diameter: 0.040 inch (1.0 mm).
    - 3) Ducts 52 to 60 Inches (1320 to 1525 mm) in Diameter: 0.052 inch (1.3 mm).
    - 4) Ducts 62 to 84 Inches (1575 to 2130 mm) in Diameter: 0.064 inch (1.6 mm).
  - c. Round Mitered Elbows: Continuously welded construction with the following metal thickness for pressure classes from 2- to 10-inch wg (500 to 2500 Pa):
    - 1) Ducts 3 to 26 Inches (75 to 660 mm) in Diameter: 0.034 inch (0.85 mm).
    - 2) Ducts 27 to 50 Inches (685 to 1270 mm) in Diameter: 0.040 inch (1.0 mm).
    - 3) Ducts 52 to 60 Inches (1320 to 1525 mm) in Diameter: 0.052 inch (1.3 mm).
    - 4) Ducts 62 to 84 Inches (1575 to 2130 mm) in Diameter: 0.064 inch (1.6 mm).
  - d. Flat-Oval Mitered Elbows: Continuously welded construction with same metal thickness as longitudinal-seam flat-oval duct.
  - e. 90-Degree, 2-Piece, Mitered Elbows: Use only for supply systems or for material-handling Class A or B exhaust systems and only where space restrictions do not permit using radius elbows. Fabricate with single-thickness turning vanes.

- f. Round Elbows 8 Inches (200 mm) and Less in Diameter: Fabricate die-formed elbows for 45- and 90-degree elbows and pleated elbows for 30, 45, 60, and 90 degrees only. Fabricate nonstandard bend-angle configurations or nonstandard diameter elbows with gored construction.
- g. Round Elbows 9 through 14 Inches (225 through 355 mm) in Diameter: Fabricate gored or pleated elbows for 30, 45, 60, and 90 degrees unless space restrictions require mitered elbows. Fabricate nonstandard bend-angle configurations or nonstandard diameter elbows with gored construction.
- h. Round Elbows Larger than 14 Inches (355 mm) in Diameter and All Flat-Oval Elbows: Fabricate gored elbows unless space restrictions require mitered elbows.
- i. Die-Formed Elbows for Sizes through 8 Inches (200 mm) in Diameter and All Pressures 0.040 inch (1.0 mm) thick with 2-piece continuously welded construction.
- j. Round Gored-Elbow Metal Thickness: Same as non-elbow fittings specified above.
- k. Flat-Oval Elbow Metal Thickness: Same as longitudinal-seam flat-oval duct specified above.
- l. Pleated Elbows for Sizes through 14 Inches (355 mm) in Diameter and Pressures through 10-Inch wg (2500 Pa): 0.022 inch (0.55 mm).

### 1.3 FLEXIBLE DUCTS:

- A. Manufacturers:
  - 1. Genflex
  - 2. Thermaflex
  - 3. Thermold
  - 4. Wiremold
  - 5. Hart & Cooley
- B. Basis of Design: Thermaflex, Model G-KM.
- C. U.L. 181 Class 1 flexible air duct complying with NFPA standard 90A; factory fabricated assembly composed of an inner liner, coated wound spring steel wire, 1 inch (25 mm) thick fiberglass insulation (installed R-value 4.3), and a vapor barrier outer jacket; 6 inches WG (2.50 kPa) positive working pressure and 1 inch WG (250 Pa) negative working pressure for ducts up to 10 inch (254 mm) diameter, 4 inches WG (2.50 kPa) positive working pressure and 1.0 inches WG (250 Pa) negative working pressure for ducts 12 inches to 16 inches (305 to 406 mm) diameter; 4000 fpm (20.3 m/sec) maximum working velocity, 20 degrees F to 200 degrees F (-23 degrees C to 71 degrees C) working temperatures.

### 1.4 HANGERS AND SUPPORTS

- A. Hanger Materials: Galvanized sheet steel or threaded steel rod at the Contractor's option, with the following limitations:
  - 1. Hangers Exposed in Finished Areas: Use threaded rod.
  - 2. Hangers for Medium Pressure Ductwork: Use threaded rod.
  - 3. Hangers for Low Pressure Ductwork greater than 12" diameter round or rectangular with either side greater than 16" in length: Use threaded rod.

4. Hangers Installed in Corrosive Atmospheres: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
  5. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards-- Metal and Flexible" for steel sheet width and thickness and for steel rod diameters.
  6. Galvanized-steel straps attached to aluminum ducts shall have contact surfaces painted with zinc-chromate primer.
- B. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- C. Trapeze and Riser Supports: Steel shapes complying with ASTM A 36/A 36M.
1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
  2. Supports for Stainless-Steel Ducts: Stainless-steel support materials.
  3. Supports for Aluminum Ducts: Aluminum support materials unless materials are electrolytically separated from ducts.

## 1.5 SEALANT MATERIALS

- A. Joint and Seam Sealants, General: The term "sealant" is not limited to materials of adhesive or mastic nature but includes tapes and combinations of open-weave fabric strips and mastics.
- B. Water-Based Joint and Seam Sealant: Flexible, adhesive sealant, resistant to UV light when cured, UL 723 listed, and complying with NFPA requirements for Class 1 ducts.
- C. Solvent-Based Joint and Seam Sealant: One-part, nonsag, solvent-release-curing, polymerized butyl sealant formulated with a minimum of 75 percent solids.
- D. Flanged Joint Mastic: One-part, acid-curing, silicone, elastomeric joint sealant complying with ASTM C 920, Type S, Grade NS, Class 25, Use O.
- E. Flange Gaskets: Butyl rubber or EPDM polymer with polyisobutylene plasticizer.

## EXECUTION

### 1.1 DUCT APPLICATIONS

- A. Static-Pressure Classes: Unless otherwise indicated, construct ducts according to the following. Medium velocity ducts shall include all supply ductwork between fans and VAV boxes. Medium velocity ductwork shall also include exhaust systems with velocities in excess of 1800 fpm.
1. Low Velocity Ducts: 2-inch wg (500 Pa) or 1.5 times the listed external pressure of the fan serving the duct system, whichever is higher.
  2. Medium Velocity Ducts: 6-inch wg (1500 Pa) or 1.5 times the listed external pressure of the fan serving the duct system, whichever is higher.
- B. All ducts shall be galvanized steel except as follows:

1. Range Hood Exhaust Ducts: Comply with NFPA 96.
  - a. Concealed: Carbon-steel sheet.
  - b. Exposed: Type 304, stainless steel with finish to match kitchen equipment and range hood.
  - c. Continuously weld seams and joints.
2. Dishwasher Hood Exhaust Ducts:
  - a. Type 304, stainless steel with finish to match kitchen equipment and range hood. Continuously weld seams and joints.
  - b. Aluminum, with seams and laps arranged on top of duct.
3. Acid-Resistant (Fume-Handling) Ducts: Type 316 stainless-steel. Continuously weld joints.
4. Underground Ducts: Concrete-encased galvanized steel or PVC-coated galvanized steel with thicker coating on duct exterior.

## 1.2 DUCT INSTALLATION

- A. Construct and install ducts according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," unless otherwise indicated.
- B. Install round and flat-oval ducts in lengths not less than 12 feet (3.7 m) unless interrupted by fittings.
- C. Install ducts with fewest possible joints.
- D. Install fabricated fittings for changes in directions, size, and shape and for connections.
- E. Install couplings tight to duct wall surface with a minimum of projections into duct. Secure couplings with sheet metal screws. Install screws at intervals of 12 inches (300 mm), with a minimum of 3 screws in each coupling.
- F. Install ducts, unless otherwise indicated, vertically and horizontally and parallel and perpendicular to building lines; avoid diagonal runs.
- 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 (25 mm), plus allowance for insulation thickness.
- I. Conceal ducts from view in finished spaces. Do not encase horizontal runs in solid partitions unless specifically indicated.
- J. Coordinate layout with suspended ceiling, fire- and smoke-control dampers, lighting layouts, and similar finished work.
- K. Seal all joints and seams. Apply sealant to male end connectors before insertion, and afterward to cover entire joint and sheet metal screws.

- L. Electrical Equipment Spaces: Route ducts to avoid passing through transformer vaults and electrical equipment spaces and enclosures.
- M. Non-Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls and are exposed to view, conceal spaces between construction openings and ducts or duct insulation with sheet metal flanges of same metal thickness as ducts. Overlap openings on 4 sides by at least 1-1/2 inches (38 mm).
- N. Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls, install appropriately rated fire or fire/smoke dampers, sleeves, and firestopping sealant. Fire and smoke dampers are specified in Division 23 Section "Duct Accessories." Firestopping materials and installation methods are specified in Division 7 Section "Through-Penetration Firestop Systems."
- O. Install ducts with hangers and braces designed to withstand, without damage to equipment, seismic force required by applicable building codes. Refer to SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems."
- P. Protect duct interiors from the elements and foreign materials until building is enclosed. Follow SMACNA's "Duct Cleanliness for New Construction."
- Q. Paint interiors of metal ducts, that do not have duct liner, for 24 inches (600 mm) upstream of registers and grilles. Apply one coat of flat, black, latex finish coat over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Division 9 painting Sections.

### **1.3 SEAM AND JOINT SEALING**

- A. Seal duct seams and joints according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for duct pressure class indicated.
  - 1. For pressure classes lower than 2-inch wg (500 Pa), seal transverse joints.
- B. Seal ducts before external insulation is applied.

### **1.4 HANGING AND SUPPORTING**

- A. Support horizontal ducts within 24 inches (600 mm) of each elbow and within 48 inches (1200 mm) of each branch intersection.
- B. Support vertical ducts at maximum intervals of 16 feet (5 m) and at each floor.
- C. Install upper attachments to structures with an allowable load not exceeding one-fourth of failure (proof-test) load.
- D. Install concrete inserts before placing concrete.

## 1.5 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections according to SMACNA's "HVAC Air Duct Leakage Test Manual" and prepare test reports:
1. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
  2. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If pressure classes are not indicated, test entire system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure. Give seven days' advance notice for testing.
  3. Maximum Allowable Leakage: Comply with requirements for Leakage Class 3 for round and flat-oval ducts, Leakage Class 12 for rectangular ducts in pressure classes lower than and equal to 2-inch wg (500 Pa) (both positive and negative pressures), and Leakage Class 6 for pressure classes from 2- to 10-inch wg (500 to 2500 Pa).
  4. Remake leaking joints and retest until leakage is equal to or less than maximum allowable.
- B. The entire duct system is required to be tested. At the contractor's option, portions of the system may be tested. In these cases, the sum of leakages shall be added to determine the entire system leakage for verification that the entire system is within acceptable leakage limits. No portion of the system shall be made inaccessible until the entire system has been tested.
1. Exceptions
    - a. In zoned systems, zone ductwork may be covered when the zone has been determined to be within acceptable limits.
    - b. The Contractor may obtain written approval from the Owner's Representative to cover portions of a system prior to complete system testing. In such cases, the Contractor shall demonstrate that tested portions of the system are such that, when considered in aggregate with the remaining portions of the system, acceptable leakage rates will be achieved assuming remaining test results are similar to those obtained in the area to be covered.

## 1.6 CLEANING NEW SYSTEMS

- A. Mark position of dampers and air-directional mechanical devices before cleaning and perform cleaning before air balancing.
- B. Use service openings, as required, for physical and mechanical entry and for inspection.
1. Create other openings to comply with duct standards.
  2. Disconnect flexible ducts as needed for cleaning and inspection.
  3. Remove and reinstall ceiling sections to gain access during the cleaning process.
- C. Vent vacuuming system to the outside. Include filtration to contain debris removed from HVAC systems, and locate exhaust down wind and away from air intakes and other points of entry into building.
- D. Clean the following metal duct systems by removing surface contaminants and deposits:
1. Air outlets and inlets (registers, grilles, and diffusers).
  2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and



- return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
  4. Coils and related components.
  5. Return-air ducts, dampers, and actuators except in ceiling plenums and mechanical equipment rooms.
  6. Supply-air ducts, dampers, actuators, and turning vanes.
- E. Mechanical Cleaning Methodology:
1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
  2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
  3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
  4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet.
  5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
- F. Cleanliness Verification:
1. Visually inspect metal ducts for contaminants.
  2. Where contaminants are discovered, re-clean and reinspect ducts.

## 1.7 CLEANING EXISTING SYSTEMS

- A. Use service openings, as required, for physical and mechanical entry and for inspection.
1. Use existing service openings where possible.
  2. Create other openings to comply with duct standards.
  3. Disconnect flexible ducts as needed for cleaning and inspection.
  4. Reseal rigid fiberglass duct systems according to NAIMA recommended practices.
  5. Remove and reinstall ceiling sections to gain access during the cleaning process.
- B. Mark position of dampers and air-directional mechanical devices before cleaning and restore to their marked position on completion.
- C. Particulate Collection and Odor Control:
1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron size (or larger) particles.
  2. When venting vacuuming system to the outside, use filtration to contain debris removed from HVAC system, and locate exhaust down wind and away from air intakes and other points of entry into building.
- D. Clean the following metal duct systems by removing surface contaminants and deposits:

1. Air outlets and inlets (registers, grilles, and diffusers).
  2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
  3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
  4. Coils and related components.
  5. Return-air ducts, dampers, and actuators except in ceiling plenums and mechanical equipment rooms.
  6. Supply-air ducts, dampers, actuators, and turning vanes.
  7. Dedicated exhaust and ventilation components and makeup air systems.
- E. Mechanical Cleaning Methodology:
1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
  2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
    - 1) Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
    - 2) Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
    - 3) Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
    - 4) Provide operative drainage system for washdown procedures.
    - 5) Biocidal Agents and Coatings: Apply biocidal agents if fungus is present. Apply biocidal agents according to manufacturer's written instructions after removal of surface deposits and debris.
  - b. Cleanliness Verification:
    - 1) Verify cleanliness after mechanical cleaning and before application of treatment, including biocidal agents and protective coatings.

VISUALLY INSPECT METAL DUCTS FOR CONTAMINANTS.
    - 2) Where contaminants are discovered, re-clean and reinspect ducts.
  - c. Gravimetric Analysis: At discretion and expense of Owner, sections of metal duct system, chosen randomly by Owner, may be tested for cleanliness according to NADCA vacuum test gravimetric analysis.
    - 1) If analysis determines that levels of debris are equal to or lower than suitable levels, system shall have passed cleanliness verification.
    - 2) If analysis determines that levels of debris exceed suitable levels, system cleanliness verification will have failed and metal duct system shall be re-cleaned and re-verified.
  - d. Verification of Coil Cleaning: Cleaning must restore coil pressure drop to within 10 percent of pressure drop measured when coil was first installed. If original pressure drop is not known, coil will be considered clean only if it is free of foreign matter and chemical residue,

**Gensler**  
005.2096.400

August 20, 2019  
Addendum No. 3

**Gill Coliseum Women's  
Basketball Locker Room  
Renovation** Corvallis,  
Oregon

based on thorough visual inspection.

END OF SECTION 233100

## **SECTION 23 33 00 - DUCT ACCESSORIES**

### **PART 1 GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Section 230000 – General HVAC Requirements

#### **1.2 REFERENCES**

- A. General
  - 1. NFPA 90A - Installation of Air Conditioning and Ventilating Systems
  - 2. NFPA 92A - Smoke Control Systems
  - 3. NFPA 96 - Installation of Equipment for the Removal of Smoke and Grease Laden Vapors for Commercial Cooking Equipment
  - 4. SMACNA - HVAC Duct Construction Standards - Metal and Flexible
  - 5. UL 33 - Heat Responsive Links for Fire-Protection Service
  - 6. UL 555 - Fire Dampers and Ceiling Dampers
  - 7. UL 555S - Leakage Rated Dampers for Use in Smoke Control Systems

#### **1.3 SUBMITTALS**

- A. General
  - 1. Product data for specified materials.

#### **1.4 QUALITY ASSURANCE**

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

## 1.5 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
- B. Fire and Fire/Smoke Dampers
  - 1. Fusible Links: Furnish quantity equal to 10% of amount installed for each temperature rating.

## 1.6 DRAWING SCHEDULES

- A. Refer to equipment schedules on drawings for additional information.

## PART 2 PRODUCTS

### 2.1 BACKDRAFT DAMPERS

- A. Manufacturers
  - 1. Air Control Products
  - 2. American Warming and Ventilation
  - 3. Greenheck
  - 4. Pottorff
  - 5. Ruskin
- B. Description: Multiple-blade; parallel action; gravity balanced; center-pivoted blades of maximum 6-inch (150-mm) width; sealed edges; assembled in rattle-free manner with 90-degree stop; steel ball bearings and axles; adjustment device to permit setting for varying differential static pressure.
- C. Construction: 0.063-inch- (1.6-mm-) thick extruded aluminum frame with welded corners and mounting flange; 0.050-inch- (1.2-mm-) thick aluminum sheet blades; neoprene blade seals; galvanized steel blade axles; aluminum tie bars and brackets; adjustable tension return spring.

### 2.2 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.

### **2.3 DUCT-MOUNTING ACCESS DOORS**

- A. Manufacturers
1. CESCO Products
  2. Ductmate Industries, Inc.
  3. Elmdor
  4. Greenheck
  5. McGill AirFlow Corporation
  6. Nailor Industries Inc
  7. Pottorff
  8. Ventfabrics, Inc.
  9. Durodyne
- B. General Description: Fabricate doors airtight and suitable for duct pressure class.
- C. Standard Access Door: Double wall; duct mounting; fabricated of galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class; 1-by-1-inch (25-by-25-mm) butt or piano hinge, and cam latches; galvanized sheet steel frame with bend-over tabs and foam gaskets.
1. Provide number of hinges and locks as follows:
    - a. Less Than 12 Inches (300 mm) Square: Secure with two sash locks.
    - b. Up to 18 Inches (450 mm) Square: Two hinges and two sash locks.
    - c. Up to 24 by 48 Inches (600 by 1200 mm): Three hinges and two compression latches.
    - d. Sizes 24 by 48 Inches (600 by 1200 mm) and Larger: One additional hinge.
- D. Pressure Relief Access Door: Double wall and duct mounting; fabricated of galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class; latches and retaining chain; galvanized sheet steel frame with bend-over tabs and foam gaskets; seal around frame attachment to duct and door to frame with neoprene or foam rubber; 1-inch- (25-mm-) thick, fibrous-glass or polystyrene-foam board when used on insulated duct.

### **2.4 FIRE AND SMOKE DAMPERS**

- A. Manufacturers

1. Air Balance
  2. Cesco
  3. Greenheck
  4. Nailor Industries, Inc
  5. Pottorff
  6. Ruskin
- B. Fire Dampers: Roll-formed, 0.034-inch- (0.85-mm-) thick galvanized steel frame with mitered and interlocking corners; galvanized sheet steel sleeve of 0.052 or 0.138 inch (1.3 or 3.5 mm) minimum thickness and of length to suit application; stainless steel closure springs; heat retardant non-asbestos retardant blanket as required; roll-formed, interlocking, 0.034-inch- (0.85-mm-) thick, galvanized sheet steel blades; replaceable fusible link. Labeled in accordance with UL 555.
- C. Combination Fire/Smoke Dampers: Roll-formed, 0.064-inch- (1.62-mm-) thick galvanized steel frame with mitered and interlocking corners; galvanized sheet steel sleeve of 0.052 or 0.138 inch (1.3 or 3.5 mm) minimum thickness and of length to suit application; stainless steel closure springs; roll-formed, 0.034-inch- (0.85-mm-) thick, galvanized sheet steel blades; stainless steel blade edge seals; replaceable fusible link; actuators manufactured by Belimo with integral spring return mechanism; enclose spring mechanism in removable housing designed for service or adjustments; end switches on actuator; leakage class I or II as indicated on drawings; damper closure shall be controlled through actuator to close the damper in no less than 7 seconds and no greater than 15 seconds. Labeled in accordance with UL 555 and UL 555S.
- D. Smoke Dampers: Roll-formed, 0.064-inch- (1.62-mm-) thick galvanized steel frame with mitered and interlocking corners; galvanized sheet steel sleeve of 0.052 or 0.138 inch (1.3 or 3.5 mm) minimum thickness and of length to suit application; stainless steel closure springs; roll-formed, 0.034-inch- (0.85-mm-) thick, galvanized sheet steel blades; stainless steel blade edge seals; actuators manufactured by Belimo with integral spring return mechanism; enclose spring mechanism in removable housing designed for service or adjustments; end switches on actuator; leakage class I or II as indicated on drawings; damper closure shall be controlled through actuator to close the damper in no less than 7 seconds and no greater than 15 seconds. Labeled in accordance with UL 555S.

## **2.5 FLEXIBLE CONNECTORS**

- A. Manufacturers
1. American Warming and Ventilating
  2. CESCO Products
  3. Ductmate Industries, Inc.

4. Greenheck
  5. McGill AirFlow Corporation
  6. Nailor Industries Inc.
  7. Pottorff
  8. Ventfabrics, Inc.
- B. General Description: Flame-retardant or noncombustible fabrics, coatings, and adhesives complying with UL 181, Class 1.
- C. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2-inches (89-mm-) wide attached to two strips of 2-3/4-inch- (70-mm-) wide, 0.028-inch- (0.7-mm-) thick, galvanized sheet steel or 0.032-inch- (0.8-mm-) thick aluminum sheets. Select metal compatible with ducts.
- D. Flexible Connector Fabric
1. Indoor Applications: Glass fabric double coated with neoprene; 26 oz./sq. yd. (880 g/sq. m) minimum weight; 480 lbf/inch (84 N/mm) tensile strength in the warp and 360 lbf/inch (63 N/mm) in the filling; minus 40 to plus 200 deg F (minus 40 to plus 93 deg C) service temperature.
  2. Outdoor Applications: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone; 24 oz./sq. yd. (810 g/sq. m) minimum weight; 530 lbf/inch (93 N/mm) tensile strength in the warp and 440 lbf/inch (77 N/mm) in the filling; minus 50 to plus 250 deg F (minus 45 to plus 121 deg C) service temperature.
  3. High Temperature Applications: Glass fabric coated with silicone rubber; 16 oz./sq. yd. (542 g/sq. m) minimum weight; 285 lbf/inch (50 N/mm) tensile strength in the warp and 185 lbf/inch (32 N/mm) in the filling; minus 67 to plus 500 deg F (minus 55 to plus 260 deg C) service temperature.
  4. High-Corrosive-Environment Systems: Glass fabric with chemical-resistant coating; 14 oz./sq. yd. (474 g/sq. m) minimum weight; 450 lbf/inch (79 N/mm) tensile strength in the warp and 340 lbf/inch (60 N/mm) in the filling; minus 67 to plus 500 deg F (minus 55 to plus 260 deg C) service temperature.

## 2.6 SHEET METAL MATERIALS

- A. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods, unless otherwise indicated.
- B. Galvanized Sheet Steel: Lock-forming quality; complying with ASTM A 653/A 653M and having G60 (Z180) coating designation; ducts shall have mill-phosphatized finish for surfaces exposed to view.



- C. Stainless Steel: ASTM A 480/A 480M.
- D. Aluminum Sheets: ASTM B 209 (ASTM B 209M), alloy 3003, temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.
- E. Extruded Aluminum: ASTM B 221 (ASTM B 221M), alloy 6063, temper T6.
- F. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- G. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for lengths 36 inches (900 mm) or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

## 2.7 TURNING VANES

- A. Manufacturers
  - 1. American Warming and Ventilating
  - 2. CESCO Products
  - 3. Ductmate Industries, Inc.
  - 4. Elmdor
  - 5. Greenheck
  - 6. McGill AirFlow Corporation
  - 7. Nailor Industries Inc.
  - 8. Potorff
  - 9. United McGill
  - 10. Ventfabrics, Inc.
- B. Single Vane Construction: 1-1/2-inch- (38-mm-) wide; single-vane; curved blades of galvanized sheet steel set 3/4 inch (19 mm) o.c.; supported with bars perpendicular to blades set 2 inches (50 mm) o.c.; and set into vane runners suitable for duct mounting.
- C. Double Vane Construction: High efficiency; double vane; 2 inch (50 mm) long airfoil leading edge; 3 inch (75 mm) long airflow trailing edge.
  - 1. Basis of Design: AeroDyne H-E-P.
- D. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.

## 2.8 VOLUME BALANCING DAMPERS

- A. Manufacturers
  - 1. American Warming and Ventilation
  - 2. Greenheck
  - 3. Pottorff
  - 4. Ruskin
  - 5. Durodyne
- B. General Description: Factory fabricated with required hardware and accessories; damper blades stiffened for stability; locking device to hold single-blade dampers in a fixed position without vibration; duct penetrations for damper components sealed consistent with pressure class.
  - 1. Pressure Classes of 3-Inch wg (750 Pa) or Higher: End bearings or other seals for ducts with axles full length of damper blades and bearings at both ends of operating shaft.
- C. Standard Volume Dampers: Hat-shaped galvanized sheet steel channel steel frame, minimum of 0.064 inch (1.62 mm) thick with mitered and welded corners; 0.064-inch- (1.62-mm-) thick roll-formed galvanized sheet steel blades; galvanized steel blade axles; oil-impregnated bronze bearing; galvanized steel tie bars and brackets; standard leakage rating; suitable for horizontal or vertical applications.
- D. Low-Leakage Volume Dampers: Hat, U, or angle-shaped, galvanized sheet steel channel steel frame, minimum of 0.064 inch (1.62 mm) thick with mitered and welded corners; 0.064-inch- (1.62-mm-) thick roll-formed galvanized stainless sheet steel galvanized steel blade axles; oil-impregnated bronze bearings, thrust or ball type; vinyl blade seals; cambered stainless steel jamb seals; galvanized steeltie bars and brackets; low leakage rating; suitable for horizontal or vertical installation.
- E. Jackshaft: 1-inch- (25-mm-) diameter, galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
  - 1. Length and Number of Mountings: Appropriate to connect linkage of each damper in multiple-damper assembly.
- F. Damper Hardware: Zinc-plated, die-cast core with dial and handle made of 3/32-inch- (2.4-mm-) thick zinc-plated steel and a 3/4-inch (19-mm) hexagon locking nut; center hole to suit damper operating-rod size; elevated platform for insulated duct mounting.

## **PART 3 EXECUTION**

### **3.1 GENERAL**

- A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards--Metal and Flexible".

### **3.2 ACCESS DOORS**

- A. Application
  - 1. Provide access doors (in building walls, ceilings, etc.) as required to access all system components that require maintenance. While Division 08 has been referenced for material specifications, doors shall be furnished and installed by Division 23. It is the Contractor's responsibility to determine required quantities and locations of access doors based on the as-installed conditions and coordination with other trades.

### **3.3 BACKDRAFT DAMPERS**

- A. Application
  - 1. Provide backdraft dampers at all outside air intake and exhaust air outlet locations including, but not limited to, louvers, cowls, goosenecks and fans discharging to the outdoors.
    - a. When equipment at point of termination (louver, fan, cowl, etc.) has been indicated to be provided with backdraft dampers, supplemental backdraft dampers are not required unless specifically noted.
    - b. When equipment at point of termination (louver, fan, cowl, etc.) has not been indicated to be provided with backdraft dampers, provide backdraft dampers in accordance with this section in the ductwork connecting to the equipment at the point of termination. Damper shall be located as close to the equipment as possible.

### **3.4 DUCT ACCESSORY HARDWARE**

- A. Application
  - 1. Provide duct accessories of materials suited to duct materials. Use galvanized-steel accessories in galvanized-steel duct systems, stainless-steel accessories in stainless-steel duct systems, and aluminum accessories in aluminum duct systems.
  - 2. Provide test holes at fan inlets and outlets and elsewhere as indicated.

### 3.5 DUCT-MOUNTING ACCESS DOORS

#### A. General

1. Label access doors according to Division 23 Section "HVAC Identification."

#### B. Application

1. Standard Access Door
  - a. Provide where required for testing and balancing purposes.
  - b. Provide where required to provide access to all system components that require maintenance.
  - c. At a minimum, provide at the following locations:
    - 1) On both sides of duct coils, filters, and in-line fans.
    - 2) Adjacent to motorized control dampers.
    - 3) Adjacent to fire, fire/smoke, and smoke dampers, providing access to reset or reinstall fusible links.
    - 4) Downstream of all duct-mounted equipment
    - 5) To interior of ducts for cleaning; before and after each change in direction, at maximum 50-foot (15-m) spacing.
2. Pressure Relief Access Door
  - a. Provide downstream of all fire, fire/smoke and smoke dampers in medium pressure duct systems.

### 3.6 FIRE AND SMOKE DAMPERS

#### A. General

1. Install fire and smoke dampers according to manufacturer's UL-approved written instructions.
2. Provide standard access and pressure relief access doors as required by applicable codes and specified elsewhere in this section.

#### B. Application

1. Provide fire dampers at all duct penetrations of fire rated assemblies.
2. Provide smoke dampers at all duct penetrations of smoke rated assemblies.
3. Provide fire/smoke dampers at all duct penetrations of fire and smoke rated assemblies.

#### C. Demonstration

1. Demonstrate access to dampers, visual inspection of damper operation, and re-setting of dampers during training period.

### **3.7 FLEXIBLE CONNECTORS**

- A. Install flexible connectors immediately adjacent to equipment in ducts associated with fans and motorized equipment supported by vibration isolators.
- B. For fans developing static pressures of 5-inch wg (1250 Pa) and higher, cover flexible connectors with loaded vinyl sheet held in place with metal straps.

### **3.8 FLEXIBLE DUCTS**

- A. Connect terminal units to rigid supply ducts directly or with maximum 12-inch (300-mm) length of flexible duct. Do not use flexible ducts to change directions. Install flexible duct taught and straight
- B. Connect diffusers or light troffer boots to low pressure ducts directly or with maximum 60-inch (1500-mm) lengths of flexible duct clamped or strapped in place. Do not use flexible ducts to create bends greater than 45°.
- C. Connect flexible ducts to metal ducts with draw bands.

### **3.9 MOTORIZED CONTROL DAMPERS**

- A. Application
  - 1. Coordinate with 230900 for damper quantities, locations, and installation requirements.
  - 2. Install motorized control dampers for which material specifications have been provided in 230900.

### **3.10 TURNING VANES**

- A. Application
  - 1. Provide turning vanes in all elbows that are not radiused for all duct systems. Use single vane construction for low velocity systems and double vane construction for medium velocity systems.
    - a. Exception: Do not provide turning vanes in Type I kitchen exhaust, clothes dryer exhaust, or other product-conveying systems.
  - 2. Refer to 233110 for additional application information.

### **3.11 VOLUME BALANCING DAMPERS**

- A. Installation

1. Install dampers in ducts with liner to avoid damage to and erosion of duct liner.
  2. Install with sufficient clearance from duct transitions and other equipment to prevent binding.
  3. Install at a minimum of two duct widths from branch takeoff.
  4. Where dampers are installed above inaccessible ceilings, provide concealed damper regulator and coverplate.
- B. Application
1. Provide at points on low pressure supply, return, and exhaust systems where branches lead from larger ducts as required for air balancing. Use standard volumd dampers unless noted to be low leakage volume dampers.
  2. Provide for each GRD in the ductwork serving that GRD, whether indicated on the drawings or not. Optional register dampers provided as an accessory to GRD's are not an acceptable alternative, unless such accessory dampers are scheduled on the drawings and supplementary balancing dampers are not shown on the floor plan drawings. Use standard volumd dampers unless noted to be low leakage volume dampers.
- C. Install duct test holes where indicated and required for testing and balancing purposes.

END OF SECTION 233300

## **SECTION 23 37 10 - GRILLES, REGISTERS, AND DIFFUSERS**

### **PART 1 GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Section 230000 – General HVAC Requirements
- C. Section 09900 – Paints and Coatings

#### **1.2 REFERENCES**

- A. General
  - 1. AAMA 605.2 - Voluntary Specification for High Performance Organic Coatings on Architectural Extrusions and Panels
  - 2. ADC 1062 - Certification, Rating and Test Manual
  - 3. AMCA 500 - Test Method for Louvers, Dampers and Shutters
  - 4. SMACNA - HVAC Duct Construction Standard - Metal and Flexible
- B. Air Inlets/Outlets
  - 1. ARI 650 - Air Outlets and Inlets
  - 2. ASHRAE 70 - Method of Testing for Rating the Air Flow Performance of Outlets and Inlets

#### **1.3 SUBMITTALS**

- A. General
  - 1. Product Data: For each product indicated, include the following:
    - a. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
- B. Grilles, Registers, and Diffusers Schedule
  - 1. Indicate Drawing designation, room location, quantity, model number, size, and accessories furnished.

## **1.4 QUALITY ASSURANCE**

- A. Test and rate air outlet and inlet performance in accordance with ADC Equipment Test Code 1062 and ASHRAE 70.

## **1.5 DRAWING SCHEDULES**

- A. Refer to drawings for specific capacities, dimensions, accessories, and other requirements supplemental to these specifications.

## **PART 2 PRODUCTS**

### **2.1 GENERAL**

- A. Dampers: Provided as an accessory to GRD's when scheduled on the drawings. Dampers shall be opposed blade, heavy gauge steel, and shall be adjustable from the face of the inlet or outlet.
- B. Frame types and mounting hardware: Coordinated with ceiling types. Architectural plans shall take precedence when referencing ceiling types, and Contractor shall reference the architectural plans for verification of ceiling type prior to ordering.
- C. Finish: White unless noted otherwise on the drawings.

### **2.2 GENERAL GRILLES, REGISTERS, AND DIFFUSERS**

- A. Manufacturers
  - 1. Anemostat
  - 2. Krueger
  - 3. Pottorff
  - 4. Price
  - 5. Titus
  - 6. Tuttle & Bailey
- B. Sidewall Supply Grilles (Double Deflection): Steel, aluminum, or stainless steel construction as scheduled on the drawings; 1 1/4 inch (32 mm) border with fully welded corners; blades in both the long and short dimension with spacing as scheduled on the drawings; individually adjustable blades with steel friction pivots on both ends to allow adjustment without loosening or rattling; countersunk screw mounting holes.
  - 1. Basis of design: Titus 300/301 Series



- C. Return Grilles: Steel, aluminum, or stainless steel construction as scheduled on the drawings; 1 1/4 inch (32 mm) border with fully welded corners; fixed blades parallel to the long dimension with spacing and deflection as scheduled on the drawings; countersunk screw mounting holes for surface mount; no mounting holes for lay-in mount.
  - 1. Basis of design: Titus 350/355 Series
- D. Modular Core Ceiling Diffusers: Steel or aluminum construction; minimum 1 inch (25 mm) depth for duct connection; 4 fixed louver directional modules, individually removable and adjustable without tools.
  - 1. Basis of design: Titus MCD Series

## **PART 3 EXECUTION**

### **3.1 GENERAL**

- A. Examination
  - 1. 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.
  - 2. Proceed with installation only after unsatisfactory conditions have been corrected.
  - 3. Check locations and make necessary adjustments in position to conform with architectural features, symmetry, and lighting arrangement. Locate in accordance with architectural reflected ceiling plan when indicated.
- B. Installation
  - 1. Check locations and make necessary adjustments in position to conform with architectural features, symmetry, and lighting arrangement. Locate in accordance with architectural reflected ceiling plan when indicated.
  - 2. Install diffusers, registers, and grilles level and plumb.
  - 3. 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 practicable. 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.
  - 4. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire and fire/smoke dampers.

5. Paint ductwork visible behind GRD's matte black in accordance with the requirements of Division 09.
6. Fasten all pan and lay-in style diffusers in lay-in ceilings with earthquake tabs.
7. Provide volume balancing dampers for each GRD in the ductwork serving that GRD, whether indicated on the drawings or not. Optional register dampers provided as an accessory to GRD's are not an acceptable alternative, unless such accessory dampers are scheduled on the drawings and supplementary balancing dampers are not shown on the floor plan drawings.

C. Adjusting

1. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

**END OF SECTION 23 37 10**

## SECTION 26 05 00 - COMMON WORK RESULTS FOR ELECTRICAL

### PART 1 - GENERAL

#### ~~1.1~~ RELATED DOCUMENTS

- ~~A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.~~

#### 1.21.1 SUMMARY

- A. This section includes general electrical requirements for all Division 26 work and is supplemental and in addition to the requirements of Division 01. See Division 01 for sequence of work.
- B. It is the intention of this Division of the Specifications and the Contract Drawings to describe and provide for the furnishing, installing, testing and placing in satisfactory and fully operational condition all equipment, materials, devices and necessary appurtenances to provide a complete electrical system. Provide all materials, appliances and apparatus not specifically mentioned herein or shown on the drawings, but which are necessary to make a complete, fully operational installation of all electrical systems shown on the contract drawings or described herein. Connect equipment and devices furnished and installed under other Divisions of this specification (or the Owner) under this Division.
- C. Workmanship shall be of the best quality and competent and experienced electricians shall be employed and shall be under the supervision of a competent and experienced foreman.
- D. The drawings and specifications are complimentary and what is called for (or shown) in either is required to be provided as if called for in both. Where conflicting information occurs within the drawings and specifications or between the drawings and specifications, the more expensive alternative shall be used as a basis for bidding and construction.
- E. Branch Circuit Wiring: Where the drawings identify circuit numbers for items requiring electrical power, but do not indicate the manner of the wiring between the item and its source, the manner of the wiring shall be devised by the contractor utilizing the following provisions:
1. Wire sizes:
    - a. Derate wiring for thermal restrictions imposed by the National Electrical Code.
    - b. If wire sizes are not otherwise indicated, wire sizes shall limit the voltage drop for circuits serving general purpose receptacles (180VA per strap) to less than 3%, based on the receptacle in the circuit that is farthest from the source being utilized with a load of 14 amps at 80% power factor. The following wire sizes and circuit lengths comply with this requirement:

- 1) #12 up to 75 feet
  - 2) #10 up to 125 feet
  - 3) #8 up to 190 feet
- c. Wire sizes for other loads shall limit the voltage drop to less than 3% based on the load indicated on the panel schedule.
2. Multiwire circuits: Multiwire circuits shall not be used unless specifically indicated or noted on the drawings. Provide a dedicated neutral conductor for each single pole circuit breaker.
  3. Do not combine wiring of different source panels in the same raceway system, unless the panels are interconnected with sub feed or through feed lugs with no intervening disconnecting means.
  4. Outlet and junction boxes: Arrange wiring extensions from junction boxes to outlet boxes to restrict the number of wires in an outlet box as required by NEC Article 314.
  5. Single tubular raceways extending into panels or switchboards shall not contain more than 20 wires.

### ~~1.3 WORK IN OTHER DIVISIONS~~

~~A. Refer to Division 27 for Communications and Division 28 for Electronic Safety and Security. System elements of those Divisions require conformance and integration with the work of Division 26.~~

~~B. See all other specifications for other work which includes but is not limited to:~~

~~Cutting and Patching~~

~~Door Hardware~~

~~Fire Protection~~

~~Mechanical Systems and Control Wiring~~

~~Painting, Refinishing and Finishes~~

### 1.41.2 CODES, PERMITS, INSPECTION FEES

- A. The following codes and standards are referenced in the Division 26 specifications. Perform all work and provide materials and equipment in accordance with the latest referenced codes and standards of the following organizations:
1. American National Standards Institute (ANSI)
  2. National Electrical Manufacturer's Association (NEMA)
  3. National Fire Protection Association (NFPA)
  4. Underwriter's Laboratories (UL)
  5. National Electrical Contractor's Association (NECA)

- B. Install the electrical systems based on the following:
  - NFPA 70 National Electrical Code as adopted and amended by the Local Jurisdiction.
  - IBC International Building Code as adopted and amended by the Local Jurisdiction.
- C. The referenced codes establish a minimum level of requirements. Where provision of the various codes conflict with each other, the more stringent provision shall govern. If any conflict occurs between referenced codes and this specification, the codes are to govern. Compliance with code requirements shall not be construed as relieving the Contractor from complying with any requirements of the drawings or specifications which may be in excess of requirements of the governing codes and rules and not contrary to same.
- D. Obtain and pay for all licenses, permits and inspections required by laws, ordinances and rules governing work specified herein. Arrange for inspection of work by the inspectors and give the inspectors all necessary assistance in their work of inspection.
- E. Copies of all electrical permits and inspections, including final inspections, shall be given to the OSU project manager and the OSU FS Electric Shop within ten (10) days of receipt.

#### 1.51.3 COORDINATION

- A. Coordination during the bidding and pricing aspects of the contract includes determining where the work of other Divisions relies on the work of this Division for electricity and including the electrical system to match the requirements.
- B. Coordinate work with that of the other Contractors and/or other trades doing work on the project. Examine all drawings and specifications of other trades for construction details and coordination. Make every reasonable effort to provide timely notice of work affecting other trades to prevent conflicts or interference as to space requirements, dimensions, openings, block-outs, sleeving or other matters which will cause delays or necessitate work-around methods.
- C. Obtain submittals and shop drawings of all equipment with electrical connections furnished under other divisions of the specification and by the Owner. Provide all wiring in accordance with specific equipment requirements. Immediately advise the Architect of any changes which may affect the contract price.
- D. Special attention is called to the following items. Coordinate all conflicts prior to installation:
  - 1. Door swings such that switches will be located on the "strike" side of the door.
  - 2. Location of grilles, pipes, sprinkler heads, ducts and other mechanical equipment so that all electrical outlets, lighting fixtures and other electrical outlets and equipment are clear from and in proper relation to these items.

3. Location of cabinets, counters and doors so that electrical outlets, lighting fixtures and equipment are clear from and in proper relation to these items.
  4. Recessing and concealing electrical materials in CMU walls, concrete construction and precast construction.
  5. At each switchboard and panelboard location the Contractor shall monitor the work of all trades to assure that the space and clearance requirements of code are met.
  6. Review specifications for other Divisions of the work to determine where other Divisions are requiring electrical connections. Verify electrical provisions shown on contract drawings by examining shop drawing submittals of other Divisions prior to submission to the owner. Do not proceed with ordering of supporting electrical equipment, such as circuit breakers, until electrical characteristics are verified. Proceed with rough-in only after verification of shop drawings.
- E. Digital format copies of bid drawings will be furnished to the successful bidder. Augment bid documents with additional information to ensure coordination between trades. Provide digital format electrical systems drawings showing all ceiling devices, fixtures, raceways and cable tray locations and routing to mechanical contractor to be used for coordination drawings provided by mechanical contractor. Include dimensions and elevations of devices, fixtures, raceway and cable tray.
- F. Furnish, install and place in satisfactory condition all raceways, boxes, conductors and connections and all other materials required for the electrical systems shown or noted in the contract documents to be complete, fully operational and fully tested upon completion of the project. Raceways, boxes and ground connections are shown diagrammatically only and indicate the general character and approximate location. The layout does not necessarily show the total number of raceways or boxes for the circuits required, nor are the locations of indicated runs intended to show the actual routing of the raceways.
- Where routings of major raceways and telecommunication pathways are indicated on plan sheets, the routing information supplements the information on diagrams. If no routing information is shown, route the systems in a manner that will coordinate with new and existing infrastructure and the work of other trades.
- G. The horsepower of motors and apparatus wattage's shown on the drawings are estimated requirements of equipment furnished under other Divisions of this contract. Provide overload elements to suit actual equipment nameplate current. Where connections to variable speed drives furnished under other sections of this specification are shown, obtain the drive input current and verify the indicated drive circuit is compatible. Advise Architect of any equipment changes or substitutions affecting electrical systems.
- H. Consult the architectural drawings for the exact height and location of all electrical equipment not specified herein or shown on the drawings. Make any minor changes (less than 6'-6" horizontal) in the location of the raceways, outlets, boxes, devices, wiring, etc., from those shown on the drawings without extra charge, where coordination requires or if so directed by the Architect before rough-in.

- I. Provide inserts or sleeves for outlet boxes, conductors, cables and/or raceways as required. Coordinate the installation thereof with other trades.
- J. The Contractor will not be paid for relocation of work, cuttings, patching and finishing required for work requiring reinstallation due to lack of coordination prior to installation.

#### **1.61.4 WARRANTY**

- A. ~~Refer to General Conditions of the Contract~~ Comply with the requirements of Division 01.

#### **1.71.5 CORRECTION OF WORK**

- A. Comply with the requirements of Division 01.

~~A. Within one year after the date of Substantial Completion of the work, the Contractor shall correct any work found to be not in conformance with the Contract Documents promptly after written notice from the owner to do so, unless the Owner has previously given the Contractor a written acceptance of such condition. This obligation shall survive acceptance of the work under this Contract and termination of the Contract. The Owner shall give such notice promptly after discovery of the condition.~~

#### **1.81.6 CHANGE ORDERS**

- A. Comply with the requirements of Division 01.
- ~~B. Material pricing shall be based on competitive market conditions and include contractor net discounting. "List" or "book" pricing of material will not be accepted. Upon request, demonstrate that pricing is competitive by furnishing quotes from competing vendors or distributors.~~
- ~~C. Labor units shall be based on standard publications such as NECA or RS Means, using standard (not "change order") construction production. Where the change order requires additional work that is not normally part of the construction process, separately itemize the work and identify specific inefficiencies.~~
- ~~D. Labor pricing shall include an average of the journeyman and apprentice labor classification rates used to perform the work.~~

#### **1.91.7 SUBMITTALS AND SHOP DRAWINGS**

- A. Submittals and Shop Drawings: Comply with the requirements of Division 01. In addition, provide the below described information. Allow two weeks for review for each submittal and resubmittal. Incomplete submittals and shop drawings which do not comply with these requirements will be returned for correction, revision and resubmittal. Provide submittals for each product proposed for the project. See General Conditions for format, quantity, etc.

- B. Submittals shall show:
1. Indicate listing by UL or other approved testing agency.
  2. Highlight adequate information to demonstrate materials being submitted fully comply with contract documents.
  3. Review and check all material prior to submittal and stamp "Reviewed and Approved".
- C. Shop drawings shall show:
1. Ratings of items and systems.
  2. How the components of an item or system are assembled, interconnected, function together and how they will be installed on the project.
  3. System layout floor plans with complete device layout, point-to-point wiring connection between all components of the system, wire sizes and color coding.
  4. Riser diagrams showing vertical wiring between components.
  5. Line diagrams and or logical/control schematics including interface to other systems as applicable. Provide point to point wiring diagrams, indicate terminal identification at item of equipment. Typical diagrams may be used when accompanied by wire schedules that are specific to each product.
  6. Coordinate with other division shop drawings and submittals. Identify interface points and indicate method of connection.
  - ~~7. Electrical rooms: Submit 1/2" – 1'0" detail plans and wall elevations of each room showing actual size of equipment in place. Identify coordinating elements such as structural beams or mechanical systems. Submittals shall show coordination among all suppliers of equipment, including power components, fire alarm, racks, nurse call, public address, security, etc. Submit room layouts at same time as material submittals, and prior to installation of any equipment.~~
  - ~~8.7.~~ List of all Division 23 equipment noting actual rating of equipment that will be installed. For discrepancies between the requirements of the proposed equipment and the equipment provisions indicated on the drawings, indicate the contractor's proposed no cost change to the electrical system to accommodate the submitted equipment.
- D. Release of Drawing Data files
1. Contractor may request to utilize the project drawing data files for assistance in producing shop drawings. Request shall be made by signing owner/design team's requested documentation for release of the data files.
- E. The Contractor agrees:
1. Submittals and shop drawings processed by the Architect are not change orders.
  2. The purpose of submittals and shop drawings by the Contractor is to demonstrate to the Engineer that the Contractor understands the design concept.



3. Submittals demonstrate equipment and material Contractor intends to furnish and install and indicate detailing fabrication and installation methods Contractor intends to use.
  4. To accept all responsibility for assuring that all materials furnished under this Division of the specifications meet, in full, all requirements of the contract documents.
  5. To pay for Engineers review cost of submittal review beyond one resubmittal.
- F. The Engineer's review is only for general conformance with the design concept of the project and general compliance with the information given in the contract documents. Corrections or comments made during this review do not relieve contractor from compliance with the requirements of the drawings and specifications. Contractor is responsible for: Dimensions which shall be confirmed and correlated at the job site; fabrication process and techniques of construction; coordination of his work with that of all other trades; performing his work in a safe and satisfactory manner.
- G. Submittals and shop drawings are required per the individual sections

#### 1.101.8 PROJECT CLOSE-OUT

- A. ~~Coordinate with close-out provisions in Division 01—General Requirements—Comply with the requirements of Division 01.~~

~~B.—Request For Final Punchlist~~

- ~~1.—To request a final electrical punch list, forward a letter to the Architect, stating: "The electrical work on this project is complete, all punch list items to date are complete, items a.—n. in the Punchlist Procure paragraph in Section 260500—Common Work Results For Electrical are complete and the project is ready for final punch list observation."~~

~~2.B. Project Punchlist Procedure:~~ Perform the following procedures for project closeout of electrical portions of work.

- ~~a.1.~~ Perform testing, tests and documentation per Section 260126 - Maintenance Testing of Electrical Systems.
- ~~b.2.~~ Provide engraved nameplates on electrical equipment.
- ~~c.3.~~ Refinish electrical equipment finishes which are damaged.
- ~~d.4.~~ Clean light fixtures per Section 260500 - Common Work Results For Electrical.
- ~~e.5.~~ Insert word processed (typed) Panel Schedules in all new and existing panelboards with actual "as-built" circuit descriptions.
- ~~f.6.~~ Number all circuit breakers.
- ~~g.7.~~ Obtain final electrical permit inspection. Include copies in O & M manual.
- ~~h.8.~~ Provide written warranty in O & M per the General Conditions of the Contract.
- ~~i.9.~~ Furnish Record Drawings per this section. Obtain signature on Job Completion Form.
- ~~j.10.~~ Furnish O & M Manuals per this section. Obtain signature on Job Completion Form.

- ~~k.11.~~ Give instruction periods to owner's personnel per this section. Obtain signature on Job Completion Form.
- ~~l.12.~~ To request final acceptance of project, fill out Job Completion Form in this section and forward to Architect. Note: If inspectors have not signed form, a copy of signed-off permits will suffice.
- ~~m.13.~~ Include with Job Completion Form, a copy of the final punch list with the word "DONE", and the date and Contractor's initials after each item on the list.

#### ~~1.11.9~~ ELECTRICAL EQUIPMENT OPERATION AND MAINTENANCE (O&M) MANUALS

- A. Provide O&M manuals required in Division 01 - General Requirements for all equipment furnished under Division 26 - Electrical of the specifications. ~~Submit a preliminary copy, complete except for the bound cover, 60 days prior to completion of the project for checking and review. Deliver final bound corrected copies as noted in Division 1 - General Requirements 20 days prior to scheduled instruction periods. Obtain a receipt for the manuals and forward a copy of the receipt to the Engineer with the Job Completion Form.~~
- B. The information included must be the exact equipment installed. Where sheets show the equipment installed and other equipment, the installed equipment shall be neatly and clearly identified on such sheets.
- C. These O&M manuals shall contain all the information needed to operate and maintain all systems and equipment provided in the project. Present and arrange information in a logical manner for efficient use by the Owner's operating personnel. The information provided shall include but not be limited to the following:
1. Equipment manufacturer, make, model number, size, nameplate data, etc.
  2. Description of system configuration and operation including component identification and interrelations. A master control schematic drawing(s) may be required for this purpose.
  3. Dimensional and performance data for specific unit provided as appropriate.
  4. Manufacturer's recommended operation instructions.
  5. Manufacturer's recommended lubrication and servicing data including frequency.
  6. Complete parts list including reordering information, recommended spares and anticipated useful life (if appropriate). Parts lists shall give full ordering information assigned by the original parts manufacturer. Relabeled and/or renumbered parts information as reassigned by equipment supplier not acceptable. Include the parts list and part diagram that was included with the product's packaging, note that a "catalog cut" will not meet this criterion.
  7. Shop drawings.
  8. Wiring diagrams.

9. Signal equipment submittals shall contain step-by-step circuit description information designed to acquaint maintenance personnel with equipment operation in each mode of operation.
  10. A complete list of local (nearest) manufacturer representative and distributor contacts for each type of equipment and manufacturer. Include name, company, address, phone, fax, e-mail address, and web site.
- D. Furnish complete wiring diagrams for each system for the specific system installed under the contract. "Typical" line diagrams will not be acceptable unless revised to indicate the exact field installation.

~~E. Group the information contained in the manuals in an orderly arrangement by specification index. Provide a typewritten index and divider sheets between categories with identifying tabs. Bind the completed manuals with hard board covers not exceeding 5" thick. (Provide two or more volumes if required.) Signal and communication systems shall be in separate volumes. Imprint the covers with the name of the job, Owner, Architect, Electrical Engineer, Contractor and year of completion. Imprint the back edge with the name of the job, Owner and year of completion. Hard board covers and literature contained may be held together with screw post binding.~~

#### 1.121.10 INSTRUCTION PERIODS

A. Comply with the requirements of Division 01.

~~A.B.~~ After substantial completion of the work and 20 days after the O&M manuals have been delivered to the owner and after all tests and final inspection of the work by the Authority(s) Having Jurisdiction; demonstrate the electrical systems and instruct the Owner's designated operating and maintenance personnel in the operation and maintenance of the various electrical systems. The Contractor shall arrange scheduled instruction periods with the Owner. The Contractor's representatives shall be superintendents or foremen knowledgeable in each system and suppliers representatives when so specified. When more than one training session is specified, the second session shall be 30 to 90 days after the first as agreed to by the Owner.

~~B.C.~~ Include in each instruction session an overview of the system, presentation of information in maintenance manuals with appropriate references to drawings. Conduct tours of the building areas with explanations of maintenance requirements, access methods, servicing and maintenance procedures, equipment cleaning procedures and adjustment locations.

~~C.D.~~ Include the following scheduled instruction periods:

	1 <sup>st</sup> Session	2 <sup>nd</sup> Session
1. Power Distribution System	4 hours	4 hours
2. Lighting Control & Dimming System	4 hours	4 hours

~~D.E.~~ Factory trained suppliers representatives shall provide instruction for lighting control/dimming, power generation & transfer switches, and transient voltage suppression system(s).

~~E. Provide one professionally produced digitally recorded or video tape of each training session in DVD format. Furnish two (2) copies to the owner.~~

#### **1.131.11 RECORD DRAWINGS**

~~A. Comply with the requirements of Division 01.~~

~~A. Record drawings shall be kept on: the contract drawings, shop drawings indicating field wiring, vendor diagrams indicating field wiring, and similar documents.~~

~~B. Continually record the actual electrical system(s) installation on a set of prints kept readily available at the project during construction. These prints shall be used for this purpose alone.~~

- ~~1. Mark record prints with red erasable pencil. Mark the set to show the actual installation where the installation varies substantially from the work as originally shown.~~
- ~~2. Accurately locate with exact dimensions all underground and underslab raceways and stub-outs.~~
- ~~3. Note changes of directions and locations, by dimensions and elevations, as utilities are actually installed.~~
- ~~4. Include addenda items and revisions made during construction.~~
- ~~5. Erase conditions not constructed or "X-out" and annotate "not constructed" to clearly convey the actual "as constructed" condition.~~
- ~~6. Organize record drawings sheets in manageable sets, bind and print suitable titles, dates and other identification on the cover of each set.~~
- ~~7. Where "typical" wiring diagrams were used during submittals the record drawings shall indicate exact point to point wiring with exact terminal number designations.~~

~~C.B. Transfer the changes marked up on the record prints into Revit drawing files at the completion of the work. The version of Revit shall not be earlier than the most recent version available at the date the project bids were received. Revit files shall not include the stamp of the engineer of record. Provide two (2) sets of prints, one set of fixed line reproducible drawings and one set of Revit drawing files on CD Rom. Transmit drawings, Revit drawing files and the record drawing mark-ups to the Architect. Final payment to the contractor will not be authorized until these documents have been submitted to and accepted by the Architect.~~

#### **1.14 FINAL ACCEPTANCE REQUEST**

~~A. Submit to the Architect, a Division 26 Job Completion Form (form attached in this section) properly filled out prior to the time final acceptance of the electrical work is requested.~~

## 1.151.12 ABBREVIATIONS AND DEFINITIONS

- A. When the following abbreviations and definitions are used in relation to the work for Division 26 they shall have the following meanings:

<u>Item</u>	<u>Meaning</u>
AHJ	Authority Having Jurisdiction.
Boxes	Outlet, Junction or Pull Boxes.
Code	All applicable codes currently enforced at project location.
Compression	Compressed using a leveraged powered (hydraulic or equivalent) crimping tool.
Connection	All materials and labor required for equipment to be fully operational.
Exterior Location	Outside of or penetrating the outer surfaces of the building weather protective membrane.
Fully Operational	Tested, approved, and operating to the satisfaction of the AHJ, manufacturer and contract documents.
Furnish	Deliver to the jobsite
Install	To enter permanently into the project and make fully operational.
Kcml	Thousand circular mils (formerly MCM).
Mfr.	Manufacturer.
NEC	National Electrical Code, National Fire Protection Association, Publication #70.
NIC	Not in Contract.
Noted	Shown or specified in the contract documents.
Provide	Furnish and install.
Required	As required by code, AHJ, contract documents, or manufacturer for the particular installation to be fully operational.
Shown	As indicated on the drawings or details.
Wiring	Raceway, conductors and connections.

## PART 2 - PRODUCTS

### 2.1 GENERAL

- A. All materials and equipment installed shall have been tested and listed by Underwriters Laboratories or other approved testing organization and shall be so labeled unless otherwise permitted by the Authority Having Jurisdiction (Inspector).
- B. All materials to be new, free from defects and not less than quality herein specified. Materials shall be designated to insure satisfactory operation and operational life in the environmental conditions which will prevail where they are being installed.
- C. Each type of materials furnished shall be of the same make, be standard products of manufacturers regularly engaged in production of such materials and be the manufacturer's latest standard design.

- D. All materials, equipment and systems furnished that include provisions for storing, displaying, reporting, interfacing, inputting, or functioning using date specific information shall perform properly in all respects regardless of the century. Any interface to other new or existing materials, equipment or systems shall function properly and shall be century compliant, both in regards to information sent and received.

## 2.2 SUBSTITUTION OF MATERIALS

### A. Comply with the requirements of Division 01.

#### A. No Substitute:

~~Where a specified product is indicated "no substitute", it is the intent of this specification to require new materials to be compatible with the existing installation or as specifically requested by the owner. To this end certain materials and systems no substitution will be allowed.~~

#### B. Prior to Bid Opening:

~~Acceptance of products other than those specified will be issued by addendum to the bid documents only after the following requirements are met and the proposed listed material is determined to meet or exceed the requirements:~~

- ~~1. Requests for listing to be original material, clearly indicating the product fully complies with contract documents and be neatly marked with yellow felt tip marker to clearly define and describe the product for which listing is requested.~~
- ~~2. Include certified laboratory test report for lighting fixtures.~~
- ~~3. Samples shall be submitted if requested.~~
- ~~4. Requests shall be received 10 days prior to bid opening.~~
- ~~5. Requests containing insufficient information to confirm compliance with contract documents will not be considered.~~

#### C. After Award of Contract:

~~Substitution of products will be considered after award of contract only under the following conditions:~~

- ~~1. The Contractor shall have placed orders for specified materials promptly after contract is awarded and the specified products can not be delivered to the project to meet the Owner's construction schedule.~~
- ~~2. The reason for the unavailability is beyond the Contractor's control, i.e., due to strikes, bankruptcy, discontinuance of manufacturer, acts of God.~~
- ~~3. The specified product is no longer manufactured.~~
- ~~4. There is compelling economic advantage to the Owner.~~

- ~~D. In all cases, should a substituted material result in requiring electrical system or building modifications; the Contractor alone shall pay all costs to provide these~~

~~modifications including all costs to the Engineer and Architect for redesign, and updating of record drawings required to accommodate the required modifications.~~

### **2.3 NAMEPLATES**

- A. Provide nameplates per Section 260553 - Identification for Electrical Systems.

## **PART 3 - EXECUTION**

### **3.1 GENERAL**

- A. All work shall be done in accordance with NECA construction standards.
- B. Adhere to industry standards of care for safety, including:
  - 1. Occupational Safety and Health Act.
  - 2. Accident Prevention Manual for Industrial Operations, National Safety Council.
  - 3. ANSI/NFPA 70E, Electrical Safety Requirements for Employee Workplaces.
  - 4. American National Standards for Personnel Protection: Lockout/Tagout.
  - 5. Applicable state and local safety operating procedures.

### **3.2 PRODUCT DELIVERY, STORAGE AND HANDLING**

- A. Deliver, store, and handle products according to the manufacturer's recommendations, using means and methods that will prevent damage, deterioration, and loss, including theft. Handle all equipment carefully to prevent damage, breakage, denting, and scoring of finishes. Do not install damaged equipment.
- B. Store products subject to damage by the elements above ground, undercover in a weather tight enclosure, with ventilation adequate to prevent condensation. Maintain temperature and humidity within range required by manufacturer's instruction.

### **3.3 CUTTING BUILDING CONSTRUCTION**

- A. Obtain permission from the Architect and coordinate with other trades prior to cutting. Locate cuttings so they will not weaken structural components. Cut carefully and only the minimum amount necessary. Cut concrete with diamond core drills or concrete saws except where space limitations prevent the use of such tools.
- B. All construction materials damaged or cut into during the installation of this work must be repaired or replaced with materials of like kind and quality as original materials by skilled labor experienced in that particular building trade.

### **3.4 PENETRATION OF BUILDING ELEMENTS**

- A. General:

1. Penetrations of building elements by electrical systems shall not compromise the performance and integrity of the building element (structural, fire, smoke, waterproof, etc.)
- B. Fire and smoke rated elements:
  1. Electrical penetrations of fire and smoke rated floor and wall assemblies shall maintain fire-resistance or smoke barrier rating of the assembly. Firestopping materials and installation requirements are specified in Division 7 section "Firestopping".

### **3.5 PAINTING**

- A. Items furnished under this Division that are scratched or marred in shipment or installation shall be refinished with touchup paint selected to match installed equipment finish.

### **3.6 EQUIPMENT CONNECTION**

- A. For equipment furnished under this or other Divisions of the specifications, or by owner, provide all electrical connections necessary to serve such equipment and provide required control connections to all equipment so that the equipment is fully operational upon completion of the project. Investigate existing equipment to be relocated and provide new connections as required.
- B. Contract Coordination: Investigate vendor equipment proposed for installation and address and integrate the following into the construction process:
  1. Special equipment requirements identified in shop drawings or submittals.
  2. Equipment requirements for distribution system performance, for example, an external disconnect switch or fused disconnect switch to provide compliance with a governing code, a short circuit current rating, or a listing.
- C. Obtain rough-in requirements for equipment furnished under other divisions of this specification prior to roughing-in.

### **3.7 HOUSEKEEPING PADS**

- A. Provide steel reinforced concrete housekeeping pad under each floor mounted switchboard, transformer, motor control center, generator and/or other free standing electrical equipment. Size 4" greater (horizontal minimum) than base of equipment mounted thereon. Minimum height 3-1/2". Use 3000-psi (20.7-Mpa), 28 day compressive strength concrete and reinforcement as specified in Division 3 Section "Cast-in-Place Concrete". Chamfer edges and finish smooth with all blockouts square and plumb.
- B. When housekeeping pad is poured on previously poured concrete or is for engine or motor driven equipment, the pad shall be reinforced (4# rebar, 12" o.c., both ways) and



the rebar shall be tied to the existing floor via #4 rebar epoxy grouted into the existing concrete on 18" centers or other acceptable means. The existing slab shall be thoroughly cleaned and prepared for the pad just before the pour.

### 3.8 CLEAN UP

- A. Contractor shall continually remove debris, cuttings, crates, cartons, etc., created by his work. Such clean up shall be done daily and at sufficient frequency to eliminate hazard to the public, other workmen, the building or the Owner's employees. Before acceptance of the installation, Contractor shall carefully clean cabinets, panels, lighting fixtures, wiring devices, cover plates, etc., to remove dirt, cuttings, paint, plaster, mortar, concrete, etc. Blemishes to finished surfaces of apparatus shall be removed and new finish equal to the original applied.
1. Wipe surfaces of electrical equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
  2. 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, high pressure sodium, metal halide, and mercury vapor fixtures to comply with requirements for new fixtures.

### 3.9 TESTING AND DEMONSTRATION

A. [Comply with the requirements of Division 01.](#)

A.B. Demonstrate that all electrical equipment operates as specified and in accordance with manufacturer's instructions. Perform tests in the presence of the Architect, Owner or Engineer. Provide all instruments, manufacturer's operating instructions and personnel required to conduct the tests. Repair or replace any electrical equipment that fails to operate as specified and or in accordance with manufacturer's requirements.

B.C. Contractor shall remove and replace covers of electrical equipment, open manholes and remove/replace ceiling tiles to permit engineer to observe equipment and wiring provided. For manholes: Furnish OSHA safety compliant equipment and personnel, including ventilation, safety harness, ladder and flashlight.

DIVISION 26 ELECTRICAL JOB COMPLETION FORM

PROJECT NAME: OSU Women's Basketball Locker Room Renovation

PROJECT

LOCATION: Oregon State University

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

A. Electrical Inspectors Final Acceptance (Copy of certificate attached.)

Name	Agency	Date
------	--------	------

B. Fire Marshal's Final Acceptance of Fire Alarm System (Copy of certificate attached.)

Name	Agency	Date
------	--------	------

C. The following systems have been demonstrated to Owner's representative.

1. <u>Power Distribution System</u>	<u>Owner's Rep.</u>	<u>Date</u>
-------------------------------------	---------------------	-------------

2. <u>Lighting Control &amp; Dimming System</u>	<u>Owner's Rep</u>	<u>Date</u>
---	--------------------	-------------

D. Record Drawings  
Attached Transmitted previously to \_\_\_\_\_  
Date

E. O & M Manuals  
Attached Transmitted previously to \_\_\_\_\_

F. Test Reports  
Attached Transmitted previously to \_\_\_\_\_  
Date

G. The work is complete in accordance with contract documents and authorized changes except for

\_\_\_\_\_ and the architect/engineer's representative is requested to meet with

\_\_\_\_\_  
Supervisor of Electrical Work at \_\_\_\_\_ on \_\_\_\_\_  
Time Date

\_\_\_\_\_  
Contractors Rep. Signature Date

**Gensler**  
005.2096.400

August 20, 2019  
Addendum No. 3

**Gill Coliseum Women's  
Basketball Locker Room  
Renovation** Corvallis,  
Oregon

**END OF SECTION 26 05 00**

## SECTION 27 05 00 - COMMON WORK RESULTS FOR COMMUNICATIONS

### PART 1 - GENERAL

#### 1.1 ~~RELATED DOCUMENTS~~

- ~~A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.~~
- ~~B. Section 270526 Grounding and Bonding for Communications Systems~~
- ~~C. Section 270529 Hangers and Supports for Communications Systems~~
- ~~D. Section 270533 Conduits and Backboxes for Communications Systems~~
- ~~E. Section 270544 Sleeves and Sleeve Seals for Communications, Pathways and Cabling~~
- ~~F. Section 271500 Communications Horizontal Cabling~~
- ~~G. Section 283111 Digital, Addressable Fire Alarm System~~

#### 1.21.1 SUMMARY

- A. This section includes general requirements for all Division 27 work and is supplemental and in addition to the requirements of Division 01.
- B. It is the intention of this Division of the Specifications and the Contract Drawings to describe and provide for the furnishing, installing, testing and placing in satisfactory and fully operational condition all equipment, materials, devices and necessary appurtenances to provide a complete communication system. Provide all materials, appliances and apparatus not specifically mentioned herein or shown on the drawings, but which are necessary to make a complete, fully operational installation of all communications systems shown on the contract drawings or described herein. Connect equipment and devices furnished and installed under other Divisions of this specification (or the Owner) under this Division.
- C. Workmanship shall be of the best quality and competent and experienced technicians shall be employed and shall be under the supervision of a competent and experienced foreman.
- D. The drawings and specifications are complementary and what is called for (or shown) in either is required to be provided as if called for in both. Where conflicting information occurs within the drawings and specifications or between the drawings and specifications, the more expensive alternative shall be used as a basis for bidding and construction.
- E. See Division 01 for sequence of work.

#### 1.3 ~~WORK IN OTHER DIVISIONS~~

- ~~A. See all other specifications for other work which includes but is not limited to:  
Cutting and Patching  
Door Hardware  
Electronic Safety and Security  
Equipment Wiring~~

~~Fire Stopping~~  
~~Mechanical Control Wiring~~  
~~Mechanical Equipment~~  
~~Painting, Refinishing and Finishes~~  
~~Temporary Power~~

#### **1.41.2 CODES, PERMITS, INSPECTION FEES**

- A. The following codes and standards are referenced in the Division 27 specifications. Perform all work and provide materials and equipment in accordance with the latest referenced codes and standards of the following organizations:
1. American National Standards Institute (ANSI)
  2. National Electrical Manufacturer's Association (NEMA)
  3. National Fire Protection Association (NFPA)
  4. Underwriter's Laboratories (UL)
  5. American Society for Testing and Materials (ASTM)
  6. BICSI (A Telecommunications Association)
  7. International Building Code (IBC)
  8. Insulated Cable Engineers Association (ICEA)
  9. Institute of Electrical and Electronic Engineers (IEEE)
  10. Federal Communications Commission Rules and Regulations (FCC)
  11. National Electrical Code (NFPA Article 70) (NEC)
  12. National Electrical Safety Code (NESC)
  13. Occupational Safety and Health Administration (OSHA)
  14. Rural Utilities Service (RUS)
  15. Telecommunications Industry Association (TIA)
  16. Electronics Industry Alliance (EIA)
  17. Uniform Building Code (UBC)
  18. UL 2043 & UL 2239
  19. NEMA VE1 & VE2
- B. Install the communications systems based on the following:
- |         |   |
|---------|---|
| NFPA 70 | National Electrical Code as adopted and amended by the Local Jurisdiction.    |
| IBC     | International Building Code as adopted and amended by the Local Jurisdiction. |
- C. Communications Specific:
1. TIA/EIA-455: Fiber Optic Test Standards

2. TIA-526: Optical Fiber Systems Test Procedures
  3. TIA/EIA-568-C.2: Commercial Building Telecommunications Cabling Standard
  4. TIA-568-0.D
  5. TIA-568-3.D
  6. TIA-526-7-A
  7. TIA-526-14-C
  8. TIA-569-D: Commercial Building Standard for Telecommunications Pathways and Spaces
  9. TIA-606-B: Administration Standard for Commercial Telecommunications Infrastructure
  10. ANSI/TIA-607-C: Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications
  11. TIA-758-B: Customer-owned Outside Plant Telecommunications Infrastructure Standard
  12. TIA-942-B: Telecommunications Infrastructure Standard for Data Centers
  13. TIA/EIA: Technical Service Bulletins (TSBs) (related to the above TIA/EIA standards)
  14. IEEE 802.11 Wireless Local Area Network Standard, including the IEEE 802.11a, 802.11b, 802.11g, and 802.11n standards
  15. BICSI: BICSI Customer Owned Outside Plant Design Manual, Latest Edition
  16. BICSI: BICSI LAN and Internetworking Design Manual, Latest Edition
  17. BICSI: BICSI Telecommunications Distribution Methods Manual, Latest Edition
  18. BICSI: BICSI Telecommunications Cabling Installation Manual, Latest Edition
  19. NEC: NFPA 70
  20. FCC Part 68: Connection of Terminal Equipment to Telephone Network.
- D. The referenced codes establish a minimum level of requirements. Where provision of the various codes conflict with each other, the more stringent provision shall govern. If any conflict occurs between referenced codes and this specification, the codes are to govern. Compliance with code requirements shall not be construed as relieving the Contractor from complying with any requirements of the drawings or specifications which may be in excess of requirements of the governing codes and rules and not contrary to same.
- E. Obtain and pay for all licenses, permits and inspections required by laws, ordinances and rules governing work specified herein. Arrange for inspection of work by the inspectors and give the inspectors all necessary assistance in their work of inspection.

### 1-51.3 COORDINATION

- A. Coordinate work with that of the other Contractors and/or other trades doing work on the project. Examine all drawings and specifications of other trades for construction

details and coordination. Make every reasonable effort to provide timely notice of work affecting other trades to prevent conflicts or interference as to space requirements, dimensions, openings, block-outs, sleeving or other matters which will cause delays or necessitate work-around methods.

- B. Obtain submittals and shop drawings of all equipment with electrical connections furnished under other divisions of the specification and by the Owner. Provide all wiring in accordance with specific equipment requirements. Immediately advise the Architect of any changes which may affect the contract price.
- C. Special attention is called to the following items. Coordinate all conflicts prior to installation:
  - 1. Location of grilles, pipes, sprinkler heads, ducts and other mechanical equipment so that all communications outlets and equipment are clear from and in proper relation to these items.
  - 2. Location of cabinets, counters and doors so that communications outlets, and equipment are clear from and in proper relation to these items.
  - 3. Recessing and concealing communications materials in CMU walls, concrete construction and precast construction.
  - 4. In every telecommunication room with either active or passive equipment the Contractor shall monitor the work of all trades to assure that the space and clearance requirements of code are met.
  - 5. Review specifications for other Divisions of the work to determine where other Divisions are requiring communication connections. Verify provisions shown on contract drawings by examining shop drawing submittals of other Divisions prior to submission to the Owner. Do not proceed with ordering of supporting equipment, until characteristics are verified. Proceed with rough-in only after verification of shop drawings.
- D. Digital format copies of bid drawings will be furnished to the successful bidder. Augment bid documents with additional information to ensure coordination between trades. Provide digital format communications systems drawings showing all ceiling devices, fixtures, raceways and cable tray locations and routing to mechanical contractor to be used for coordination drawings provided by mechanical contractor. Include dimensions and elevations of devices, fixtures, raceway and cable tray.
- E. Furnish, install and place in satisfactory condition all raceways, boxes, conductors and connections and all other materials required for the communication systems shown or noted in the contract documents to be complete, fully operational and fully tested upon completion of the project. Raceways, boxes and ground connections are shown diagrammatically only and indicate the general character and approximate location. Where routings of major raceways and telecommunication pathways are indicated on plan sheets, the routing information supplements the information on diagrams. If no routing information is shown, route the systems in a manner that will coordinate with new and existing infrastructure and the work of other trades.
- F. Consult the architectural drawings for the exact height and location of all communication and electrical equipment not specified herein or shown on the drawings. Make any minor changes (less than 6'-6" horizontal) in the location of the raceways,

outlets, boxes, devices, wiring, etc., from those shown on the drawings without extra charge, where coordination requires or if so directed by the Architect before rough-in.

- G. Provide inserts or sleeves for outlet boxes, conductors, cables and/or raceways as required. Coordinate the installation thereof with other trades.
- H. The Contractor will not be paid for relocation of work, cuttings, patching and finishing required for work requiring reinstallation due to lack of coordination prior to installation.

#### **1.61.4 APPROVED CONTRACTOR**

- A. Contractor shall be both an approved Ortronics Certified Install Plus (CIP) and a certified Corning Cabling System NPI Installer within the State of Oregon.

#### **1.71.5 WARRANTY**

- A. Ortronics/Superior Essex nCompass Limited Lifetime warranty for horizontal subsystem.
  - 1. nCompass Category 6+ cabling, connectivity hardware and patch cables shall be covered by a, nCompass Limited Lifetime warranty labor and application assurance warranty. The application assurance portion shall provide coverage for the cabling system to support the applications that are designed for the specifications outlined in ANSI/TIA/EIA 568-C.0-2. These applications include but are not limited to 10BASE-T, 100BASE-T, 1000BASE-T and 155 Mb/s ATM.
  - 2. Corning 25-year Warranty for fiber optic riser and outside plant backbone subsystems.

#### **1.81.6 CORRECTION OF WORK**

A. Comply with the requirements of Division 01.

~~A. Within one year after the date of Substantial Completion of the work, the Contractor shall correct any work found to be not in conformance with the Contract Documents promptly after written notice from the Owner to do so, unless the Owner has previously given the Contractor a written acceptance of such condition. This obligation shall survive acceptance of the work under this Contract and termination of the Contract. The Owner shall give such notice promptly after discovery of the condition.~~

#### **1.91.7 ITEMIZED SCHEDULE OF COSTS**

- A. Complete the Schedule of Values included at the end of this section. This schedule shall be adhered to for the communication contractor to facilitate analysis and approval of the monthly progress billings. Refer to the Supplementary Conditions of General Contract and Division 1 - General Requirements for details, and conform thereto. Provide a copy directly to Stantec.

#### **1.101.8 SUBMITTALS AND SHOP DRAWINGS**

A. Submittals and Shop Drawings: Comply with the requirements of Division 01. In addition, provide the below described information.



- ~~A. Submittals and Shop Drawings: Comply with Division 1. Allow two weeks for review for each submittal and resubmittal. Incomplete submittals and shop drawings which do not comply with these requirements will be returned for correction, revision and resubmittal. See General Conditions for format, quantity, etc.~~
- B. Product Submittals shall show:
1. Indicate listing by UL or other approved testing agency.
  2. Highlight with yellow or blue marker adequate information to demonstrate materials being submitted fully comply with contract documents.
  3. Review and check all material prior to submittal and stamp "Reviewed and Approved".
  4. Provide Manufacturer and/or lab certification that all product materials are PCB-free.
- C. Contractor Qualification Data: Provide most recent valid certification documentation for installation technician, installation supervisor, and field inspector. These include BICSI ITS Installation Certifications and all relevant specific manufacture product installation certifications.
- D. Shop drawings shall show:
1. Ratings of items and systems.
  2. How the components of an item or system are assembled, interconnected, function together and how they will be installed on the project.
  3. System layout floor plans with complete device layout, point-to-point wiring connection between all components of the system, wire sizes and color coding.
  4. Coordinate with other division shop drawings and submittals. Identify interface points and indicate method of connection.
  5. Communications Rooms: Submit 1/2" = 1'-0" detail plans and wall elevations of each room showing actual size of equipment in place. Identify coordinating elements such as structural beams or mechanical systems. Submittals shall show coordination among all suppliers of equipment, including power components, fire alarm, racks, nurse call, public address, security, etc. Submit room layouts at same time as material submittals, and prior to installation of any equipment.
- E. The Contractor agrees:
1. Submittals and shop drawings processed by the Architect are not change orders.
  2. The purpose of submittals and shop drawings by the Contractor is to demonstrate to the Engineer that the Contractor understands the design concept.
  3. Submittals demonstrate equipment and material Contractor intends to furnish and install and indicate detailing fabrication and installation methods Contractor intends to use.
  4. To accept all responsibility for assuring that all materials furnished under this Division of the specifications meet, in full, all requirements of the contract documents.

5. To pay for Engineers review cost of submittal review beyond one resubmittal.
- F. The Engineer's review is only for general conformance with the design concept of the project and general compliance with the information given in the contract documents. Corrections or comments made during this review do not relieve contractor from compliance with the requirements of the drawings and specifications. Contractor is responsible for: Dimensions which shall be confirmed and correlated at the job site; fabrication process and techniques of construction; coordination of this work with that of all other trades; performing this work in a safe and satisfactory manner.
- G. Submittals and shop drawings are required per the submittals schedule at the end of this Section.

#### 1.11.9 PROJECT CLOSE-OUT

A. Comply with the requirements of Division 01.

~~A. Coordinate with close out provisions in Division 01—General Requirements.~~

~~B. Request For Final Punchlist~~

~~1. To request a final low voltage punch list, forward a letter to Stantec, stating; "The communications work on this project is complete, all punch list items to date are complete, items a. i. in the Punchlist Procure paragraph in Section 270500—Common Work Results For Communications are complete and the project is ready for final punch list observation."~~

~~2. Project Punchlist Procedure: Perform the following procedures for project closeout of communications portions of work.~~

~~a. Color code junction boxes per Section 260533—Raceways and Boxes For Electrical Systems.~~

~~b. Provide written warranty in O & M per the General Conditions of the Contract.~~

~~c. Furnish Record Drawings per this section. Obtain signature on Job Completion Form.~~

~~d. Furnish O & M Manuals per this section. Obtain signature on Job Completion Form.~~

~~e. Give instruction periods to Owner's personnel per this section. Obtain signature on Job Completion Form.~~

~~f. To request final acceptance of project, fill out Job Completion Form in this section and forward to Stantec. Note: If inspectors have not signed form, a copy of signed off permits will suffice.~~

~~g. Include with Job Completion Form, a copy of the final punch list with the word "DONE", and the date and Contractor's initials after each item on the list.~~

**1-121.10 COMMUNICATIONS EQUIPMENT OPERATION AND MAINTENANCE  
(O&M) MANUALS**

- A. Provide O&M manuals required in Division 01 - General Requirements plus one manual for Stantec for all equipment furnished under Division 27 - Communications of the specifications.
- B. The information included must be the exact equipment installed. Where sheets show the equipment installed and other equipment, the installed equipment shall be neatly and clearly identified on such sheets.
- C. These O&M manuals shall contain all the information needed to operate and maintain all systems and equipment provided in the project. Present and arrange information in a logical manner for efficient use by the Owner's operating personnel. The information provided shall include but not be limited to the following:
  - 1. Equipment manufacturer, make, model number, size, nameplate data, etc.
  - 2. Description of system configuration and operation including component identification and interrelations. A master control schematic drawings(s) may be required for this purpose.
  - 3. Dimensional and performance data for specific unit provided as appropriate.
  - 4. Manufacturer's recommended operation instructions.
  - 5. Complete parts list including reordering information, recommended spares and anticipated useful life (if appropriate). Parts lists shall give full ordering information assigned by the original parts manufacturer. Relabeled and/or renumbered parts information as reassigned by equipment supplier not acceptable.
  - 6. Shop drawings.
  - 7. Wiring diagrams.
  - 8. Signal equipment submittals shall contain step-by-step circuit description information designed to acquaint maintenance personnel with equipment operation in each mode of operation.
  - 9. A complete list of local (nearest) manufacturer representative and distributor contacts for each type of equipment and manufacturer. Include name, company, address, phone, fax, e-mail address, and web site.
  - 10. Cable test reports.
- D. Furnish complete wiring diagrams for each system for the specific system installed under the contract. "Typical" line diagrams will not be acceptable unless revised to indicate the exact field installation.

**1-131.11 INSTRUCTION PERIODS**

A. Comply with the requirements of Division 01.

~~A. After substantial completion of the work and 20 days after the O&M manuals have been delivered to the Owner and after all tests and final inspection of the work by the Authority(s) Having Jurisdiction; demonstrate the electrical systems and instruct the~~

~~Owner's designated operating and maintenance personnel in the operation and maintenance of the various electrical systems. The Contractor shall arrange scheduled instruction periods with the Owner. The Contractor's representatives shall be superintendents or foremen knowledgeable in each system and suppliers representatives when so specified. When more than one training session is specified, the second session shall be 30 to 90 days after the first as agreed to by the Owner.~~

- ~~B. Include in each instruction session an overview of the system, presentation of information in maintenance manuals with appropriate references to drawings. Conduct tours of the building areas with explanations of maintenance requirements, access methods, servicing and maintenance procedures, equipment cleaning procedures and adjustment locations.~~
- ~~C. Include the following scheduled instruction periods: 1<sup>st</sup> Session 2<sup>nd</sup> Session  
1. Communications System 4 hours 4 hours~~
- ~~D. Provide one professionally produced digitally recorded of each training session in DVD format. Furnish two (2) copies to the Owner.~~

#### **1.141.12 RECORD DRAWINGS**

- A. Comply with the requirements of Division 01
- ~~B. Continually record the actual low voltage system(s) installation on a set of prints kept readily available at the project during construction. These prints shall be used for this purpose alone.
  - ~~1. Mark record prints with red-erasable pencil. Mark the set to show the actual installation where the installation varies substantially from the work as originally shown.~~
  - ~~2. Accurately locate with exact dimensions all underground and underslab raceways and stub-outs.~~
  - ~~3. Note changes of directions and locations, by dimensions and elevations, as utilities are actually installed.~~
  - ~~4. Include addenda items and revisions made during construction.~~
  - ~~5. Erase conditions not constructed or "X-out" and annotate "not constructed" to clearly convey the actual "as constructed" condition.~~
  - ~~6. Organize record drawings sheets in manageable sets, bind and print suitable titles, dates and other identification on the cover of each set.~~~~
- B. Transfer the changes marked up on the record prints into Revit drawing files at the completion of the work. The version of Revit shall not be earlier than the most recent version available at the date the project bids were received. Revit files shall not include the stamp of the engineer of record. Provide two (2) sets of prints, one set of fixed line reproducible drawings and one set of Revit drawing files on CD Rom. Transmit drawings, Revit drawing files and the record drawing mark-ups to the Architect. Final payment to the contractor will not be authorized until these documents have been submitted to and accepted by the Architect.

~~1.15 FINAL ACCEPTANCE REQUEST~~

- ~~A. Submit to the Architect, with a copy to the Stantec Engineer, a Stantec Job Completion Form (form attached in this section) properly filled out prior to the time final acceptance of the electrical work is requested.~~

~~1.161.13 ABBREVIATIONS AND DEFINITIONS~~

- A. When the following abbreviations and definitions are used in relation to the work for Division 27 they shall have the following meanings:

<u>Item</u>	<u>Meaning</u>
AHJ	Authority Having Jurisdiction.
Boxes	Outlet, Junction or Pull Boxes.
Code	All applicable codes currently enforced at project location.
Compression	Compressed using a leverage powered (hydraulic or equivalent) crimping tool.
Connection	All materials and labor required for equipment to be fully operational.
Exterior Location	Outside of or penetrating the outer surfaces of the building weather protective membrane.
Fully Operational	Tested, approved, and operating to the satisfaction of the AHJ, manufacturer and contract documents.
Install	To enter or attach permanently into the project and make fully operational.
Mfr.	Manufacturer.
NEC	National Electrical Code, National Fire Protection Association, Publication #70.
Noted	Shown or specified in the Contract Documents.
Provide	Furnish and install.
Required	As required by code, AHJ, contract documents, or manufacturer for the particular installation to be fully operational.
Shown	As indicated on the drawings or details.
Wiring	Raceway, conductors and connections.
Accepted/Acceptable	Work or materials conforming with the intent of the project, and in general, conforming to the pertinent information in the Construction Documents.
Approved/Approval	The written approval of the Engineer.
Accessible/Easy access	Access attained without requiring extensive removal of other materials to gain access.
Accessible Ceiling	Acoustical tile hanging ceilings ("Hard-lid" ceilings even when provided with access panels, are not considered an Accessible Ceiling.)
Agreement	The contractual agreement between the Owner and the Contractor.
Communications Infrastructure System:	A communications Cabling System combined with a Communications Raceway System.

Concealed	Hidden from sight in interstitial building spaces, chases, furred spaces, shafts, crawl spaces, etc.
Construction Documents	Collective term for the entire set of bound or unbound material describing the construction and services required, including all Drawings, Specifications, addenda issued prior to execution of the contract, and modifications issued after Execution of the Contract (such as change orders, construction change directives, supplemental instructions, etc.).
The Contractor	The party responsible for providing the system(s) as indicated herein.
Drawings	The graphic and pictorial portions of the Contract Documents, wherever located and whenever issued, showing the design, location and dimensions of the Work, generally including (but not limited to) plans, elevations, sections, details, schedules and/or diagrams.
Engineer/Consultant	The party responsible for producing the communications system(s) Construction Documents.
Exposed Final Completion	Not concealed (see above) and not installed underground. The date when the Engineer confirms in writing that the Contractor has completed the work in accordance with the Construction Documents, including completion of all punch list items, cleanup work and delivery of all required guarantees, warranties, licenses, releases and other required deliverables.
Furnish	To purchase, supply, and deliver to the project materials in new and operable condition, ready for installation.
Governing Requirements	Collective term for regulations, laws, ordinances, codes, rules, standards, requirements, and guidelines that govern the installation and inspection of the work defined in the Contract Documents. See "Part 1 – General, 1.8 Governing Requirements" herein.
Governing Authorities	Entities or their representatives charged with formation and/or enforcement of Governing Requirements, such as the Authority Having Jurisdiction (AHJ).
Install Inside Plant (ISP)	To place in final position in fully operable, tested condition. Infrastructure within a building; includes raceways, cabling, termination components and racks/cabinets.
Or Equal, Or Equivalent	Materials approved for use by the Engineer and which are dimensionally suitable and operationally identical to the specified item.
Outside Plant (OSP)	Infrastructure exterior to a building.
Owner The Project	The Owner and the Owner's designated representative(s). The total construction of which the Work performed under the Contract Documents may be the whole or a part, and which may include construction by the Owner and/or separate contractors.

Substantial Completion	The date when all work required by the Construction Documents shall be complete (subject to the final punch list to be prepared by the Engineer) and on which the applicable jurisdictional authorities have issued a temporary certification of occupancy.
Section	An individual section of the Specifications.
Shown on Drawings	Noted, indicated, scheduled, detailed, or any other written reference made on the Drawings.
Specifications	The portion of the Contract Documents consisting of the written requirements for materials, equipment, construction systems, standards and workmanship for the Work and performance of related services.
Specification Section(s)	One or more sections of the Specifications.
Structured Cabling System (SCS)	Alternative term for Communications Cabling System
The Work	The construction and services required by the Contract Documents, whether completed or partially completed, and all other labor, materials, equipment and services provided or to be provided by the Contractor to fulfill the Contractor's obligations. The Work may constitute the whole or a part of the Project.

## **PART 2 - PRODUCTS**

### **2.1 GENERAL**

- A. All materials and equipment installed shall have been tested and listed by Underwriters Laboratories or other approved testing organization and shall be so labeled unless otherwise permitted by the Authority Having Jurisdiction (Inspector).
- B. All materials to be new, free from defects and not less than quality herein specified. Materials shall be designated to insure satisfactory operation and operational life in the environmental conditions which will prevail where they are being installed.
- C. Each type of materials furnished shall be of the same make, be standard products of manufacturers regularly engaged in production of such materials and be the manufacturer's latest standard design.
- D. All materials, equipment and systems furnished that include provisions for storing, displaying, reporting, interfacing, inputting, or functioning using date specific information shall perform properly in all respects regardless of the century. Any interface to other new or existing materials, equipment or systems shall function properly and shall be century compliant, both in regards to information sent and received.
- E. All materials shall be PCB-free.
- F. All paint to be low-VOC.

### **2.2 SUBSTITUTION OF MATERIALS**

- A. Comply with Division 01.

## **PART 3 - EXECUTION**

### **3.1 PRODUCT DELIVERY, STORAGE AND HANDLING**

- A. Deliver, store, and handle products according to the manufacturer's recommendations, using means and methods that will prevent damage, deterioration, and loss, including theft. Handle all equipment carefully to prevent damage, breakage, denting, and scoring of finishes. Do not install damaged equipment.
- B. Store products subject to damage by the elements above ground, undercover in a weather tight enclosure, with ventilation adequate to prevent condensation. Maintain temperature and humidity within range required by manufacturer's instruction.

### **3.2 CUTTING BUILDING CONSTRUCTION**

- A. Obtain permission from the Architect and coordinate with other trades prior to cutting. Locate cuttings so they will not weaken structural components. Cut carefully and only the minimum amount necessary. Cut concrete with diamond core drills or concrete saws except where space limitations prevent the use of such tools.
- B. All construction materials damaged or cut into during the installation of this work must be repaired or replaced with materials of like kind and quality as original materials by skilled labor experienced in that particular building trade.

### **3.3 FIRESTOPPING**

- A. Apply firestopping to communications penetrations of fire rated floor and wall assemblies to maintain fire-resistance rating of the assembly. Firestopping materials and installation requirements are specified in Division 7 section "Firestopping".

### **3.4 PAINTING**

- A. Items furnished under this Division that are scratched or marred in shipment or installation shall be refinished with touchup paint selected to match installed equipment finish.

### **3.5 EQUIPMENT CONNECTION**

- A. For equipment furnished under this or other Divisions of the specifications, or by owner, provide complete all electrical connections necessary to serve such equipment and provide required control connections to all equipment so that the equipment is fully operational upon completion of the project.
- B. Investigate existing equipment to be relocated and provide new connections as required.
- C. Obtain rough-in requirements for equipment furnished under other divisions of this specification prior to roughing-in. Review shop drawings and submittals of other Divisions to determine requirements.

### **3.6 CLEAN UP**

- A. Contractor shall continually remove debris, cuttings, crates, cartons, etc., created by this work. Such clean up shall be done daily and at sufficient frequency to eliminate hazard to the public, other workers, the building or the Owner's employees. Before acceptance



of the installation, Contractor shall carefully clean cabinets, panels, lighting fixtures, wiring devices, cover plates, etc., to remove dirt, cuttings, paint, plaster, mortar, concrete, etc. Blemishes to finished surfaces of apparatus shall be removed and new finish equal to the original applied.

1. Wipe surfaces of low voltage equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
  2. Equipment installed prior to final clean-up shall be cleaned by the contractor. Jacks and patch panels that have construction dirt and dust shall be cleaned to like new condition.
- B. Materials recycling and salvage:
1. Recycle all scrap metal.
  2. Salvage operable equipment removed from site and deliver to local resale organization.

### 3.7 TESTING AND DEMONSTRATION

A. Comply with the requirements of Division 01.

A-B. Demonstrate that all electrical equipment operates as specified and in accordance with manufacturer's instructions. Perform tests in the presence of the Architect, Owner or Engineer. Provide all instruments, manufacturer's operating instructions and personnel required to conduct the tests. Repair or replace any electrical equipment that fails to operate as specified and or in accordance with manufacturer's requirements.

STANTEC COMMUNICATIONS JOB COMPLETION FORM

PROJECT NAME: OSU Women's Locker Room Renovation  
PROJECT  
LOCATION: Oregon State University  
DATE: \_\_\_\_\_

- A. Fire Marshal's Final Acceptance of Fire Alarm System (Copy of certificate attached.)

Name	Agency	Date
B. The following systems have been demonstrated to Owner's representative.		
1. Communications System	Owner's Rep.	Date
5. Master Antenna Television System	Owner's Rep	Date

- C. Record Drawings  
Attached Transmitted previously to \_\_\_\_\_  
Date

- D. O & M Manuals  
Attached Transmitted previously to \_\_\_\_\_

- E. Test Reports  
Attached Transmitted previously to \_\_\_\_\_  
Date

- F. The work is complete in accordance with contract documents and authorized changes except for

\_\_\_\_\_ and the Architect/Engineer's representative is requested to meet with  
\_\_\_\_\_ at \_\_\_\_\_ on \_\_\_\_\_  
Supervisor of Communications Time Date  
Work

\_\_\_\_\_  
Contractors Rep. Signature Date

**Stantec Schedule of Values for OSU Women's Basketball Locker Room  
Renovation**

<b>Description of Work</b>	<b>Amount</b>
Material and Labor Allowance	
Hangers and Supports - Material & Labor	
Raceways - Conduit - Material & Labor	
Raceways – Cable tray - Material & Labor	
Equipment Racks - Material & Labor	
Rough-in Cabling - Material & Labor	
Install jacks and faceplates - Materials & Labor	
Equipment room terminations - Materials & Labor	
Backbone cabling, Installation & Testing - Materials & Labor	
Horizontal Cable Labeling & Testing - Materials & Labor	
Strap Support Allowance (for existing systems) - Labor & Materials	
Testing, Demonstration (AHJ approvals)	
Training	
Close Out (Record Drawings, O&M, etc.) - Materials & Labor	
<b>TOTAL DIVISION 27</b>	

**STANTEC SUBMITTAL LIST OSU Women's Basketball Locker Room  
Renovation**

<b>SECTION</b>	<b>DESCRIPTION</b>	<b>SUBMIT RECEIVE DATE</b>	<b>STATUS</b>
270526	GROUNDING AND BONDING FOR COMMUNICATIONS		
270528	SYSTEMS		
270529	PATHWAYS FOR COMMUNICATIONS SYSTEMS		
	HANGERS AND SUPPORTS FOR COMMUNICATION SYSTEMS		
270533	CONDUIT AND BACKBOXES FOR COMMUNICATION SYSTEMS		
270544	SLEEVES AND SLEEVE SEALS FOR COMMUNICATIONS PATHWAYS AND CABLING		
271500	COMMUNICATIONS HORIZONTAL CABLING		

**END OF SECTION 27 05 00**

## SECTION 28 05 00 - COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY

### PART 1 - GENERAL

#### ~~1.1~~ ~~RELATED DOCUMENTS~~

~~A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.~~

#### ~~B.1.1~~ SUMMARY

~~C.A.~~ This section includes general electrical requirements for all Division 28 work and is supplemental and in addition to the requirements of Division 1.

~~D.B.~~ It is the intention of this Division of the Specifications and the Contract Drawings to describe and provide for the furnishing, installing, testing and placing in satisfactory and fully operational condition all equipment, materials, devices and necessary appurtenances to provide a complete electrical system. Provide all materials, appliances and apparatus not specifically mentioned herein or shown on the drawings, but which are necessary to make a complete, fully operational installation of all electrical systems shown on the contract drawings or described herein. Connect equipment and devices furnished and installed under other Divisions of this specification (or the Owner) under this Division.

~~E.C.~~ Workmanship shall be of the best quality and competent and experienced electricians shall be employed and shall be under the supervision of a competent and experienced foreman.

~~F.D.~~ The drawings and specifications are complimentary and what is called for (or shown) in either is required to be provided as if called for in both.

#### ~~G.~~ WORK IN OTHER DIVISIONS

~~H. Refer to Division 27 for Communications and Division 28 for Electronic Safety and Security. System elements of those Divisions require conformance and integration with the work of Division 26.~~

~~I. See all other specifications for other work which includes but is not limited to:~~

~~Cutting and Patching~~

~~Door Hardware~~

~~Fire Protection~~

~~Mechanical Systems and Control Wiring~~

~~Painting, Refinishing and Finishes~~

#### ~~J.1.2~~ CODES, PERMITS, INSPECTION FEES

~~K.A.~~ The following codes and standards are referenced in the Division 28 specifications. Perform all work and provide materials and equipment in accordance with the latest referenced codes and standards of the following organizations:

1. American National Standards Institute (ANSI)

2. National Electrical Manufacturer's Association (NEMA)
3. National Fire Protection Association (NFPA)
4. Underwriter's Laboratories (UL)
5. NECA National Electrical Contractor's Association

L.B. Install the electrical systems based on the following:

NFPA 70	National Electrical Code as adopted and amended by the Local Jurisdiction.
IBC	International Building Code as adopted and amended by the Local Jurisdiction.

M.C. The referenced codes establish a minimum level of requirements. Where provision of the various codes conflict with each other, the more stringent provision shall govern. If any conflict occurs between referenced codes and this specification, the codes are to govern. Compliance with code requirements shall not be construed as relieving the Contractor from complying with any requirements of the drawings or specifications which may be in excess of requirements of the governing codes and rules and not contrary to same.

N.D. Obtain and pay for all licenses, permits and inspections required by laws, ordinances and rules governing work specified herein. Arrange for inspection of work by the inspectors and give the inspectors all necessary assistance in their work of inspection.

#### 4.21.3 COORDINATION

- A. Coordination during the bidding and pricing aspects of the contract includes determining where the work of other Divisions relies on the work of this Division for electricity and including the electrical system to match the requirements.
- B. Coordinate work with that of the other Contractors and/or other trades doing work on the project. Examine all drawings and specifications of other trades for construction details and coordination. Make every reasonable effort to provide timely notice of work affecting other trades to prevent conflicts or interference as to space requirements, dimensions, openings, block-outs, sleeving or other matters which will cause delays or necessitate work-around methods.
- C. Obtain submittals and shop drawings of all equipment with electronic safety and security connections furnished under other divisions of the specification and by the Owner.
- D. Provide all wiring in accordance with specific equipment requirements.
- E. Immediately advise the Architect of any changes which may affect the contract price.
- F. Special attention is called to the following items. Coordinate all conflicts prior to installation:
  1. Location of grilles, pipes, sprinkler heads, ducts and other mechanical equipment so that all outlets and other equipment is clear from and in proper relation to these items.
  2. Location of cabinets, counters and doors so that electrical outlets and equipment are clear from and in proper relation to these items.

3. Recessing and concealing electrical materials in CMU walls, concrete construction and precast construction.
- G. Furnish, install and place in satisfactory condition all raceways, boxes, conductors and connections and all other materials required for the electronic safety and security systems shown or noted in the contract documents to be complete, fully operational and fully tested upon completion of the project. Raceways, boxes and ground connections are shown diagrammatically only and indicate the general character and approximate location. The layout does not necessarily show the total number of raceways or boxes for the circuits required, nor are the locations of indicated runs intended to show the actual routing of the raceways.
- H. Consult the architectural drawings for the exact height and location of all electrical equipment not specified herein or shown on the drawings. Make any minor changes (less than 6'-6" horizontal) in the location of the raceways, outlets, boxes, devices, wiring, etc., from those shown on the drawings without extra charge, where coordination requires or if so directed by the Architect before rough-in.
- I. Review system product requirements for outlet boxes prior to roughing in. Where product requirements exceed the requirements of other aspects of this specification, increase the outlet box size to match system requirements. Notify Architect prior to installation if conflicts occur between required box depth and wall thickness.
- J. Provide inserts or sleeves for outlet boxes, conductors, cables and/or raceways as required. Coordinate the installation thereof with other trades.
- K. The Contractor will not be paid for relocation of work, cuttings, patching and finishing required for work requiring reinstallation due to lack of coordination prior to installation.

#### **4.31.4 WARRANTY**

- A. Refer to General Conditions of the Contract.

#### **4.41.5 CORRECTION OF WORK**

- ~~A. Comply with requirements of Division 01.~~

~~A. Within one year after the date of Substantial Completion of the work, the Contractor shall correct any work found to be not in conformance with the Contract Documents promptly after written notice from the owner to do so, unless the Owner has previously given the Contractor a written acceptance of such condition. This obligation shall survive acceptance of the work under this Contract and termination of the Contract. The Owner shall give such notice promptly after discovery of the condition.~~

#### **4.5 ITEMIZED SCHEDULE OF COSTS**

- ~~A. Complete the Schedule of Values included at the end of this section. This schedule shall be adhered to for the electrical contractor to facilitate analysis and approval of the monthly progress billings. Refer to the Supplementary Conditions of General Contract and Division 1 - General Requirements for details, and conform thereto.~~

## 1.6 CHANGE ORDERS

### A. Comply with requirements of Division 01.

## 1.61.7 SUBMITTALS AND SHOP DRAWINGS

- A. Submittals and Shop Drawings: Comply with the requirements of Division 01. In addition, provide the below described information. Allow two weeks for review for each submittal and resubmittal. Incomplete submittals and shop drawings which do not comply with these requirements will be returned for correction, revision and resubmittal. Provide submittals for each product proposed for the project. See General Conditions for format, quantity, etc.
- B. Submittals shall show:
1. Indicate listing by UL or other approved testing agency.
  2. Highlight with yellow or blue marker adequate information to demonstrate materials being submitted fully comply with contract documents.
  3. Review and check all material prior to submittal and stamp "Reviewed and Approved".
- C. Shop drawings shall show:
1. Ratings of items and systems.
  2. How the components of an item or system are assembled, interconnected, function together and how they will be installed on the project.
  3. System layout floor plans with complete device layout, point-to-point wiring connection between all components of the system, wire sizes and color coding.
  4. Riser diagrams showing vertical wiring between components.
  5. Line diagrams and or logical/control schematics including interface to other systems as applicable. Provide point to point wiring diagrams, indicate terminal identification at item of equipment. Typical diagrams may be used when accompanied by wire schedules that are specific to each product.
  6. Coordinate with other division shop drawings and submittals. Identify interface points and indicate method of connection.
- D. Release of Drawing Data Files:
1. Contractor may request to utilize project drawing data files for assistance in producing shop drawings. Request shall be made by signing owner/design team's requested documentation for release of the data files.
- E. The Contractor agrees:
1. Submittals and shop drawings processed by the Architect are not change orders.
  2. The purpose of submittals and shop drawings by the Contractor is to demonstrate to the Engineer that the Contractor understands the design concept.
  3. Submittals demonstrate equipment and material Contractor intends to furnish and install and indicate detailing fabrication and installation methods Contractor intends to use.



4. To accept all responsibility for assuring that all materials furnished under this Division of the specifications meet, in full, all requirements of the contract documents.
5. To pay for Engineers review cost of submittal review beyond one resubmittal.
- F. The Engineer's review is only for general conformance with the design concept of the project and general compliance with the information given in the contract documents. Corrections or comments made during this review do not relieve contractor from compliance with the requirements of the drawings and specifications. Contractor is responsible for: Dimensions which shall be confirmed and correlated at the job site; fabrication process and techniques of construction; coordination of his work with that of all other trades; performing his work in a safe and satisfactory manner.
- G. Submittals and shop drawings are required per the submittals schedule at the end of this Section.

#### 4.71.8 PROJECT CLOSE-OUT

- A. ~~Coordinate with close out provisions in Division 01—General Requirements. Comply with the requirements of Division 01.~~
- B. ~~Request For Final Punchlist~~
  1. ~~To request a final electrical punch list, forward a letter to the Architect stating: "The electrical work on this project is complete, all punch list items to date are complete, items a. — i. in the Punchlist Procure paragraph in Section 280500—Common Work Results For Electronic Safety and Security are complete and the project is ready for final punch list observation."~~
- 2.B. Project Punchlist Procedure: Perform the following procedures for project closeout of electrical portions of work.
  - a.1. Provide engraved nameplates on equipment.
  - b.2. Refinish equipment finishes which are damaged.
  - e.3. Obtain final electrical permit inspection. Include copies in O & M manual.
  - d.4. Provide written warranty in O & M per the General Conditions of the Contract.
  - e.5. Furnish Record Drawings per this section. Obtain signature on Job Completion Form.
  - f.6. Furnish O & M Manuals per this section. Obtain signature on Job Completion Form.
  - g.7. Give instruction periods to owner's personnel per this section. Obtain signature on Job Completion Form.
  - h.8. To request final acceptance of project, fill out Job Completion Form in this section and forward to the Architect. Note: If inspectors have not signed form, a copy of signed-off permits will suffice.
  - i.9. Include with Job Completion Form, a copy of the final punch list with the word "DONE", and the date and Contractor's initials after each item on the list.

**4.81.9 ELECTRICAL EQUIPMENT OPERATION AND MAINTENANCE (O&M)  
MANUALS**

- A. Provide O&M manuals required in Division 01 - General Requirements for all equipment furnished under Division 28 - Electronic Safety and Security specifications. ~~Submit a preliminary copy, complete except for the bound cover, 60 days prior to completion of the project for checking and review. Deliver final bound corrected copies as noted in Division 1—General Requirements 20 days prior to scheduled instruction periods. Obtain a receipt for the manuals and forward a copy of the receipt to the Engineer with the Job Completion Form.~~
- B. The information included must be the exact equipment installed. Where sheets show the equipment installed and other equipment, the installed equipment shall be neatly and clearly identified on such sheets.
- C. These O&M manuals shall contain all the information needed to operate and maintain all systems and equipment provided in the project. Present and arrange information in a logical manner for efficient use by the Owner's security and operating personnel. The information provided shall include but not be limited to the following:
1. Equipment manufacturer, make, model number, size, nameplate data, etc.
  2. Description of system configuration and operation including component identification and interrelations. A master control schematic drawings(s) may be required for this purpose.
  3. Dimensional and performance data for specific unit provided as appropriate.
  4. Manufacturer's recommended operation instructions.
  5. Manufacturer's recommended preventative maintenance program and service instructions for the system as a whole and for each component, function, and operation in detail.
  6. Complete parts list including reordering information, recommended spares and anticipated useful life (if appropriate). Parts lists shall give full ordering information assigned by the original parts manufacturer. Relabeled and/or renumbered parts information as reassigned by equipment supplier not acceptable.
  7. Shop drawings.
  8. Wiring diagrams.
  9. Signal equipment submittals shall contain step-by-step circuit description information designed to acquaint maintenance personnel with equipment operation in each mode of operation.
  10. A complete list of local (nearest) manufacturer representative and distributor contacts for each type of equipment and manufacturer. Include name, company, address, phone, fax, e-mail address, and web site.
  11. Trouble-shooting guide for each system including a list of troubles, causes, and recommended remedies.
  12. A recommended spare parts list for owner consideration.

D. Furnish complete wiring diagrams for each system for the specific system installed under the contract. "Typical" line diagrams will not be acceptable unless revised to indicate the exact field installation.

~~E. Group the information contained in the manuals in an orderly arrangement by specification index. Provide a typewritten index and divider sheets between categories with identifying tabs. Bind the completed manuals with hard board covers not exceeding 5" thick. (Provide two or more volumes if required.) Signal and communication systems shall be in separate volumes. Imprint the covers with the name of the job, Owner, Architect, Electrical Engineer, Contractor and year of completion. Imprint the back edge with the name of the job, Owner and year of completion. Hard board covers and literature contained may be held together with screw post binding.~~

#### 4.91.10 INSTRUCTION PERIODS

A. ~~Comply with the requirements of Division 01.~~

~~A.B.~~ After substantial completion of the work and 20 days after the O&M manuals have been delivered to the owner and after all tests and final inspection of the work by the Authority(s) Having Jurisdiction; demonstrate the electrical systems and instruct the Owner's designated operating and maintenance personnel in the operation and maintenance of the various electrical systems. The Contractor shall arrange scheduled instruction periods with the Owner. The Contractor's representatives shall be superintendents or foremen knowledgeable in each system and suppliers representatives when so specified. When more than one training session is specified, the second session shall be 30 to 90 days after the first as agreed to by the Owner.

~~B.C.~~ Include in each instruction session an overview of the system, presentation of information in maintenance manuals with appropriate references to drawings. Conduct tours of the building areas with explanations of maintenance requirements, access methods, servicing and maintenance procedures, equipment cleaning procedures and adjustment locations.

~~C.D.~~ Include the following scheduled instruction periods. Reference other Division 28 Specification Sections as noted:

	1 <sup>st</sup> Session	2 <sup>nd</sup> Session
1 Fire Detection and Alarm	2 hours	2 hours

~~D.E.~~ Manufacture certified representatives shall provide instruction for each of the sessions listed above.

~~E. Provide one professionally produced digitally recorded or video tape of each training session in DVC. Furnish two (2) copies to the owner.~~

#### 4.401.11 RECORD DRAWINGS

A. ~~Comply with the requirements of Division 01.~~

~~A. Continually record the actual electrical system(s) installation on a set of prints kept readily available at the project during construction. These prints shall be used for this purpose alone.~~

- ~~1. Mark record prints with red erasable pencil. Mark the set to show the actual installation where the installation varies substantially from the work as originally shown.~~
- ~~2. Accurately locate with exact dimensions all underground and underslab raceways and stub-outs.~~
- ~~3. Note changes of directions and locations, by dimensions and elevations, as utilities are actually installed.~~
- ~~4. Include addenda items and revisions made during construction.~~
- ~~5. Erase conditions not constructed or "X-out" and annotate "not constructed" to clearly convey the actual "as constructed" condition.~~
- ~~6. Organize record drawings sheets in manageable sets, bind and print suitable titles, dates and other identification on the cover of each set.~~

- B. Transfer the changes marked up on the record prints into Revit drawing files at the completion of the work. The version of Revit shall not be earlier than the most recent version available at the date the project bids were received. Revit files shall not include the stamp of the engineer of record. Provide two (2) sets of prints, one set of fixed line reproducible drawings and one set of Revit drawing files on CD ROM. Transmit drawings, Revit drawing files and the record drawing mark-ups to the Architect. Final payment to the contractor will not be authorized until these document have been submitted to and accepted by the Architect.

#### ~~4.11 FINAL ACCEPTANCE REQUEST~~

- ~~A. Submit to the Architect, a Division 28 Job Completion Form (form attached in this section) properly filled out prior to the time final acceptance of the electrical work is requested.~~

#### 1.12 ABBREVIATIONS AND DEFINITIONS

- A. When the following abbreviations and definitions are used in relation to the work for Division 28 they shall have the following meanings:

<u>Item</u>	<u>Meaning</u>
AHJ	Authority Having Jurisdiction.
Boxes	Outlet, Junction or Pull Boxes.
Code	All applicable codes currently enforced at project location.
Compression	Compressed using a leverage powered (hydraulic or equivalent) crimping tool.
Connection	All materials and labor required for equipment to be fully operational.
Exterior Location	Outside of or penetrating the outer surfaces of the building weather protective membrane.
Fully Operational	Tested, approved, and operating to the satisfaction of the AHJ, manufacturer and contract documents.
Furnish	Deliver to the jobsite

Install	To enter permanently into the project and make fully operational.
Kcml	Thousand circular mils (formerly MCM).
Mfr.	Manufacturer.
NEC	National Electrical Code, National Fire Protection Association, Publication #70.
Noted	Shown or specified in the contract documents.
Provide	Furnish and install.
Required	As required by code, AHJ, contract documents, or manufacturer for the particular installation to be fully operational.
Shown	As indicated on the drawings or details.
Wiring	Raceway, conductors and connections.

## PART 2 - PRODUCTS

### 2.1 GENERAL

- A. All materials and equipment installed shall have been tested and listed by Underwriters Laboratories or other approved testing organization and shall be so labeled unless otherwise permitted by the Authority Having Jurisdiction (Inspector).
- B. All materials to be new, free from defects and not less than quality herein specified. Materials shall be designated to insure satisfactory operation and operational life in the environmental conditions which will prevail where they are being installed.
- C. Each type of materials furnished shall be of the same make, be standard products of manufacturers regularly engaged in production of such materials and be the manufacturer's latest standard design.
- D. All materials, equipment and systems furnished that include provisions for storing, displaying, reporting, interfacing, inputting, or functioning using date specific information shall perform properly in all respects regardless of the century. Any interface to other new or existing materials, equipment or systems shall function properly and shall be century compliant, both in regards to information sent and received.

### 2.2 SUBSTITUTION OF MATERIALS

A. Comply with the requirements of Division 01.

~~A. No Substitute:~~

~~Where a specified product is indicated "no substitute", it is the intent of this specification to require new materials to be compatible with the existing installation or as specifically requested by the owner. To this end, no substitution will be allowed for certain materials and systems.~~

~~B. Prior to Bid Opening:~~

~~Acceptance of products other than those specified will be issued by addendum to the bid documents only after the following requirements are met and the proposed listed material is determined to meet or exceed the requirements:~~

- ~~1. Requests for listing to be original material, clearly indicating the product fully complies with contract documents and be neatly marked with yellow felt tip marker to clearly define and describe the product for which listing is requested.~~
- ~~2. Requests shall be received 10 days prior to bid opening.~~
- ~~3. Requests containing insufficient information to confirm compliance with contract documents will not be considered.~~

~~C. After Award of Contract:~~

~~Substitution of products will be considered after award of contract only under the following conditions:~~

- ~~1. The Contractor shall have placed orders for specified materials promptly after contract is awarded and the specified products can not be delivered to the project to meet the Owner's construction schedule.~~
- ~~2. The reason for the unavailability is beyond the Contractor's control, i.e., due to strikes, bankruptcy, discontinuance of manufacturer, acts of God.~~
- ~~3. The specified product is no longer manufactured.~~
- ~~4. There is compelling economic advantage to the Owner.~~

~~D. In all cases, should a substituted material result in requiring electrical system or building modifications; the Contractor alone shall pay all costs to provide these modifications including all costs to the Engineer and Architect for redesign, and updating of record drawings required to accommodate the required modifications.~~

## 2.3 NAMEPLATES

- A. Provide nameplates per Section 260553 - Identification for Electrical Systems.

## PART 3 - EXECUTION

### 3.1 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Deliver, store, and handle products according to the manufacturer's recommendations, using means and methods that will prevent damage, deterioration, and loss, including theft. Handle all equipment carefully to prevent damage, breakage, denting, and scoring of finishes. Do not install damaged equipment.
- B. Store products subject to damage by the elements above ground, undercover in a weather tight enclosure, with ventilation adequate to prevent condensation. Maintain temperature and humidity within range required by manufacturer's instruction.

### 3.2 CUTTING BUILDING CONSTRUCTION

- A. Obtain permission from the Architect and coordinate with other trades prior to cutting. Locate cuttings so they will not weaken structural components. Cut carefully and only the minimum amount necessary. Cut concrete with diamond core drills or concrete saws except where space limitations prevent the use of such tools.

- B. All construction materials damaged or cut into during the installation of this work must be repaired or replaced with materials of like kind and quality as original materials by skilled labor experienced in that particular building trade.

### **3.3 PENETRATION OF BUILDING ELEMENTS**

- A. General:
  - 1. Penetrations of building elements by electrical systems shall not compromise the performance and integrity of the building element (structural, fire, smoke, waterproof, etc.)
- B. Fire and smoke rated elements:
  - 1. Electrical penetrations of fire and smoke rated floor and wall assemblies shall maintain fire-resistance or smoke barrier rating of the assembly. Firestopping materials and installation requirements are specified in Division 7 section "Firestopping".

### **3.4 PAINTING**

- A. Items furnished under this Division that are scratched or marred in shipment or installation shall be refinished with touchup paint selected to match installed equipment finish.

### **3.5 EQUIPMENT CONNECTION**

- A. For equipment furnished under this or other Divisions of the specifications, or by owner, provide all electrical connections necessary to serve such equipment and provide required control connections to all equipment so that the equipment is fully operational upon completion of the project. Provide disconnect switch as required by code whenever an equipment connection is shown on the drawings.
- B. Investigate existing equipment to be relocated and provide new connections as required.
- C. Obtain rough-in requirements for equipment furnished under other divisions of this specification prior to roughing-in. Review shop drawings and submittals of other Divisions to determine requirements.

### **3.6 CLEAN UP**

- A. Contractor shall continually remove debris, cuttings, crates, cartons, etc., created by his work. Such clean up shall be done daily and at sufficient frequency to eliminate hazard to the public, other workmen, the building or the Owner's employees. Before acceptance of the installation, Contractor shall carefully clean cabinets, panels, lighting fixtures, wiring devices, cover plates, etc., to remove dirt, cuttings, paint, plaster, mortar, concrete, etc. Blemishes to finished surfaces of apparatus shall be removed and new finish equal to the original applied.
  - 1. Wipe surfaces of electrical equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.

**3.7 TESTING AND DEMONSTRATION**

A. Comply with the requirements of Division 01.

A.B. Demonstrate that all electrical equipment operates as specified and in accordance with manufacturer's instructions. Perform tests in the presence of the Architect, Owner or Engineer. Provide all instruments, manufacturer's operating instructions and personnel required to conduct the tests. Repair or replace any electrical equipment that fails to operate as specified and or in accordance with manufacturer's requirements.



DIVISION 28 ELECTRONIC JOB COMPLETION FORM

PROJECT NAME: OSU Women's Basketball Locker Room Renovation  
PROJECT LOCATION: Oregon State University  
DATE: \_\_\_\_\_

A. Electrical Inspectors Final Acceptance (Copy of certificate attached.)

\_\_\_\_\_  
Name Agency Date

B. Fire Marshal's Final Acceptance of Fire Alarm System (Copy of certificate attached.)

\_\_\_\_\_  
Name Agency Date

C. The following systems have been demonstrated to Owner's representative.

1. Fire Detection and Alarm \_\_\_\_\_  
Owner's Rep Date

D. Record Drawings  
Attached Transmitted previously to \_\_\_\_\_  
Date

E. O & M Manuals  
Attached Transmitted previously to \_\_\_\_\_

F. Test Reports  
Attached Transmitted previously to \_\_\_\_\_  
Date

G. The work is complete in accordance with contract documents and authorized changes except for

\_\_\_\_\_  
and the architect/engineer's representative is requested to meet with  
\_\_\_\_\_  
Supervisor of Electrical Work at \_\_\_\_\_ on \_\_\_\_\_  
Time Date

\_\_\_\_\_  
Contractors Rep. Signature Date

**Division 28 Schedule of Values for OSU Women's Basketball Locker Room  
Renovation**

<b>Description of Work</b>	<b>Amount</b>
Device Rough-in (boxes and raceways) - Labor and Materials	
Circuit Conductors - Labor and Materials	
Fire Detection and Alarm - Labor and Materials	
Testing, Demonstration (AHJ approvals)	
Training	
Close Out (Record Drawings, O&M, etc.) - Materials & Labor	
TOTAL DIVISION 28	

**DIVISION 28 SUBMITTAL LIST OSU Women's Basketball Locker Room Renovation**

<b>SECTION</b>	<b>DESCRIPTION</b>	<b>SUBMIT RECEIVE DATE</b>	<b>STATU S</b>
283100	FIRE DETECTION AND ALARM		

**END OF SECTION 28 05 00**



# 2 SERIES LED 2PD

## ACCESSORIES

### ALTERNATE EFFECTS DEVICES

- HCL-2** Honeycomb Louver <sup>7,8</sup>
- CGL-2** Clear Glass Lens <sup>8</sup>
- SFL-2** Soft Focus Lens
- FGL-2** Frosted Glass Lens
- UVL-2** Ultra Violet Lens
- FLSL-2** Frosted Linear Spread Lens <sup>7</sup>
- SFL-2-SP** Shatterproof Soft Focus Lens
- FGL-2-SP** Shatterproof Frosted Lens

<sup>7</sup> Dry/Damp location only  
<sup>8</sup> Not for use with 90W13H Warm Dim

### REPLACEMENT OPTIC

- Interchangeable optics accessible through fixture aperture.
- RO-50-20-2** 20° optic
  - RO-50-40-2** 40° optic

**ROUTER TOOL GUIDE** (Dry / Damp locations only)  
 Recommended for Zero-Sightline installations in wood ceilings.

- DLA-RTG-2S-RD** Tool, router guide; reusable

### FURRING CHANNEL KIT

Recommended for furring channel installations

- DHA-FC-KIT** Furring channel kit; one kit per housing

## EMERGENCY LIGHTING - REMOTE MOUNT ONLY

- EMB-S-20/25-120/277-LEDX** 20/25 watt max capacity, 120 or 277 VAC 60Hz
- EMB-S-100-120-LEDX** 100 watt max capacity, 120 VAC 60Hz
- EMB-S-100-277-LEDX** 100 watt max capacity, 277 VAC 60Hz
- EMB-S-250-120/277-LEDX** 250 watt max capacity, 120 or 277 VAC 60Hz

During disruption of main power, emergency battery inverter provides temporary 120V or 277V to fixture.

## TECHNICAL

### CONSTRUCTION

**Downlight:** Steel and aluminum; extruded aluminum heat-sink; painted finishes are granulated powder coat.

**Trim Adapter:** High-impact composite and stainless steel.

**Housing:** 22 Gauge galvanized steel.

**Appliqué:** Zinc alloy.

### LED

Proprietary Citizen 2 step MacAdam ellipse LED module available in 80+, 90+ and 97+ CRI configurations in color temperatures of 2700K, 3000K, 3500K and 4000K. Average rated lamp life: 50,000 hours. LED and driver assemblies are field-replaceable.

### WARM DIM LED

Proprietary 3 step MacAdam ellipse warm dim LED module available in 90+ CRI configuration. 3200K at full brightness, warming to 1800K at full dim. Average rated lamp life: 50,000 hours. LED and driver assemblies are field-replaceable.

### POWER SUPPLY PERFORMANCE AND DIMMING INFORMATION

Power Supply	2 WIRE		ECOSYSTEM		0-10V				DALI	
	L23	TR2	LH1	LP1	EA2	LA2	AN4	LN2	ED1	LD1
Minimum °C	0 °C	-20 °C	0 °C	0 °C	-20 °C	-20 °C	-20 °C	-20 °C	-20 °C	-20 °C
Maximum °C	40 °C	40 °C	40 °C	40 °C	40 °C	40 °C	40 °C	40 °C	40 °C	40 °C
Dimming %	1.0%	2.0%	1.0%	0.1%	0.1%	0.1%	1.0%	1.0%	0.1%	0.1%

Note: For EA2, LA2 and L23 drivers consult chart on page 4 to confirm appropriate dimming curve for compatibility with selected control.

### LISTING

cTUVus listed to UL1598 standard for Dry / Damp and Wet locations. Chicago Plenum, Airtight and Title 24 JA8-2016 Listed.

### WARRANTY

Manufacturer's 1-year warranty guarantees product(s) listed to be free from defects in material and workmanship under normal use and service. 5-year warranty on LED and power supply to operate with 70% of the original flux and remain within a range of 3 duv. 10-year Lutron Advantage limited warranty available on Lutron equipped systems. Warranty period begins from the date of shipment by Seller and conditional upon the use of manufacturer-supplied power supply. Consult website for full warranty terms and conditions.



### TITLE 24 JA8-2016 COMPLIANT CONFIGURATIONS

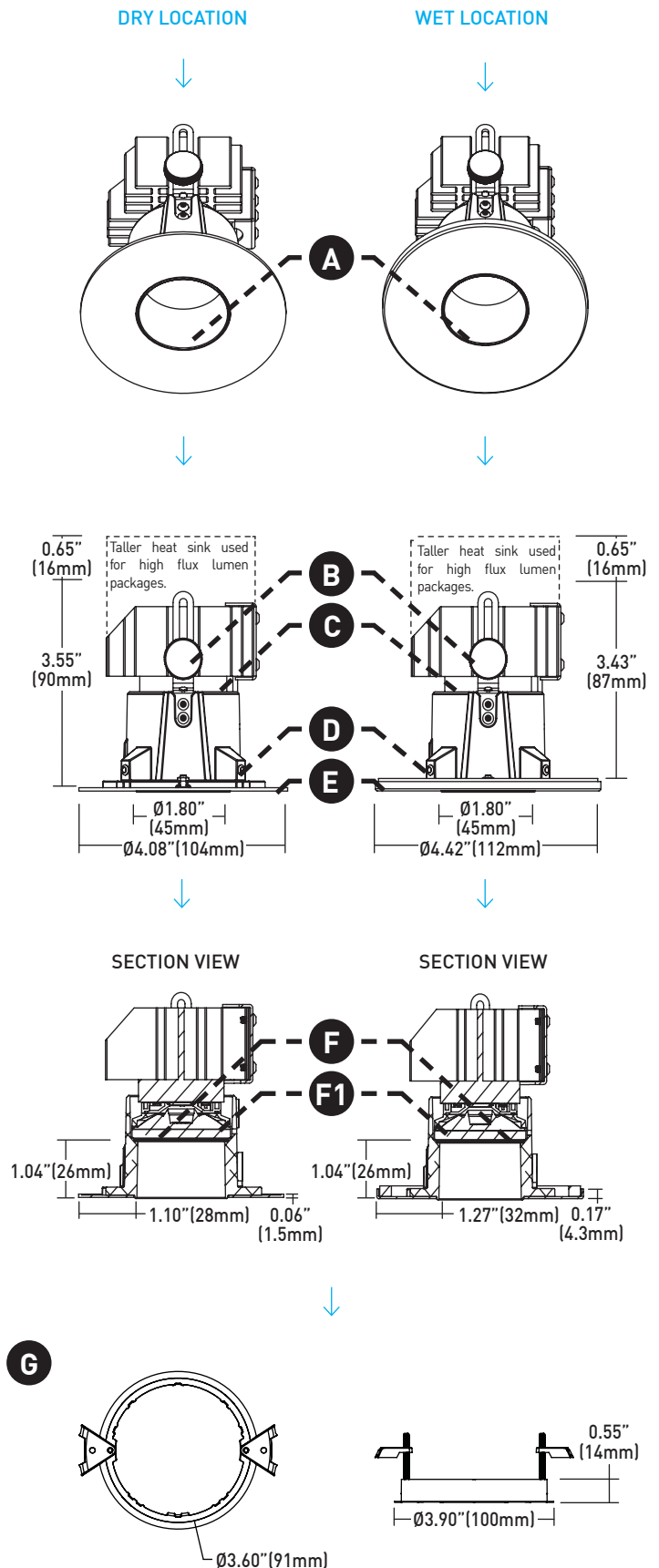
Lumen Package	90CA10L	90CA14L	90CA19H	97CA10L	97CA12L	97CA17H	90WA13H
20° Optic							
40° Optic	✓	✓	✓	✓	✓	✓	✓

# 2 SERIES LED 2PD

## DOWNLIGHT

- A BAFFLE**  
Die-cast deep baffle minimizes aperture glare and conceals view into housing; black finish standard.
- B ADJUSTABLE YOKE**  
Adjustable yoke allows for quick exchange of reflectors and effects devices. Accommodates up to 2 effects devices; add 0.16" (4.1mm) to fixture height with use of each effects device.
- C OPTICS**  
Optic interchangeable between 20° & 40°.
- D RETENTION**  
Engineered integral ball plungers correspond to trim adapter ensuring snug fit against finished ceiling.
- E TRIM PLATE**  
Wet location fixture features sealed aperture and integral silicone gasket.  
Dry / Damp Location: Thickness measures 0.065" (1.7mm).  
Wet Location: 0.15" (3.8mm) return, installed as flange overlay only.
- F EFFECTS DEVICES**  
Soft Focus Lens standard; effects device must be specified. Lens is sealed in place in Wet location fixture.
- F1** Optional effects device available for Dry / Damp and Wet locations.
- G DOWNLIGHT TRIM ADAPTER**  
Included with fixture and required for installation. Uses (2) #6-32 flat-head screws with varying lengths to accommodate ceiling depth. Installed after ceiling is complete. Requires 3.75" (95mm) diameter cutout for flange overlay applications.

## DIMENSIONS / DRAWINGS



# 2 SERIES LED 2PD

## HOUSING / MOUNTING

### H LOW FLUX NIC HOUSING

- Minimum 0.50" (13mm) setback from combustible and non-combustible materials on all sides and top of housing.
- Minimum 3.00" (76mm) setback from insulation material having max R-Value 30 on all sides and top of housing.
- Minimum 6.00" (152mm) setback from polycell spray foam insulation having max R-Value 60.
- Included with NC and NR install types specified with Low Flux lumen packages.

### LOW FLUX IC HOUSING

- Chicago Plenum, Airtight and Title 24 (JA8) listed with AT and AR install types.
- No setback from polycell spray foam insulation having max R-Value of 60 on all sides and top of housing.
- Included with IC, IR, AT, and AR install types specified with Low Flux lumen packages.

### I HIGH FLUX HOUSING

- For IC and Non-IC ceilings.
- Chicago Plenum, Airtight and Title 24 (JA8) listed with AT and AR install types.
- No setback from polycell spray foam insulation having max R-Value of 60 on all sides and top of IC housing.
- Included with IC, IR, AT, and AR install types specified with High Flux lumen packages.

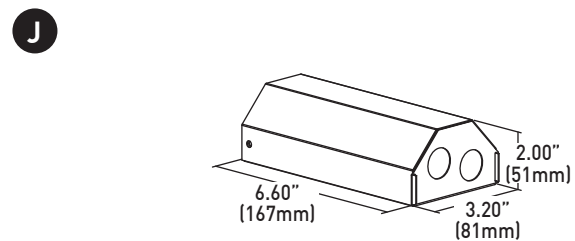
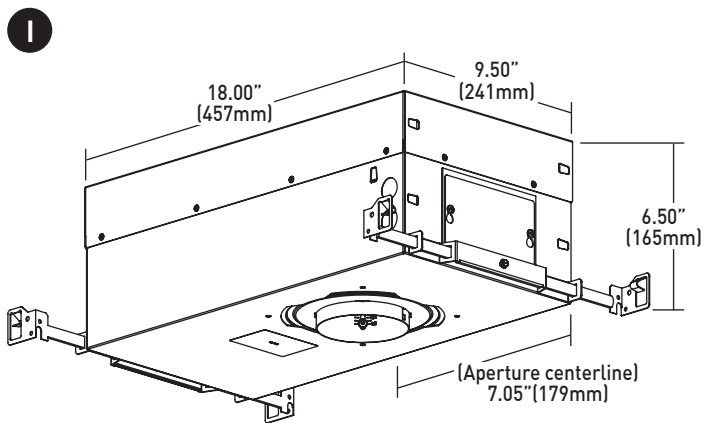
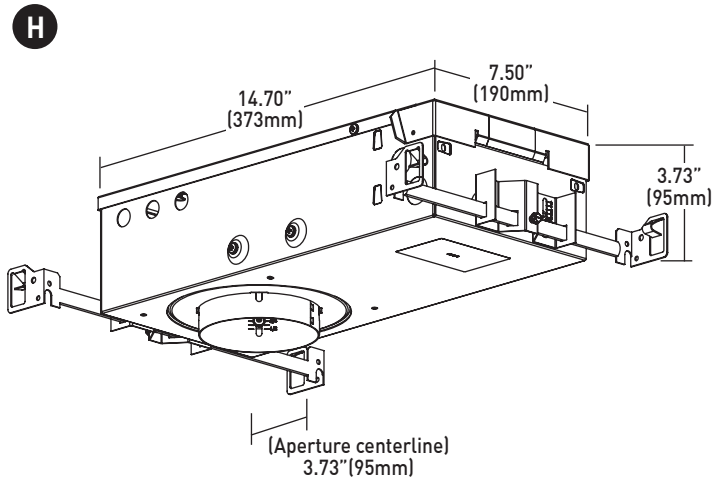
## HOUSING / MOUNTING NOTES

- Do not install in environments where ambient temperatures exceed 40°C (104°F).
- Power supply compartment and all splice connections may be serviced from room side.
- Consult factory for spacing requirements for any installations exceeding R-Value 60.
- Hanger bars fitted to short side of housing, and long side of Low Flux housings; extend from 14.0" to 24.0", but may be field cut to accommodate narrow stud spacing.
- Hanger bars and brackets add 4.00" to the overall dimension, but are exclusive of the setback requirements.
- Driver assembly ships with trim, not housing. Housing and trim feature mating quick-connect plugs for ease of installation.

## REMOTE POWER SUPPLY

- Provided with install types IR, AR and NR. Consult factory for maximum remote mounting distances.

## DIMENSIONS / DRAWINGS



# 2 SERIES LED 2PD

## REMODEL POWER SUPPLY

### K REMODEL POWER SUPPLY

- Included with RM Install Type.
- UL2043 listed for air-handling plenum.
- Fixture mounts without conventional housing using supplied downlight trim adapter.
- Minimum 0.75" (19mm) clearance from top of fixture.
- Minimum setback from combustible and non-combustible materials of 6.63" (168mm) radius from fixture centerline.
- Minimum 3.00" (76mm) setback from surfaces of power supply / junction box if not situated within above noted radius from fixture centerline.
- Minimum additional 3.00" (76mm) setback from insulation material with max R-Value 30 from any surface of downlight fixture assembly.
- Minimum additional 6.00" (152mm) setback from polycell spray foam insulation with max R-Value 60 from any surface of downlight fixture assembly.

### L REMOTE APPLICATIONS

- Remote power supply and DLA2-RMT-AK accessory kit included with RR Install Type.

## REMODEL NOTES

- Do not install in environments where ambient temperatures exceed 40°C (104°F).
- Power supply compartment and all splice connections may be serviced from room side.
- Consult factory for spacing requirements for any installations exceeding R-Value 60.

## ZERO-SIGHTLINE INSTALLATIONS

Zero-Sightline installations available for Dry / Damp location fixtures only. When installed according to manufacturer's instructions and ceiling conditions are met, fixture is flush with the ceiling plane. Consult 2-Series Installation Guidelines for appropriate ceiling cutouts and instructions for proper Zero-Sightline installations.

### M APPLIQUÉ

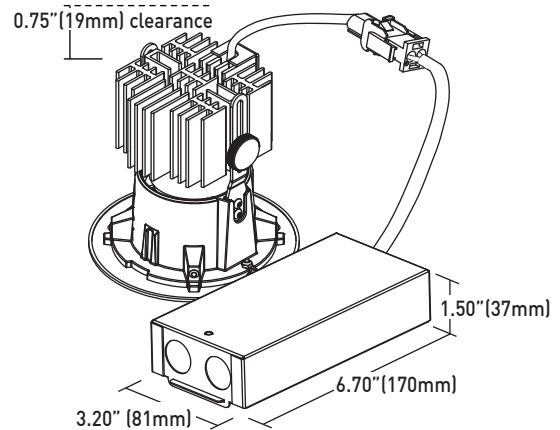
- Specified on Flange Configuration and ships with housing; ships separately on remodel installations.
- For use in sheetrock ceiling applications.
- 1/16" Appliqué (G Flange Configuration) recommended for gypsum ceiling installations and has plaster stop thickness of 1/16" (1.6mm). Recommended for painted ceiling applications.
- 1/8" Appliqué (P Flange Configuration) offers double thick plaster stop of 1/8" (3.2mm) where a heavier application of mud is preferred. Recommended for colorfast and venetian plaster applications.
- Not recommended for stucco applications.

### N ROUTER TOOL GUIDE

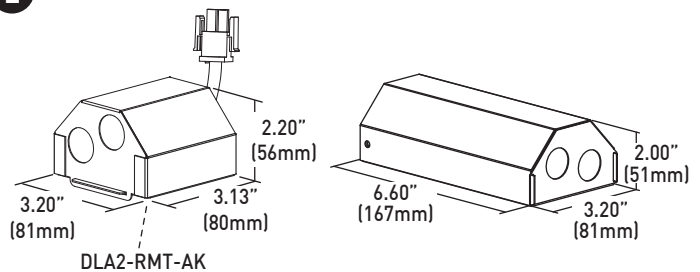
- Specified separately and used with Flange Overlay configurations.
- For use in wood ceiling applications.
- DLA-RTG-2S-RD required for wood Zero-Sightline ceiling installations.
- Router tool guide is reusable and suitable for multiple fixtures.

## DIMENSIONS / DRAWINGS

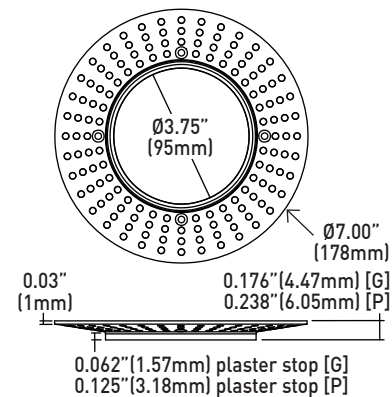
K



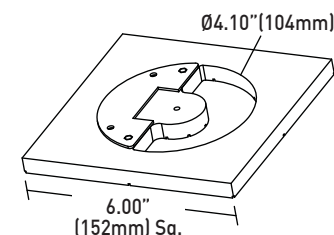
L



M



N





# 2 SERIES LED 2PD

## DIMMING COMPATIBILITY

### eldoLED DRIVER COMPATIBILITY

Power supply EA2, LA2 Dimmer / Switch Control Manufacturer	Family/Model #	Recommended Curve
Busch-Jaeger	2112U-101	Logarithmic
Jung	240-10	Logarithmic
Leviton Lighting Controls	IP710-DLX	Logarithmic
Lightolier Controls	ZP600FAM120	Logarithmic
Lutron Electronics	Nova T® - NTFTV	Linear
Lutron Electronics	Diva® - DVTV	Linear
Lutron Electronics	Nova® - NFTV	Linear
Merten	5729	Logarithmic
Pass & Seymour	CD4FB-W	Logarithmic
The Watt Stopper	DCLV1	Logarithmic
Sensor Switch	nI0 EZ	Linear
Synergy	ISD BC	Logarithmic
Lighting Control Systems		
Lutron Electronics	GrafixEye® GRX-TVI w GRX3503	Linear
Lutron Electronics	Energy Savr Node™ - QSN-4T16-S	Linear
Lutron Electronics	TVM2 Module	Linear
Crestron®	GLX-DIMFLV8	Logarithmic
Crestron®	GLXP-DIMFLV8	Logarithmic
Crestron®	GLPAC-DIMFLV4-*	Logarithmic
Crestron®	GLPAC-DIMFLV8-*	Logarithmic
Crestron®	GLPP-DIMFLVEX-PM	Logarithmic
Crestron®	GLPP-1DIMFLV2EX-PM	Logarithmic
Crestron®	GLPP-1DIMFLV3EX-PM	Logarithmic
Crestron®	DIN-A08	Logarithmic
Crestron®	DIN-4DIMFLV4	Logarithmic
Crestron®	CLS-EXP-DIMFLV	Logarithmic
Crestron®	CLCI-1DIMFLV2EX	Logarithmic
ABB	SD/S 2.16.1	Logarithmic

### LUTRON DRIVER COMPATIBILITY

Power supply L23 Product Family	Part No.	Fixtures Per Control (120V only)
Maestro WirelessR 600 W dimmer	MRF2-6ND-120-	1-8
Maestro WirelessR 1000 W dimmer	MRF2-10ND-120-	1-13
Caséta® Wireless Pro 1000 W dimmer	PD-10NXD-	1-13
GRAFIK T™ CL® dimmer	GT-250M-, GTJ-250M-	1-10
HomeWorks® QS adaptive dimmer	HQRD-6NA-	1-8
HomeWorks® QS 600 W dimmer	HQRD-6ND-	1-8
HomeWorks® QS 1000 W dimmer	HQRD-10ND-	1-13
RadioRA® 2 adaptive dimmer	RRD-6NA-	1-8
RadioRA® 2 1000 W dimmer	RRD-10ND	1-13
myRoom™ DIN power module	MQSE-4A1-D	1-6 (per output), 1A max driver input current
HomeWorks® QS DIN power module	LQSE-4A1-D	1-6 (per output), 1A max driver input current
HomeWorks® QS wallbox power module	HQRJ-WPM-6D-120	2-10 (per output), 26 total per module
HomeWorks® wallbox power module	HWI-WPM-6D-120	2-10 (per output), 26 total per module
GRAFIK Eye® QS control unit	QSGR-, QSGRJ-	2-10 (per output), 26 total per module
GRAFIK Eye® 3000 control unit	GRX-3100-, GRX-3500-	2-10 (per output), 26 total per module
RPM-4U module (LCP, HomeWorks® QS, GRAFIK Systems™, Quantum®)	HW-RPM-4U-120, LP-RPM-4U-120	2-26 (per output), 26 total per module
RPM-4A module (LCP, HomeWorks® QS, GRAFIK Systems™, Quantum®)	HW-RPM-4A-120, LP-RPM-4A-120	1-13 (per output), 26 total per module
GP dimming panels	Various	1-26
Ariadni CL 250W dimmer	AYCL-253P-	1-8
Diva CL 250W dimmer	DVCL-253P- DCSCCL-253P-	1-8
Nova T CL 250W dimmer	NTCL-250-	1-10



## Wall luminaires



White

Chrome

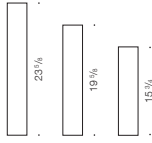
Gold plated



Enclosed wall luminaires in three sizes with different light outputs with LEDs or for fluorescent lamps.  
The hand blown, three-ply opal glass distributes the light from the lamps softly and uniformly. The range of different metal surface finishes allows the luminaires to harmonize perfectly with building details of interior and bathroom design.  
Wall luminaires for many interior applications, arranged individually or in groups. The luminaires can be installed either horizontally or vertically.



## OSU WOMIENS BBALL TYPE L08



Wall luminaires with LEDs or for fluorescent lamps  
Hand blown, three-ply opal glass, satin matte  
Finish: Die-cast aluminum housing  
• White RAL 9010  
• Chrome  
• Gold plated  
Fluorescent units include integral electronic ballast  
LEDs with integral electronic driver  
Color temperature 3000K (for 4000K, add suffix K4)  
UL listed, suitable for damp locations  
Please note:  
The luminaires should be installed either vertically or horizontally over a single gang switch box (by others).



White	Chrome	Gold plated	Lamp	Lumen	A	B	C
L 6682	L 6676	L 6670	16.0W LED	1400	15 1/4	3 1/2	3 1/4
L 6683	L 6677	L 6671	19.0W LED	1600	19 1/4	3 1/2	3 1/4
L 6684	L 6678	L 6681	19.0W LED	1600	19 1/4	3 1/2	3 1/4
L 6635	L 6637	L 2154	1 38W CF-twin-4p	2900	19 7/8	3 1/2	3 1/4
L 6603	L 6606	L 2155	1 38W CF-twin-4p	2900	23 1/4	3 1/2	3 1/4



# Bionic™ | Cove & Perimeter

## 4" Perimeter

OSU WOMENS BBALL  
TYPE L13



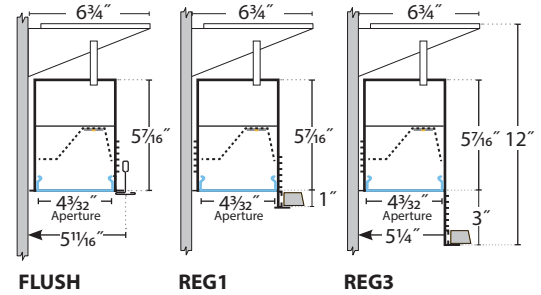
PRUDENTIAL LTG.

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Type:

Job:



WALL GRAZING UP TO **81** LM/W

	FLUSH	LO	MO	SO	HO
<b>SAL-D1</b>	lm/ft	390	575	755	900
	w/ft	4.5	7	10	12
<b>AWW-D1G</b>	lm/ft	350	550	775	900
	w/ft	4.5	7	10	12
<b>AWL-D1R</b>	lm/ft	390	600	875	1000
	w/ft	4.5	7	10	12



CLICK HERE

### High performance 4" perimeter wall grazer.

**Housing:** Extruded aluminum accommodates a wide range of ceiling systems and complex installations. Armstrong™ TechZone compatible.

**3 Optics:** Soft Glow (D1), precise Wall Graze (D1G) or Fill a corridor in light (D1R) from the Perimeter (flush recommended).

**Series:** See also our Bionic recessed linear and Wall Wash for visual continuity. Our P43 Perimeter System is nearly identical with the same great optics and a budget-friendly steel housing.

**Low Output:**  
**BIO-PSTD-FLSH-LED4-LO-AWW-D1G**  
 1408 Delivered Lumens  
 17.3 Watts  
 81 lm/w  
 4000 CCT



See page 2 for regress IES charts

Lumen output may vary +/- 5% 4000K used for lm/ft estimates above 3500K -2% If, 3000K -4%, 2700K -6% -10% LLF for 90 CRI (4K, 3500K and 3K)

See LED Details PDF for more info

SERIES	LENS POSITION	LED COLOR	OUT-PUT	NOM. LGTH	TRIM COLOR	SHIELDING	DISTRIBUTION	MOUNTING	CIRCUITING	VOLTAGE	CEILING SYSTEMS	DRIVERS	OPTIONS, SENSORS, CORNERS & LAMPS
BIO-PSTD													
Bionic Perimeter Standard	FLSH Flush Lens REG1 1" Regress Lens REG3 3" Regress Lens	LED27 2700K (90CRI) LED3 3000K LED35 3500K LED4 4000K LED3-90 90CRI LED35-90 90CRI LED4-90 90CRI	LO Low MO Medium SO Standard HO High PROG Programmable Light Output (Specify desired lm/ft or w/ft)	2' 3' 4' 6' R (Row length) Specify any row length to the 1/8"	TMW Textured Matte White (Standard) YGW Gloss White Y_ Premium Color CC Custom Color	SAL Satin Acrylic Lens (D1 only) AWW Acrylic Wall Grazer Lens (D1G only) AWL Acrylic Wall Wash Lens (D1R only)	D1 Direct (SAL only) D1G Wall Grazer (AWW only) D1R Perimeter Fill (AWL only, NA - REG3)	WTW Wall to Wall (Any row-length) LP Light Pocket (Typically 1' increments, fixture stops before wall)	SC Single Circuit	UNV (120-277) 347 (Emergency battery requires a Step Down transformer)	X1 T-Bar Exposed X1M T-Bar 3/8" X2 Interlude T-Bar X6 Slot Grid X3 Hard Ceiling X7BF Hard Ceiling (Trimless mud-over with backer flange) XTF Perimeter Tile Flange	ND Non-Dimming DM10 0-10v, 10% Dimming (Standard) DM01 0-10v, 1% Dimming STEP Step Dimming, 100-50-Off, Osram NOTE: Lumens and watts per foot may differ for STEP drivers, consult factory LDES* 5-Series EcoSystem LED LDE1* Hi-lume 1% EcoSystem LED (Soft fade on, fade-to-black dimming) LTE* Hi-lume 1% 2-Wire LED Driver (120V forward phase only) * Lutron NA with HO ECO 1% 0-10v, EldoLED (Logarithmic dimming std) ECDA 1% DALI, EldoLED (Logarithmic dimming std) SOLO 0.1% 0-10v, EldoLED (Dim-to-dark, Logarithmic dimming std) SODA 0.1% DALI, EldoLED (Dim-to-dark, Logarithmic dimming std)	EML Emergency Battery, Low (D1/D1R ~ 850 delivered lumens, D1G ~ 600) EMH Emergency Battery, High (D1/D1R ~ 1175 delivered lumens, D1G ~ 900) SENSORS: 205 WattStopper PIR Occupancy 205-STEP: Dim to 50% 205-DM: Dim to 1% CORNERS: C21 Lit 90° 2-Way Inside C20 Lit 90° 2-Way Outside DOWNLIGHT MODULES: M1 12" MR16 Module (adj.) 2/50w (max) Lamp M2 12" MR16 Module (adj.) 2/50w (max) Lamp NOTE: All MR16 lamps by others

VARIES - REFER TO FIXTURE SCHEDULE



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# Bionic™ | Cove & Perimeter

## 4" Perimeter

OSU WOMENS BBALL  
TYPE L13



PRUDENTIAL LTG.

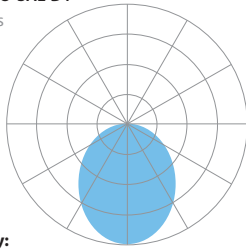
PRULITE.COM 213.746.0360

### SAL-D1 GLOW

**Low Output:**

BIO-PSTD-FLSH-LED4-LO-SAL-D1

1682 Delivered Lumens  
18 Watts  
88 lm/w  
4000 CCT  
Test #L041412304R01



**Zonal Lumen Summary:**  
0-90 = 100%

769

Vertical Angle	0°	25°	45°	65°	90°
0°	769	769	769	769	769
5°	762	763	763	760	760
15°	720	717	709	698	693
25°	642	632	612	592	582
35°	538	522	494	469	457
45°	421	403	373	349	337
55°	303	303	263	243	234
65°	199	188	171	157	151
75°	100	93	84	78	75
85°	24	23	21	21	20
90°	0	0	0	0	0

**Luminance Chart:**

Angle	0°	45°	90°
45°	5063	4494	4058
55°	4498	3899	3476
65°	4015	3434	3044
75°	3277	2773	2471
85°	2358	2054	1951

UPTO **80** LM/W

	LO	MO	SO	HO
lm/ft	375	550	725	875
w/ft	4.5	7	10	12

**3" REGRESS**

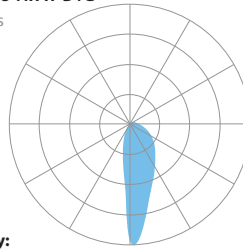
(1" Regress: 1.05 multiplier)

### WALL GRAZER

**Low Output:**

BIO-PSTD-FLSH-LED4-LO-AWW-D1G

1408 Delivered Lumens  
17 Watts  
81 lm/w  
4000 CCT  
Test #L021507502R02



**Zonal Lumen Summary:**  
0-90 = 100%

1154

Vertical Angle	0°	25°	45°	65°	90°
0°	1145	1145	1145	1145	1145
5°	1105	1117	1140	1154	1136
15°	708	749	853	1008	1075
25°	453	477	555	749	947
35°	336	342	373	504	748
45°	252	258	269	334	509
55°	178	181	189	220	299
65°	123	126	128	139	162
75°	42	67	73	70	70
85°	21	21	21	20	16
90°	0	0	0	0	0

**Luminance Chart:**

Angle	0°	45°	90°
45°	2948	3146	5954
55°	2567	2725	4312
65°	2407	2505	3170
75°	1342	2333	2237
85°	1993	1993	1518

UPTO **68** LM/W

	LO	MO	SO	HO
lm/ft	315	475	640	750
w/ft	4.5	7	10	12

**3" REGRESS**

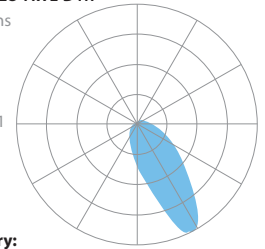
(1" Regress: 1.05 multiplier)

### PERIMETER FILL

**Low Output:**

BIO-PSTD-FLSH-LED3-LO-AWL-D1R

1594 Delivered Lumens  
19 Watts  
84 lm/w  
3000 CCT  
Test #L021507501R01



**Zonal Lumen Summary:**  
0-90 = 100%

1217

Vertical Angle	0°	22.5°	45°	67.5°	90°
0°	461	461	461	461	461
5°	552	545	525	494	460
15°	903	842	698	558	448
25°	1217	1212	1006	634	422
35°	899	944	1064	700	382
45°	614	635	730	705	325
55°	392	402	442	538	250
65°	225	230	244	301	159
75°	98	101	106	123	73
85°	15	16	17	29	12
90°	0	0	0	0	0

**Luminance Chart:**

Angle	0°	45°	90°
45°	7071	8411	3744
55°	5568	6274	3547
65°	4336	4704	3056
75°	3074	3344	2287
85°	1355	1598	1150

UPTO **80** LM/W

	LO	MO	SO	HO
lm/ft	375	550	725	875
w/ft	4.5	7	10	12

**1" REGRESS — N/A 3" REGRESS**





# Bionic™ | Cove & Perimeter

## 4" Perimeter

OSU WOMENS BBALL  
TYPE L13



PRUDENTIAL LTG.

PRULITE.COM 213.746.0360

### LUMEN MAINTENANCE

Designed to last with cool running mid-power LEDs projected to maintain 90% (L90) of their initial output for 100,000 hours (at HO), and L70 exceeding 150,000 hours.

### LED SYSTEM

LED modules and drivers are field replaceable.

### PROG (OPTIONAL)

Programmable light output. Specify desired lumens or watts per linear foot. Min: 2½ w/ft, consult factory for requests above 12 w/ft.

### BINNING

Standard binning (all Prudential LED boards) includes testing at the chip level and board integration to provide consistent color temperature within a 3-step MacAdams ellipse, with +/- 5% lumen output range and +/- .004 Duv.

### PRUBIN™ (OPTIONAL)

Prudential Ltg's exclusive 'job binning' method that ensures color temperature consistency across all luminaires on a project. Meticulously testing and labeling **EVERY LED BOARD** to +/- 25 lumens, +/- 50k CCT and +/- .004 Duv — while also separating positive from negative — allows us to match color, hue and intensity throughout a project and provides a consistent color temperature within a 2-step MacAdams ellipse.

### LABELS

ETL damp labeled and I.B.E.W. manufactured.

### ELECTRICAL

Must specify LED dimming controls. LED fixtures have constant current driver(s) with less than 20% THD when loaded to a minimum of 60%. Drivers sink a maximum of 6mA per driver. DM10 LED drivers are 0-10V dimmable and are compatible with most 0-10V wall slide dimmers and direct 0-10V analog signal dimmers. Max driver size 1¼" w x 1" h.

### CONSTRUCTION

Housing Extruded aluminum >25% PC recycled, 100% recyclable

Lens Acrylic, 100% recyclable.

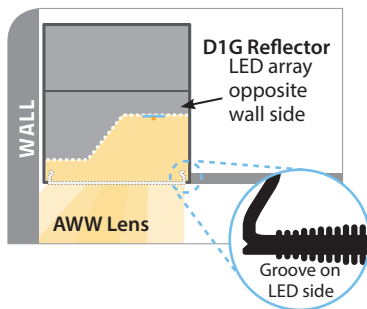
### MOUNTING

Recessed into drywall or T-bar ceilings

### WARRANTY

Single-source, 5 year limited warranty covers standard components and construction.

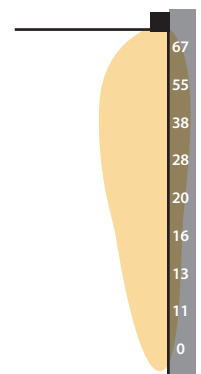
### WALL GRAZER ORIENTATION



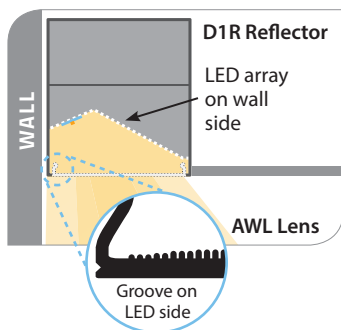
## Smooth Wall Grazing.

A tight, focused beam grazes wall textures evenly, accenting and highlighting details to elevate the visual drama.

	Watts/Ft	Ceiling Height	Average Illuminance	Max	Min	Max/Min Ratio
Standard Output - 750 lm/ft	10	9'	40fc	76fc	16fc	4.75



### PERIMETER FILL ORIENTATION



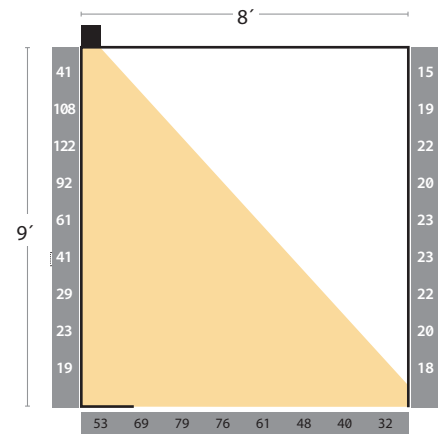
## Perimeter Fill.

Fill a Corridor with Light — from the Perimeter.

It's a perimeter optic that washes corridors in light, offering outstanding light distribution, far more energy efficient than typical soft glow solutions and significantly reduces installation cost. Ideal for corridors where budget and energy efficiency conflict with strict IES requirements for high footcandles.

Suspended, surface mounted or recessed, perimeter lighting system.

	Watts/Sq. Ft.	Ceiling Height	Average Illuminance	Max/Min	Max/Min Ratio
Standard Output - 875 lm/ft	1.25	9'	57fc	79/32	2.5:1



Footcandles along the floor Reflectances 80: 50: 20



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# Bionic™ | Cove & Perimeter

## 4" Perimeter

**OSU WOMENS BBALL  
TYPE L13**



PRUDENTIAL LTG.

PRULITE.COM 213.746.0360

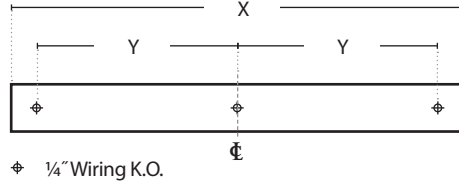


Choose from one of our Premium Colors with no set-up fee.

For paint chip samples, please email: [info@prulite.com](mailto:info@prulite.com)

### MOUNTING LOCATIONS

Mounting Detail (1) Housing Detail for 1/4"-20

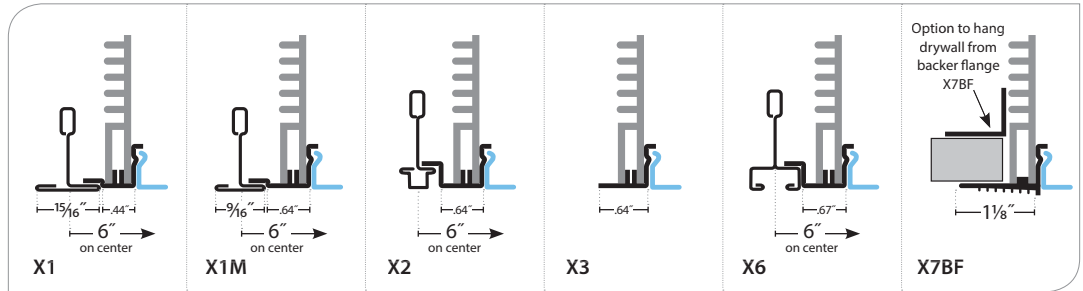


Mounting Conversion Chart

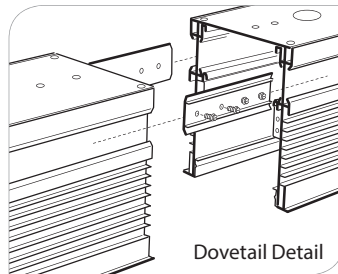
<b>X =</b>	2'	3'	4'	5'	6'	7'	8'
<b>Y =*</b>	9"	15"	21"	27"	33"	39"	45"

\* From Centerline

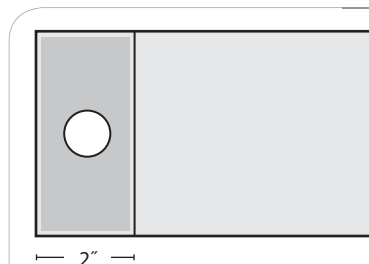
### CEILING SYSTEMS



### ADJOINING DETAIL



### CONTROL SENSORS



**NOTE:** Sensor plate will match fixture color finish

Consult factory for other sensors, please email: [info@prulite.com](mailto:info@prulite.com)



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# Bionic™ | Cove & Perimeter

## 4" Perimeter

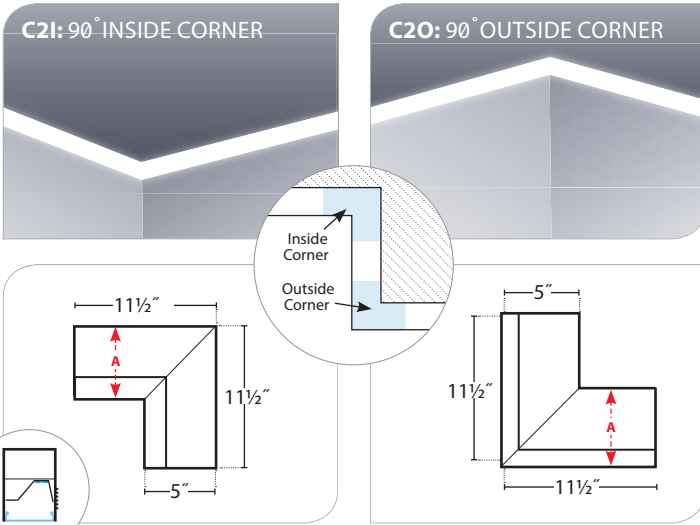
OSU WOMENS BBALL  
TYPE L13



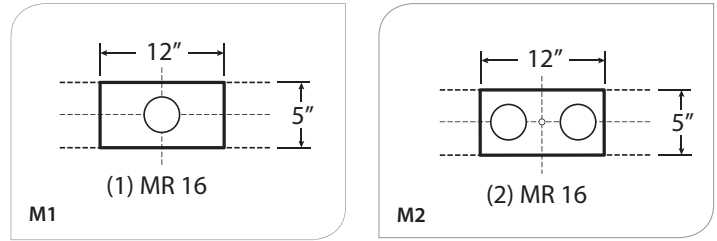
PRUDENTIAL LTG.

PRULITE.COM 213.746.0360

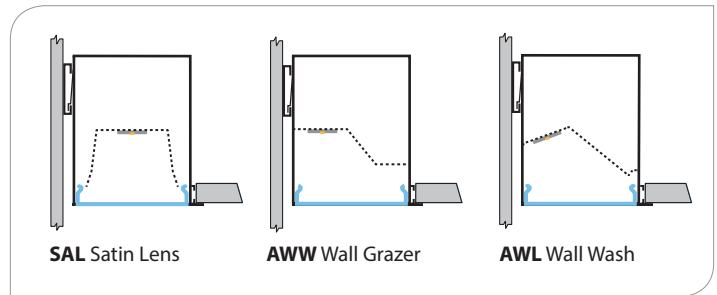
### CORNERS



### LAMPS



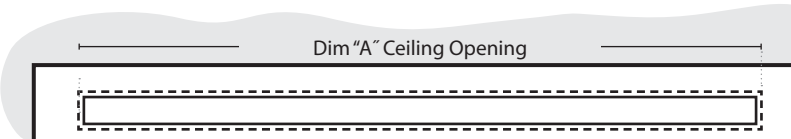
### DISTRIBUTION CROSS SECTIONS



### MOUNTING DIMENSIONS

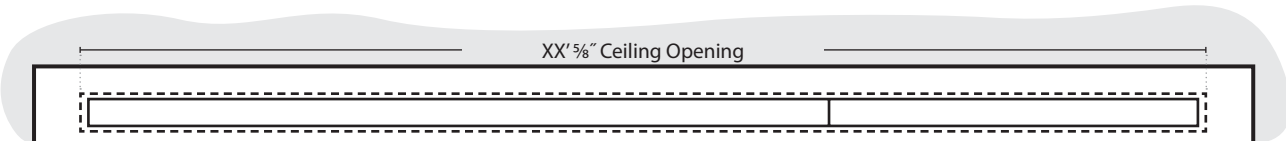
#### LIGHT POCKET INDIVIDUAL:

-----> ROW DIRECTION: INSTALL FROM LEFT TO RIGHT



FIXTURE	DIM 'A'
24"	24 $\frac{3}{8}$ "
36"	36 $\frac{3}{8}$ "
48"	48 $\frac{3}{8}$ "
72"	72 $\frac{3}{8}$ "
96"	96 $\frac{3}{8}$ "

#### LIGHT POCKET:



#### WALL TO WALL:

