

# **PROJECT MANUAL**

**20-BED ADOLESCENT PSYCHIATRIC UNIT  
SAN JORGE CHILDREN'S HOSPITAL  
SANTURCE, PUERTO RICO**

## **OWNER**

**SAN JORGE CHILDREN'S HOSPITAL  
UMC OF PUERTO RICO**

**ISSUED FOR BIDDING AND PERMIT  
DECEMBER 20, 2010**

## **ARCHITECT**

**HHCP ARCHITECTS, P.S.C.  
MAITLAND, FLORIDA  
PR 3250**

**ARCHITECT'S PROJECT NUMBER: 3333.00**

## **ARCHITECT'S CONSULTANTS**

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## **TABLE OF CONTENTS**

### **INTRODUCTORY INFORMATION**

Project Title Page  
Table of Contents

### **BIDDING REQUIREMENTS**

00105 - Invitation to Bid  
00411 - Bid Form

### **DIVISION 1 - GENERAL REQUIREMENTS**

01100 - Summary  
01250 - Contract Modification Procedures  
01270 - Unit Prices  
01290 - Payment Procedures  
01310 - Project Management and Coordination  
01320 - Construction Progress Documentation  
01330 - Submittal Procedures  
01335 - Structural Submittals  
01400 - Quality Requirements  
01410 - Structural Testing / Inspection Agency Services  
01420 - References  
01500 - Temporary Facilities and Controls  
01600 - Product Requirements  
01700 - Execution Requirements  
01731 - Cutting and Patching  
01732 - Selective Demolition  
01770 - Closeout Procedures

### **DIVISION 2 - SITE CONSTRUCTION**

02080 - Piped Utilities – Basic Materials and Methods  
02100 - Site Preparation  
02200 - Earthwork  
02221 - Excavation, Backfilling and Compacting for Structures  
02361 - Termite Control  
02721 - Aggregate Base Course  
02730 - Sanitary Sewer System  
02770 - Sidewalks

### **DIVISION 3 - CONCRETE**

03100 - Concrete Formwork

03200 - Concrete Reinforcement  
03300 - Cast-in-Place Concrete  
03600 - Non-Shrink Grout

#### **DIVISION 4 – MASONRY**

04700 - Manufactured Stone Veneer

#### **DIVISION 5 - METALS**

05100 - Structural Steel  
05300 - Steel Decking  
05400 - Cold-Formed Structural Steel  
05500 - Metal Fabrications  
05521 - Pipe and Tube Railings  
05700 - Ornamental Metal  
05730 - Ornamental Formed Metal  
05811 - Architectural Joint Systems

#### **DIVISION 6 - WOOD AND PLASTICS**

06105 - Miscellaneous Carpentry  
06402 - Interior Architectural Woodwork

#### **DIVISION 7 - THERMAL AND MOISTURE PROTECTION**

07141 - Cold Fluid-Applied Waterproofing  
07411 - Metal Roof Panels  
07552 - SBS-Modified Bituminous Membrane Roofing  
07620 - Sheet Metal Flashing and Trim  
07710 - Manufactured Roof Specialties  
07811 - Sprayed Fire-Resistive Materials  
07841 - Through-Penetration Firestop Systems  
07842 - Fire-Resistive Joint Systems  
07920 - Joint Sealants

#### **DIVISION 8 - DOORS AND WINDOWS**

08110 - Steel Doors and Frames  
08211 - Flush Wood Doors  
08411 - Aluminum-Framed Entrances and Storefronts  
08460 - Automatic Entrance Doors  
08710 - Door Hardware  
08800 - Glazing

**DIVISION 9 - FINISHES**

- 09220 - Portland Cement Plaster
- 09260 - Gypsum Board Assemblies
- 09310 - Ceramic Tile
- 09511 - Acoustical Panel Ceilings
- 09624 - Modular Athletic Flooring
- 09652 - Resilient Sheet Flooring
- 09653 - Resilient Wall Base and Accessories
- 09680 - Carpet
- 09911 - Painting
- 09912 - Painting (Mechanical Systems)
- 09931 - Wood Stains and Transparent Finishes
- 09963 - Elastomeric Coatings

**DIVISION 10 - SPECIALTIES**

- 10191 - Curtains and Tracks
- 10265 - Impact-Resistant Wall Protection
- 10505 - Metal Lockers
- 10522 - Fire Extinguisher Cabinets
- 10523 - Fire Extinguishers
- 10801 - Toilet and Bath Accessories

**DIVISION 11 - EQUIPMENT** (Not Used)

**DIVISION 12 - FURNISHINGS**

- 12484 - Floor Mats and Frames

**DIVISION 13 - SPECIAL CONSTRUCTION** (Not Used)

- 13915 - Fire Suppression System

**DIVISION 15 – MECHANICAL**

- 15050 - Basic Mechanical Materials and Methods (HVAC)
- 15060 - Hangers and Supports
- 15071 - Mechanical Vibration and Seismic Controls
- 15075 - Mechanical Identification
- 15081 - Duct Insulation
- 15083 - Pipe Insulation (HVAC)
- 15100 - Valves (HVAC)
- 15121 - Pipe Expansion Fittings and Loops
- 15122 - Meters and Gages (HVAC)
- 15140 - Domestic Water Piping

15150 - Sanitary Waste and Vent Piping  
15160 - Storm Drainage Piping  
15181 - Hydronic Piping  
15189 - HVAC Water Treatment  
15241 - Mechanical Vibration Controls and Seismic Restraints  
15815 - Metal Ducts  
15820 - Ducts Accessories  
15900 - HVAC Instrumentation and Controls  
15985 - Sequence of Operation  
15990 - Testing, Adjusting, and Balancing

**DIVISION 16 – ELECTRICAL**

16050 - Basic Electrical Material and Methods  
16120 - Conductors and Cables  
16130 - Raceways and Boxes  
16140 - Wiring Devices  
16415 - Transfer Switches  
16420 - Enclosed Controllers  
16442 - Panelboards  
16461 - Dry Type Transformers  
16511 - Interior Lighting  
16721 - Fire Alarm System

END OF TABLE OF CONTENTS

## INVITATION TO BID

1. Lump Sum proposals will be received by the Owner from invited General Contractors, including mechanical, plumbing, electrical, and site construction for all labor, materials and services required to complete the Work for construction of **20 Bed Adolescent Psychiatric Unit, San Jorge Children's Hospital, 258 San Jorge Street, Santurce, Puerto Rico 00912**. The Work is indicated and described on the Bidding Documents prepared by HHCP Architects, P.S.C., Healthcare Facilities Design, Project Number 3333.00, dated December 20, 2010.
2. The Owner is:  
  
UMC of Puerto Rico, Inc.  
253 Calle San Jorge, Edificio San Jorge II, Suite 4A  
San Juan, Puerto Rico 00910  
  
The Owner's Representative is:  
  
Rafael Menéndez  
UMC of Puerto Rico  
253 Calle San Jorge, Edificio San Jorge II, Suite 4A  
San Juan, Puerto Rico 00910  
Tel: 787 622-2200, Fax: 787 728-5366
3. The Architect is:  
  
HHCP Architects, P.S.C., Health Facilities Design  
222 West Maitland Blvd.  
Maitland, FL 32751  
Telephone: (407) 644-2656, Fax: (407) 628-3269  
Contact Person: Carlos Moleri.
4. Project Completion: The Contract Time shall be \_\_\_ calendar days as indicated on the Bid Form.
5. Bids will be received at the office of Owner's Representative (see address above) on February 23, 2011 until 2:00 p.m. EDST. Submit one signed original Bid and one photocopy in a sealed envelope. Identify the project name on the outside of the envelope. No faxed Bid Forms will be accepted. All Bids shall be hand-delivered or sent by overnight carrier and shall arrive prior to the date and time set for receipt of Bids. Bids will be privately opened and evaluated.
6. Invited General Contractors will be furnished four sets of Bidding Documents at no cost. Additional sets of Bidding Documents may be purchased by contacting the printer selected by the Owner. The cost of purchased Bidding Documents will be determined by the printer. There will be no refunds issued for purchased Bidding Documents. Purchased Bidding Documents may be picked up or will be shipped (shipping charges collect) to the Bidder. Only full sets of Bidding Documents will be issued.

7. Sub-Bidders may purchase sets of Bidding Documents by contacting the printer selected by the Owner. The cost of purchased Bidding Documents will be determined by the printer. There will be no refunds issued for purchased Bidding Documents. Purchased Bidding Documents may be picked up or will be shipped (shipping charges collect) to Sub-Bidders. Only full sets of Bidding Documents will be issued.
8. No bid may be modified, withdrawn, or canceled for a period of 60 days after time designated for receipt of Bids.
9. A Bid Bond is not required.
10. Performance Bond and Payment Bond, each in amount of 100 percent of the Contract Sum, will be required from the successful Bidder. Provide proof from Surety of Bidder's ability to obtain bonds. Submit with the Bid Form.
11. Bidders shall attach a proof of insurance document signed by their insurance provider showing types and limits of insurance coverage.
12. Proposed subcontractors for certain trades shall be indicated on the form provided and attached to the Bid Form.
13. A Pre-Bid Conference is scheduled for January 27, 2011. Attendance at the pre-bid conference is mandatory for the General Contractor Bidders and for the HVAC, plumbing, automatic sprinkler system and electrical subcontractor Sub-bidders. Other subcontractor Sub-bidders may attend. All inquiries and requests for substitutions shall be submitted to the Architect in writing no later than five calendar days prior to the date of the Pre-Bid Conference to be evaluated for inclusion in an Addendum.
14. Bidders shall indicate proposed unit prices and voluntary cost reductions on the Bid Form.
15. The Bid shall not include assumptions, qualifications, exceptions or exclusions to the Bidding Documents. A Bid that includes the aforementioned items shall be considered non-compliant and will be rejected.
16. The Owner reserves the right to reject Bids and to waive irregularities, technicalities and informalities. Bids may be rejected for whatever reason(s) the Owner deems to be in his best interests.

By: Rafael Menendez  
Owner's Representative

END OF INVITATION TO BID

**BID FORM**

(Type on Bidder's Letterhead, submit one original and one photocopy)

To: UMC of Puerto Rico, Inc.  
253 Calle San Jorge, Edificio San Jorge II, Suite 4A  
San Juan, Puerto Rico 00910

Date Due:  
Time Due:

From: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Re: **20 Bed Adolescent Psychiatric Unit, San Jorge Children's Hospital, Santurce, Puerto Rico.**

Gentlemen:

- 1. Having examined the Bidding Documents for the referenced Work prepared by HHCP Architects, P.S.C., Health Facilities Design, dated December 20, 2010 and Addenda(um) No. \_\_\_\_ through \_\_\_\_\_, receipt of which is hereby acknowledged; the under signed Bidder proposes to furnish all labor, material and equipment required for the completion of the entire Work in accordance with said Documents within a Contract Time of \_\_\_ calendar days and for the Sums indicated below:

\_\_\_\_\_ Dollars (\$ \_\_\_\_\_), which Sum is referred to as the "Base Bid."

The Base Bid contains the following sums for the work indicated below:

Electrical: (\$ \_\_\_\_\_).

HVAC: (\$ \_\_\_\_\_).

Plumbing: (\$ \_\_\_\_\_).

Fire Protection: (\$ \_\_\_\_\_).

Foundations: (\$ \_\_\_\_\_).

Low Voltage Security and Controls: (\$ \_\_\_\_\_).

Unit Prices: In accordance with Section 01270 the following sums are proposed.

Sidewalks: (\$ \_\_\_\_\_) per sq. ft.

Concrete: (\$ \_\_\_\_\_) per cu. yd.

Receptacles (\$ \_\_\_\_\_) each.

Rubber Sheet Flooring: (\$ \_\_\_\_\_) per sq.ft.

Vinyl Sheet Flooring: (\$ \_\_\_\_\_) per sq.ft.

Materials Inspection, Sampling and Testing: (\$ \_\_\_\_\_) lump sum.



2. Bidder agrees not to revoke or withdraw this Bid for 60 days following opening of Bids.
3. If the Bidder is notified in writing of the acceptance of this Bid within this time, he agrees to execute a Contract on the prescribed form and based on this Bid within ten (10) days of the notification, and at the same time to furnish Performance and Payment Bonds in the amounts specified.
4. Bidder agrees to commence work on the site with adequate force and equipment no sooner than thirty (30) days of a date to be specified in a written order from the Owner, known as a "Notice to Proceed," and to perform the Work faithfully with adequate materials and labor and to complete same within the Contract Time.
5. The Bidder has read and agrees to requirements contained in Section 01100 - Summary.

Respectfully Submitted,

Name of Bidder: \_\_\_\_\_

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

By: \_\_\_\_\_

Witnessed By: (1) \_\_\_\_\_ Title: \_\_\_\_\_

Witnessed By: (2) \_\_\_\_\_ Title: \_\_\_\_\_

Contractor's License Number: \_\_\_\_\_

Above Bidder is: ( ) Corporation ( ) Partnership ( ) Wholly-Owned Company

Full names and addresses of principals of firm are as follows:

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

Names of key personnel to be assigned to this Project.

Project Manager: \_\_\_\_\_

Superintendent: \_\_\_\_\_

END OF BID FORM

BID FORM-2

LIST OF PROPOSED SUBCONTRACTORS IS ATTACHED (Fill-in and attach list to Bid Form.)  
PROOF OF INSURANCE IS ATTACHED  
PROOF OF ABILITY TO OBTAIN PERFORMANCE AND PAYMENT BONDS

**LIST OF KEY SUBCONTRACTORS**

The following subcontractors are proposed, and if approved, will not be changed during the construction period without the consent of the Owner and Architect

**HEATING, VENTILATING AND AIR CONDITIONING:**

Subcontractor: \_\_\_\_\_  
Address: \_\_\_\_\_  
\_\_\_\_\_  
Telephone: \_\_\_\_\_  
Contact: \_\_\_\_\_

**PLUMBING**

Subcontractor: \_\_\_\_\_  
Address: \_\_\_\_\_  
\_\_\_\_\_  
Telephone: \_\_\_\_\_  
Contact: \_\_\_\_\_

**ELECTRICAL:**

Subcontractor: \_\_\_\_\_  
Address: \_\_\_\_\_  
\_\_\_\_\_  
Telephone: \_\_\_\_\_  
Contact: \_\_\_\_\_

**AUTOMATIC SPRINKLER SYSTEM:**

Subcontractor: \_\_\_\_\_  
Address: \_\_\_\_\_  
\_\_\_\_\_  
Telephone: \_\_\_\_\_  
Contact: \_\_\_\_\_

**END OF LIST OF SUBCONTRACTORS**

## SECTION 01100 - SUMMARY

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section includes:

1. Definitions.
2. Agreements.
3. Insurance.
4. Applications for Payment.
5. Work covered by Contract Documents.
6. Work by Owner.
7. Work under separate contracts.
8. Purchase contracts.
9. Owner-furnished products.
10. Access to site.
11. Coordination with occupants.
12. Protection Plan.
13. Construction Schedule.
14. Work restrictions.
15. Substitutions.
16. Inspections and Testing.
17. Temporary Facilities and Controls.
18. Record Drawings.

#### 1.2 DEFINITIONS

- A. Where the word Contractor is used, it shall mean Contractor or Construction Manager, unless otherwise indicated.

#### 1.3 AGREEMENTS

- A. The Agreement to be executed by Construction Manager will be AIA A121 CMc-2003 Standard Form of Agreement Between Owner and Construction Manager Where the Construction Manager is also the Constructor, as modified for the Project.
1. This Agreement is known as "CM at risk, with a Guaranteed Maximum Price."
- B. The Agreement to be executed by General Contractor will be AIA A101-2007 Standard form of Agreement Between Owner and Contractor where the Basis of Payment is a Stipulated Sum, as modified for the Project.
- C. This Agreement will have a provision for cost savings to be split 30 percent for the Contractor and 70 percent for the Owner.

- D. The Agreement will contain a provision for liquidated damages in an amount (to be specified by the Owner) per calendar day beyond Substantial Completion that the Work is incomplete.

#### 1.4 INSURANCE

- A. The Contractor shall carry the following types of insurance with limits acceptable to the Owner:
  - 1. Workers Compensation.
  - 2. Commercial General Liability.
  - 3. Builder' Risk.
  - 4. Automobile Liability.

#### 1.5 APPLICATIONS FOR PAYMENT

- A. The Contractor's application for payment shall be submitted to the Architect no later than the 10<sup>th</sup> day of the month.
- B. Payment will be made to the Contractor by the 15<sup>th</sup> day of the following month.
- C. Ten percent of each progress payment will be retained.
- D. Upon Substantial Completion the retainage will be reduced to five percent of the completed work.
- E. Final payment will be made upon final inspection and approval by the Architect and upon receipt of a Certificate of Occupancy from Authorities Having Jurisdiction.

#### 1.6 WORK COVERED BY CONTRACT DOCUMENTS

- A. Type of Contract
  - 1. Project will be constructed under a single prime contract.

#### 1.7 WORK BY OWNER

- A. General: Cooperate fully with Owner so work may be carried out smoothly, without interfering with or delaying work under this Contract or work by Owner. Coordinate the Work of this Contract with work performed by Owner.
- B. Concurrent Work: Owner may perform construction operations at Project site. Those operations will be conducted simultaneously with work under this Contract.
  - 1. Cooperate fully with Owner for construction performed by Owner.

## 1.8 PURCHASE CONTRACTS

- A. General: Owner may negotiate purchase contracts with vendors or suppliers of material and equipment to be incorporated into the Work.
  - 1. Cooperate fully with vendors and suppliers for delivery, storage and installation of their materials and equipment.

## 1.9 OWNER-FURNISHED PRODUCTS

- A. Owner may furnish products to be incorporated in the construction. Where required by Owner the Work includes receiving, unloading, handling, storing, protecting, and installing Owner-furnished products and making building services connections.

## 1.10 ACCESS TO SITE

- A. General: Contractor shall have limited use of Project site for construction operations as indicated on Drawings by the Contract limits and as indicated by requirements of this Section.
- B. Use of Site: Limit use of Project site to areas within the Contract limits indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.
  - 1. Driveways, Walkways and Entrances: Keep driveways loading areas, and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials.
    - a. Schedule deliveries to minimize use of driveways and entrances by construction operations.
    - b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.
- C. Condition of Existing Building: Maintain portions of existing building affected by construction operations in a weathertight condition throughout construction period. Repair damage caused by construction operations.

## 1.11 COORDINATION WITH OCCUPANTS

- A. Full Owner Occupancy: Owner will occupy existing parking building during entire construction period. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's day-to-day operations. Maintain existing exits unless otherwise indicated.
  - 1. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from Owner and approval of authorities having jurisdiction.
  - 2. Notify the Owner not less than 72 hours in advance of activities that will affect Owner's operations.

3. Particular observations and restraints in regards to the usage of the existing parking building during the construction period will be thoroughly discussed during the Pre-Bid conference scheduled for January 27, 2011.

#### 1.12 PROTECTION PLAN

- A. Within 10 days of Contract award, submit to the Owner and Architect a complete protection plan for the following:
  1. Vehicles entering the Site.
  2. Pedestrians entering the Site.
  3. Pedestrians passing the site on public sidewalks.
  4. Existing building.
  5. Existing site construction to remain.

#### 1.13 CONSTRUCTION SCHEDULE

- A. Provide a CPM schedule for the work of the Project.
- B. Update schedule for each application for payment.

#### 1.14 WORK RESTRICTIONS

- A. Work Restrictions, General: Comply with restrictions on construction operations.
  1. Comply with limitations on use of public streets and other requirements of Authorities Having Jurisdiction.
- B. On-Site Work Hours: Limit work in the existing building to normal business working hours of 7:00 a.m. to 5:00 p.m., Monday through Friday, except as otherwise indicated.
  1. Weekend Hours: Obtain Owner's permission for weekend work.
  2. Contact Owner for permission two working days prior to date(s) requested.
- C. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after providing temporary utility services according to requirements indicated:
  1. Notify Owner not less than two days in advance of proposed utility interruptions.
  2. Obtain Owner's written permission before proceeding with utility interruptions.
- D. Noise, Vibration, and Odors: Coordinate operations that may result in high levels of noise and vibration, odors, or other disruption to Owner occupancy with Owner.
  1. Notify Owner not less than two days in advance of proposed disruptive operations.
- E. Nonsmoking Project: Smoking is not permitted on the Project Site, within the building or within 25 feet of entrances, operable windows, or outdoor air intakes.
- F. Controlled Substances: Use of controlled substances is not permitted on the Project Site.

- G. Employee Identification: Provide identification tags for Contractor personnel working on the Project site. Require personnel to utilize identification tags at all times.
- H. Employee Screening: Comply with Owner's requirements regarding drug and background screening of Contractor personnel working on the Project site.
  - 1. Maintain list of approved screened personnel with Owner's Representative.

#### 1.15 SUBSTITUTIONS

- A. Owner and Architect will consider substitution requests within ninety days after Contract award.

#### 1.16 INSPECTIONS AND TESTING

- A. The Contractor shall engage the testing agency and pay for all inspections and tests.

#### 1.17 TEMPORARY FACILITIES AND CONTROLS

- A. The Contractor shall provide all temporary facilities and controls, equipment, storage and staging necessary for execution of the Work.

#### 1.18 RECORD DRAWINGS

- A. The Contractor shall maintain a red-line, marked-up set of the Contract Drawings at the Site showing changes made during construction. This set of drawings shall be identified as "Record Drawings" and given to the Owner at the completion of construction.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01100





## SECTION 01250 - CONTRACT MODIFICATION PROCEDURES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section specifies administrative and procedural requirements for handling and processing Contract modifications.
- B. Related Sections include the following:
  - 1. Division 1 Section "Product Requirements" for administrative procedures for handling requests for substitutions made after Contract award.

#### 1.3 MINOR CHANGES IN THE WORK

- A. Architect will issue supplemental instructions authorizing Minor Changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on AIA Document G710, "Architect's Supplemental Instructions."

#### 1.4 PROPOSAL REQUESTS

- A. Owner-Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
  - 1. Proposal Requests issued by Architect are for information only. Do not consider them instructions either to stop work in progress or to execute the proposed change.
  - 2. Within time specified in Proposal Request after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
    - a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
    - b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
    - c. Include an updated Contractor's Construction Schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.

- B. Contractor-Initiated Proposals: If latent or unforeseen conditions require modifications to the Contract, Contractor may propose changes by submitting a request for a change.
  - 1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
  - 2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
  - 3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
  - 4. Include an updated Contractor's Construction Schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
  - 5. Comply with requirements in Division 1 Section "Product Requirements" if the proposed change requires substitution of one product or system for product or system specified.
- C. Proposal Request Form: Use AIA Document G709 for Proposal Requests.

#### 1.5 CHANGE ORDER PROCEDURES

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

#### 1.6 CONSTRUCTION CHANGE DIRECTIVE

- A. Construction Change Directive: Architect may issue a Construction Change Directive on AIA Document G714. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.
  - 1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.
- B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.
  - 1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01250

## SECTION 01270 - UNIT PRICES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes administrative and procedural requirements for unit prices.

#### 1.2 DEFINITIONS

- A. Unit price is an amount incorporated in the Agreement, applicable during the duration of the Work as a price per unit of measurement for materials, equipment, or services, or a portion of the Work, added to or deducted from the Contract Sum by appropriate modification, if the scope of Work or estimated quantities of Work required by the Contract Documents are increased or decreased.

#### 1.3 PROCEDURES

- A. Unit prices include all necessary material, plus cost for delivery, installation, insurance, applicable taxes, overhead, and profit.
- B. Owner reserves the right to reject Contractor's measurement of work-in-place that involves use of established unit prices and to have this work measured, at Owner's expense, by an independent surveyor acceptable to Contractor.
- C. List of Unit Prices: A schedule of unit prices is indicated on the Bid Form

### PART 2 - PRODUCTS (Not Used)

### PART 3 - EXECUTION (Not Used)

END OF SECTION 01270



## SECTION 01290 - PAYMENT PROCEDURES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section specifies administrative and procedural requirements necessary to prepare and process Applications for Payment.
- B. Related Sections include the following:
  - 1. Division 1 Section "Contract Modification Procedures" for administrative procedures for handling changes in the Work.
  - 2. Division 1 Section "Construction Progress Documentation" for administrative requirements governing preparation and submittal of Contractor's Construction Schedule and Submittals Schedule.

#### 1.3 DEFINITIONS

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

#### 1.4 SCHEDULE OF VALUES

- A. Coordination: Coordinate preparation of the Schedule of Values with preparation of Contractor's Construction Schedule.
  - 1. Correlate line items in the Schedule of Values with other required administrative forms and schedules, including the following:
    - a. Application for Payment forms with Continuation Sheets.
    - b. Submittals Schedule.
  - 2. Submit the Schedule of Values to Architect at earliest possible date but no later than seven days before the date scheduled for submittal of initial Applications for Payment.
  - 3. Subschedules: Where the Work is separated into phases requiring separately phased payments, provide subschedules showing values correlated with each phase of payment.
- B. Format and Content: Use the Project Manual table of contents as a guide to establish line items for the Schedule of Values. Provide at least one line item for each Specification Section.

1. Identification: Include the following Project identification on the Schedule of Values:
  - a. Project name and location.
  - b. Name of Architect.
  - c. Architect's project number.
  - d. Contractor's name and address.
  - e. Date of submittal.
  
2. Arrange the Schedule of Values in tabular form with separate columns to indicate the following for each item listed:
  - a. Related Specification Section or Division.
  - b. Description of the Work.
  - c. Name of subcontractor.
  - d. Name of manufacturer or fabricator.
  - e. Name of supplier.
  - f. Change Orders (numbers) that affect value.
  - g. Dollar value.
    - 1) Percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent.
  
3. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with the Project Manual table of contents. Provide several line items for principal subcontract amounts, where appropriate.
4. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
5. Provide a separate line item in the Schedule of Values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
  - a. Differentiate between items stored on-site and items stored off-site. Include evidence of insurance or bonded warehousing if required.
  
6. Provide separate line items in the Schedule of Values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.
7. Allowances: Provide a separate line item in the Schedule of Values for each allowance. Show line-item value of unit-cost allowances, as a product of the unit cost, multiplied by measured quantity. Use information indicated in the Contract Documents to determine quantities.
8. Each item in the Schedule of Values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.
  - a. Temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown either as separate line items in the Schedule of Values or distributed as general overhead expense, at Contractor's option.

## 1.5 APPLICATIONS FOR PAYMENT

- A. Each Application for Payment shall be consistent with previous applications and payments as certified by Architect and paid for by Owner.
  - 1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.
- B. Payment Application Times: The date for each progress payment is indicated in the Agreement between Owner and Contractor. The period of construction Work covered by each Application for Payment is the period indicated in the Agreement.
- C. Payment Application Forms: Use AIA Document G702 and AIA Document G703 Continuation Sheets as form for Applications for Payment.
- D. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect will return incomplete applications without action.
  - 1. Entries shall match data on the Schedule of Values and Contractor's Construction Schedule. Use updated schedules if revisions were made.
- E. Transmittal: Submit 3 signed and notarized original copies of each Application for Payment to Architect by a method ensuring receipt within 24 hours. One copy shall include waivers of lien and similar attachments if required.
  - 1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.
- F. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
  - 1. List of subcontractors.
  - 2. Schedule of Values.
  - 3. Contractor's Construction Schedule (preliminary if not final).
  - 4. Schedule of unit prices.
  - 5. Submittals Schedule (preliminary if not final).
  - 6. List of Contractor's staff assignments.
  - 7. Copies of building permits.
  - 8. Copies of authorizations and licenses from Authorities Having Jurisdiction for performance of the Work.
  - 9. Initial progress report.
  - 10. Report of preconstruction conference.
  - 11. Certificates of insurance and insurance policies.
  - 12. Performance and payment bonds.
- G. Application for Payment at Substantial Completion: After issuing the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.



1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
  2. This application shall reflect Certificates of Partial Substantial Completion issued previously for Owner occupancy of designated portions of the Work.
- H. Final Payment Application: Submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
1. Evidence of completion of Project closeout requirements.
  2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
  3. Updated final statement, accounting for final changes to the Contract Sum.
  4. AIA Document G706, "Contractor's Affidavit of Payment of Debts and Claims."
  5. AIA Document G706A, "Contractor's Affidavit of Release of Liens."
  6. AIA Document G707, "Consent of Surety to Final Payment."
  7. Evidence that claims have been settled.
  8. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01290

## SECTION 01310 - PROJECT MANAGEMENT AND COORDINATION

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:

1. General project coordination procedures.
2. Coordination Drawings.
3. Administrative and supervisory personnel.
4. Requests for Information (RFIs).
5. Project meetings.

- B. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 1 Section "Construction Progress Documentation" for preparing and submitting the Contractor's Construction Schedule.
2. Division 1 Section "Execution Requirements" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
3. Division 1 Section "Closeout Procedures" for coordinating Contract closeout.

#### 1.3 COORDINATION

- A. Coordination: Coordinate construction operations included in various Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections that depend on each other for proper installation, connection, and operation.

1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
2. Coordinate installation of different components with other contractors to ensure maximum accessibility for required maintenance, service, and repair.
3. Make adequate provisions to accommodate items scheduled for later installation.

- B. If necessary, prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.

1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.
- C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and activities of other contractors to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
1. Preparation of Contractor's Construction Schedule.
  2. Preparation of the Schedule of Values.
  3. Installation and removal of temporary facilities and controls.
  4. Delivery and processing of submittals.
  5. Progress meetings.
  6. Preinstallation conferences.
  7. Project closeout activities.

#### 1.4 SUBMITTALS

- A. Coordination Drawings: Prepare Coordination Drawings if limited space availability necessitates maximum utilization of space for efficient installation of different components or if coordination is required for installation of products and materials fabricated by separate entities.
1. Indicate relationship of components shown on separate Shop Drawings.
  2. Indicate required installation sequences.
  3. Refer to Sections within Division 15 and Division 16 for specific Coordination Drawing requirements for mechanical and electrical installations.
- B. Staff Names: Within 15 days of starting construction operations, submit a list of principal staff assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including office telephone and mobile numbers. Provide names, addresses, and telephone numbers of individuals assigned as standbys in the absence of individuals assigned to Project.
1. Post copies of list in Project meeting room, in temporary field office, and by each temporary telephone.

#### 1.5 ADMINISTRATIVE AND SUPERVISORY PERSONNEL

- A. General: In addition to Project superintendent, provide other administrative and supervisory personnel as required for proper performance of the Work.
1. Include special personnel required for coordination of operations with other contractors.

#### 1.6 REQUESTS FOR INFORMATION (RFIs)

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

1. Architect will return RFIs submitted to Architect by other entities controlled by Contractor with no response.
  2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.
- B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:
1. Project name.
  2. Project number.
  3. Date.
  4. Name of Contractor.
  5. Name of Architect.
  6. RFI number, numbered sequentially.
  7. RFI subject.
  8. Specification Section number and title and related paragraphs, as appropriate.
  9. Drawing number and detail references, as appropriate.
  10. Field dimensions and conditions, as appropriate.
  11. Contractor's suggested resolution. If Contractor's solution(s) impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
  12. Contractor's signature.
  13. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
    - a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.
- C. RFI Forms: AIA Document G716 or Software-generated form with substantially the same content as indicated above, acceptable to Architect.
- D. Architect's Action: Architect will review each RFI, determine action required, and respond. Allow seven working days for Architect's response for each RFI. RFIs received by Architect after 1:00 p.m. will be considered as received the following working day.
1. The following RFIs will be returned without action:
    - a. Requests for approval of submittals.
    - b. Requests for approval of substitutions.
    - c. Requests for coordination information already indicated in the Contract Documents.
    - d. Requests for adjustments in the Contract Time or the Contract Sum.
    - e. Requests for interpretation of Architect's actions on submittals.
    - f. Incomplete RFIs or inaccurately prepared RFIs.
  2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt of additional information.
  3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Division 1 Section "Contract Modification Procedures."

- a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within 10 days of receipt of the RFI response.
- E. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within seven days if Contractor disagrees with response.
- F. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log monthly. Software log with not less than the following:
  - 1. Project name.
  - 2. Name and address of Contractor.
  - 3. Name and address of Architect.
  - 4. RFI number including RFIs that were dropped and not submitted.
  - 5. RFI description.
  - 6. Date the RFI was submitted.
  - 7. Date Architect's response was received.
  - 8. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.
  - 9. Identification of related Field Order, Work Change Directive, and Proposal Request, as appropriate.

## 1.7 PROJECT MEETINGS

- A. General: Schedule and conduct meetings and conferences at Project site, unless otherwise indicated.
  - 1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times.
  - 2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
  - 3. Minutes: Record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within 3 days of the meeting.
- B. Preconstruction Conference: Schedule a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 15 days after execution of the Agreement. Hold the conference at Project site or another convenient location. Conduct the meeting to review responsibilities and personnel assignments.
  - 1. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; manufacturers; suppliers; and other concerned parties shall attend the conference. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
  - 2. Agenda: Discuss items of significance that could affect progress, including the following:
    - a. Tentative construction schedule.
    - b. Phasing.

- c. Critical work sequencing.
- d. Designation of responsible personnel.
- e. Procedures for processing field decisions and changes in the Work.
- f. Procedures for processing Applications for Payment.
- g. Distribution of the Contract Documents.
- h. Submittal procedures.
- i. Preparation of Record Documents.
- j. Use of the premises.
- k. Responsibility for temporary facilities and controls.
- l. Parking availability.
- m. Office, work, and storage areas.
- n. Equipment deliveries and priorities.
- o. First aid.
- p. Security.
- q. Progress cleaning.
- r. Working hours.

C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity that requires coordination with other construction.

1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect of scheduled meeting dates.
2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
  - a. Contract Documents.
  - b. Options.
  - c. Related changes in the Work.
  - d. Purchases.
  - e. Deliveries.
  - f. Submittals.
  - g. Review of mockups.
  - h. Possible conflicts.
  - i. Compatibility problems.
  - j. Time schedules.
  - k. Weather limitations.
  - l. Manufacturer's written recommendations.
  - m. Warranty requirements.
  - n. Compatibility of materials.
  - o. Acceptability of substrates.
  - p. Temporary facilities and controls.
  - q. Space and access limitations.
  - r. Regulations of authorities having jurisdiction.
  - s. Testing and inspecting requirements.
  - t. Required performance results.
  - u. Protection of construction and personnel.
3. Record significant conference discussions, agreements, and disagreements.

4. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.
- D. Progress Meetings: Conduct progress meetings at intervals agreed to by the Owner and Architect. Coordinate dates of meetings with preparation of payment requests.
1. Attendees: In addition to representatives of Owner and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
  2. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
    - a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's Construction Schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
    - b. Review present and future needs of each entity present, including the following:
      - 1) Interface requirements.
      - 2) Sequence of operations.
      - 3) Status of submittals.
      - 4) Deliveries.
      - 5) Off-site fabrication.
      - 6) Access.
      - 7) Site utilization.
      - 8) Temporary facilities and controls.
      - 9) Work hours.
      - 10) Hazards and risks.
      - 11) Progress cleaning.
      - 12) Quality and work standards.
      - 13) Changes in the Work.
      - 14) Documentation of information for payment requests.
  3. Reporting: Distribute minutes of the meeting to each party present and to parties who should have been present. Include a brief summary, in narrative form, of progress since the previous meeting and report.
    - a. Schedule Updating: Revise Contractor's Construction Schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.
- E. Coordination Meetings: Conduct Project coordination meetings at weekly intervals. Project coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and preinstallation conferences.

1. Attendees: Representatives of Owner and Architect may attend coordination meetings, Representatives of each subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
2. Agenda: Review and correct or approve minutes of the previous coordination meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
  - a. Combined Contractor's Construction Schedule: Review progress since the last coordination meeting. Determine whether each contract is on time, ahead of schedule, or behind schedule, in relation to Combined Contractor's Construction Schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
  - b. Schedule Updating: Revise Combined Contractor's Construction Schedule after each coordination meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with report of each meeting.
  - c. Review present and future needs of each contractor present, including the following:
    - 1) Interface requirements.
    - 2) Sequence of operations.
    - 3) Status of submittals.
    - 4) Deliveries.
    - 5) Off-site fabrication.
    - 6) Access.
    - 7) Site utilization.
    - 8) Temporary facilities and controls.
    - 9) Work hours.
    - 10) Hazards and risks.
    - 11) Progress cleaning.
    - 12) Quality and work standards.
    - 13) Changes in the Work.
3. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01310





## SECTION 01320 - CONSTRUCTION PROGRESS DOCUMENTATION

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:

1. Preliminary Construction Schedule.
2. Contractor's Construction Schedule.
3. Submittals Schedule.
4. Daily construction reports.
5. Material location reports.
6. Field condition reports.
7. Special reports.
8. Construction photographs.

- B. Related Sections include the following:

1. Division 1 Section "Payment Procedures" for submitting the Schedule of Values.
2. Division 1 Section "Project Management and Coordination" for submitting and distributing meeting and conference minutes.
3. Division 1 Section "Submittal Procedures" for submitting schedules and reports.
4. Division 1 Section "Quality Requirements" for submitting a schedule of tests and inspections.
5. Division 1 Section "Closeout Procedures" for submitting photographic negatives as Project Record Documents at Project closeout.

#### 1.3 SUBMITTALS

- A. Submittals Schedule: Submit three copies of schedule. Arrange the following information in a tabular format:

1. Scheduled date for first submittal.
2. Specification Section number and title.
3. Submittal category (action or informational).
4. Name of subcontractor.
5. Description of the Work covered.
6. Scheduled date for Architect's final release or approval.

- B. Preliminary Construction Schedule: Submit two printed copies; one a single sheet of reproducible media, and one a print.
- C. Contractor's Construction Schedule: Submit two printed copies of initial schedule, one a reproducible print and one a blue- or black-line print, large enough to show entire schedule for entire construction period.
- D. Daily Construction Reports: Submit two copies at weekly intervals.
- E. Material Location Reports: Submit two copies at monthly intervals.
- F. Field Condition Reports: Submit two copies at time of discovery of differing conditions.
- G. Special Reports: Submit two copies at time of unusual event.

#### 1.4 COORDINATION

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

### PART 2 - PRODUCTS

#### 2.1 SUBMITTALS SCHEDULE

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

## 2.2 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

- A. Time Frame: Extend schedule from date established for commencement of the Work to date of Substantial Completion.
- B. Activities: Treat each story or separate area as a separate numbered activity for each principal element of the Work. Comply with the following:
  - 1. Activity Duration: Define activities so no activity is longer than 20 days, unless specifically allowed by Architect.
  - 2. Procurement Activities: Include procurement process activities for long lead items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
  - 3. Submittal Review Time: Include review and resubmittal times indicated in Division 1 Section "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's Construction Schedule with Submittals Schedule.
  - 4. Startup and Testing Time: Include a reasonable number of days for startup and testing.
  - 5. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect's and Construction Manager's administrative procedures necessary for certification of Substantial Completion.
- C. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.
  - 1. Owner-Furnished Products: Include a separate activity for each product. Delivery dates indicated stipulate the earliest possible delivery date.
  - 2. Area Separations: Identify each major area of construction for each major portion of the Work. Indicate where each construction activity within a major area must be sequenced or integrated with other construction activities to provide for the following:
    - a. Structural completion.
    - b. Permanent space enclosure.
    - c. Completion of mechanical installation.
    - d. Completion of electrical installation.
    - e. Substantial Completion.
- D. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the date for the commencement of the Work indicated in the Notice to Proceed, interim milestones indicated below, Substantial Completion, and Final Completion.
  - 1. Startup and testing of Owner furnished equipment.
- E. Cost Correlation: At the head of schedule, provide a cost correlation line, indicating planned and actual costs. On the line, show dollar volume of the Work performed as of dates used for preparation of payment requests.

1. Refer to Division 1 Section "Payment Procedures" for cost reporting and payment procedures.

## 2.3 PRELIMINARY CONSTRUCTION SCHEDULE

- A. Bar-Chart Schedule: Submit preliminary horizontal bar-chart-type construction schedule within seven days of date established for commencement of the Work.
- B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line. Outline significant construction activities for first 60 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.

## 2.4 CONTRACTOR'S CONSTRUCTION SCHEDULE (GANTT CHART)

- A. Gantt-Chart Schedule: Submit a comprehensive, fully developed, horizontal Gantt-chart-type, Contractor's Construction Schedule within 30 days of date established for commencement of the Work. Base schedule on the Preliminary Construction Schedule and whatever updating and feedback was received since the start of Project.
- B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line.
  1. For construction activities that require 3 months or longer to complete, indicate an estimated completion percentage in 10 percent increments within time bar.

## 2.5 REPORTS

- A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:
  1. List of subcontractors at Project site.
  2. List of separate contractors at Project site.
  3. Approximate count of personnel at Project site.
  4. High and low temperatures and general weather conditions.
  5. Accidents.
  6. Meetings and significant decisions.
  7. Unusual events (refer to special reports).
  8. Stoppages, delays, shortages, and losses.
  9. Meter readings and similar recordings.
  10. Emergency procedures.
  11. Orders and requests of Authorities Having Jurisdiction.
  12. Changes in the Work received and implemented.
  13. Construction Change Directives received.
  14. Services connected and disconnected.
  15. Equipment or system tests and startups.
  16. Partial Completions and occupancies.
  17. Substantial Completions authorized.

- B. Material Location Reports: At monthly intervals, prepare a comprehensive list of materials delivered to and stored at Project site. List shall be cumulative, showing materials previously reported plus items recently delivered. Include with list a statement of progress on and delivery dates for materials or items of equipment fabricated or stored away from Project site.
- C. Field Condition Reports: Immediately on discovery of a difference between field conditions and the Contract Documents, prepare a detailed report. Submit with a request for information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

## 2.6 SPECIAL REPORTS

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

## 2.7 CONSTRUCTION PHOTOGRAPHS

- A. Provide photographs of construction throughout progress of Work.
- B. Submit photographs with each Application for Payment.
- C. Photographs: color, matte; 8 x 10 inch size; mounted on 8-1/2 x 11 inch soft card stock.
- D. Take exterior site photographs from differing directions and interior photographs indicating relative progress of the Work, 3 days maximum prior to submitting.
- E. Identify each print on front. Identify name of Project, orientation of view, date and time of view.

## PART 3 - EXECUTION

### 3.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

- A. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.
  - 1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
  - 2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
  - 3. As the Work progresses, indicate Actual Completion percentage for each activity.

- B. Distribution: Distribute copies of approved schedule to Architect, Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.
1. Post copies in Project meeting rooms and temporary field offices.
  2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

END OF SECTION 01320

## SECTION 01330 - SUBMITTAL PROCEDURES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other miscellaneous submittals.
- B. Related Sections include the following:
  - 1. Division 1 Section "Quality Requirements" for submitting test and inspection reports and Delegated-Design Submittals and for erecting mockups.

#### 1.3 DEFINITIONS

- A. Action Submittals: Written and graphic information that requires Architect's responsive action.
- B. Informational Submittals: Written information that does not require Architect's approval. Submittals may be rejected for not complying with requirements.

#### 1.4 SUBMITTAL PROCEDURES

- A. General: Electronic copies of CAD Drawings of the Contract Drawings will not be provided by Architect for Contractor's use in preparing submittals.
- B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
  - 1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
  - 2. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
    - a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- C. Submittals Schedule: Comply with requirements in Division 1 Section "Construction Progress Documentation" for list of submittals and time requirements for scheduled performance of related construction activities.



- D. Processing Time: Allow enough time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal.
1. Initial Review: Allow 15 days for initial review of each submittal. Allow additional time if processing must be delayed to permit coordination with subsequent submittals. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
  2. If intermediate submittal is necessary, process it in same manner as initial submittal.
  3. Allow 15 days for processing each resubmittal.
  4. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing.
- E. Identification: Place a permanent label or title block on each submittal for identification.
1. Indicate name of firm or entity that prepared each submittal on label or title block.
  2. Provide a space approximately 4 by 5 inches on label or beside title block to record Contractor's review and approval markings and action taken by Architect.
  3. Include the following information on label for processing and recording action taken:
    - a. Project name.
    - b. Date.
    - c. Name and address of Architect.
    - d. Name and address of Contractor.
    - e. Name and address of subcontractor.
    - f. Name and address of supplier.
    - g. Name of manufacturer.
    - h. Unique identifier, including revision number.
    - i. Number and title of appropriate Specification Section.
    - j. Drawing number and detail references, as appropriate.
    - k. Other necessary identification.
- F. Deviations: Highlight, encircle, or otherwise identify deviations from the Contract Documents on submittals.
- G. Additional Copies: Unless additional copies are required for final submittal, and unless Architect observes noncompliance with provisions of the Contract Documents, initial submittal may serve as final submittal.
1. Additional copies submitted for maintenance manuals will be marked with action taken and will be returned.
- H. Transmittal: Package each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. Architect will return submittals, without review, received from sources other than Contractor.
1. Transmittal Form: Use AIA Document G810 or Contractor's standard form, if acceptable to Architect.
  2. Transmittal Form: Provide locations on form for the following information:

- a. Project name.
  - b. Date.
  - c. Destination (To:).
  - d. Source (From:).
  - e. Names of subcontractor, manufacturer, and supplier.
  - f. Category and type of submittal.
  - g. Submittal purpose and description.
  - h. Submittal and transmittal distribution record.
  - i. Remarks.
  - j. Signature of transmitter.
- I. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
  - J. Use for Construction: Use only final submittals with mark indicating action taken by Architect in connection with construction.

## PART 2 - PRODUCTS

### 2.1 ACTION SUBMITTALS

- A. General: Prepare and submit Action Submittals required by individual Specification Sections.
  - 1. Number of Copies: Submit seven copies of each submittal, unless otherwise indicated. Architect will return four copies. Retain one returned copy as a Project Record Document.
    - a. Initial Submittal: Submit a preliminary single copy of each submittal where selection of options, color, pattern, texture, or similar characteristics is required. Architect will return submittal with options selected.
- B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
  - 1. If information must be specially prepared for submittal because standard printed data are not suitable for use, submit as Shop Drawings, not as Product Data.
  - 2. Mark each copy of each submittal to show which products and options are applicable.
  - 3. Include the following information, as applicable:
    - a. Manufacturer's written recommendations.
    - b. Manufacturer's product specifications.
    - c. Manufacturer's installation instructions.
    - d. Standard color charts.
    - e. Manufacturer's catalog cuts.
    - f. Wiring diagrams showing factory-installed wiring.
    - g. Printed performance curves.
    - h. Operational range diagrams.
    - i. Mill reports.

- j. Standard product operating and maintenance manuals.
  - k. Compliance with recognized trade association standards.
  - l. Compliance with recognized testing agency standards.
  - m. Application of testing agency labels and seals.
  - n. Notation of coordination requirements.
- C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.
- 1. Preparation: Include the following information, as applicable:
    - a. Dimensions.
    - b. Identification of products.
    - c. Fabrication and installation drawings.
    - d. Roughing-in and setting diagrams.
    - e. Wiring diagrams showing field-installed wiring, including power, signal, and control wiring.
    - f. Shop manufacturing instructions.
    - g. Templates and patterns.
    - h. Schedules.
    - i. Design calculations.
    - j. Compliance with specified standards.
    - k. Notation of coordination requirements.
    - l. Notation of dimensions established by field measurement.
  - 2. Wiring Diagrams: Differentiate between manufacturer-installed and field-installed wiring.
  - 3. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches but no larger than 30 by 40 inches.
  - 4. Number of Copies: Submit one correctable, translucent, reproducible print and three blue- or black-line print of each submittal. Architect will return the reproducible print and one blue- or black-line print. Retain returned print as a Project Record Drawing.
- D. Coordination Drawings: Comply with requirements in Division 1 Section "Project Management and Coordination."
- E. Samples: Prepare physical units of materials or products, including the following:
- 1. Comply with requirements in Division 1 Section "Quality Requirements" for mockups.
  - 2. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.
  - 3. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from the same material to be used for the Work, cured and finished in manner specified, and physically identical with the product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.

4. Preparation: Mount, display, or package Samples in manner specified to facilitate review of qualities indicated. Prepare Samples to match Architect's sample where so indicated. Attach label on unexposed side that includes the following:
    - a. Generic description of Sample.
    - b. Product name or name of manufacturer.
    - c. Sample source.
  5. Submit Samples for review of kind, color, pattern, and texture for a final check of these characteristics with other elements and for a comparison of these characteristics between final submittal and actual component as delivered and installed.
    - a. Refer to individual Specification Sections for requirements for Samples that illustrate workmanship, fabrication techniques, details of assembly, connections, operation, and similar construction characteristics.
  6. Number of Samples for Initial Selection: Submit one full set of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected.
  7. Number of Samples for Verification: Submit three sets of Samples. Architect will retain one Sample set; remainder will be returned. Retain one returned Sample set as a Project Record Sample.
  8. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
    - a. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
- F. Delegated-Design Submittal: Comply with requirements in Division 1 Section "Quality Requirements."
- G. Submittals Schedule: Comply with requirements in Division 1 Section "Construction Progress Documentation."
- H. Application for Payment: Comply with requirements in Division 1 Section "Payment Procedures."
- I. Schedule of Values: Comply with requirements in Division 1 Section "Payment Procedures."

## 2.2 INFORMATIONAL SUBMITTALS

- A. General: Prepare and submit Informational Submittals required by other Specification Sections.
1. Number of Copies: Submit two copies of each submittal, unless otherwise indicated. Architect will not return copies.
  2. Certificates and Certifications: Provide a notarized statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.

3. Test and Inspection Reports: Comply with requirements in Division 1 Section "Quality Requirements."
- B. Contractor's Construction Schedule: Comply with requirements in Division 1 Section "Construction Progress Documentation."
- C. Maintenance Data: Prepare written and graphic instructions and procedures for operation and normal maintenance of products and equipment. Comply with requirements in Division 1 Section "Closeout Procedures."
- D. Design Data: Prepare written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.
- E. Manufacturer's Instructions: Prepare written or published information that documents manufacturer's recommendations, guidelines, and procedures for installing or operating a product or equipment. Include name of product and name, address, and telephone number of manufacturer. Include the following, as applicable:
  1. Preparation of substrates.
  2. Required substrate tolerances.
  3. Sequence of installation or erection.
  4. Required installation tolerances.
  5. Required adjustments.
  6. Recommendations for cleaning and protection.
- F. Manufacturer's Field Reports: Prepare written information documenting factory-authorized service representative's tests and inspections. Include the following, as applicable:
  1. Name, address, and telephone number of factory-authorized service representative making report.
  2. Statement on condition of substrates and their acceptability for installation of product.
  3. Statement that products at Project site comply with requirements.
  4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
  5. Results of tests and a statement of whether observed performance complies with requirements.
  6. Statement whether conditions, products, and installation will affect warranty.
  7. Other required items indicated in individual Specification Sections.
- G. Construction Photographs: Comply with requirements in Division 1 Section "Construction Progress Documentation."
- H. Material Safety Data Sheets: Submit information directly to Owner. If submitted to Architect, Architect will not review this information but will return it with no action taken.

## PART 3 - EXECUTION

### 3.1 CONTRACTOR'S REVIEW

- A. Review each submittal and check for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.
- B. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

### 3.2 ARCHITECT'S ACTION

- A. General: Architect will not review submittals that do not bear Contractor's approval stamp and will return them without action.
- B. Action Submittals: Architect will review each submittal, make marks to indicate corrections or modifications required, and return it. Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action taken.
- C. Informational Submittals: Architect will review each submittal and will not return it, or will reject and return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.
- D. Submittals not required by the Contract Documents will not be reviewed and may be discarded.

END OF SECTION 01330



## SECTION 01335 - STRUCTURAL SUBMITTALS

### PART 1 - GENERAL

#### 1.1 SECTION INCLUDES

- A. Structural submittals include shop drawings, design calculations, diagrams, illustrations, schedules, performance charts, nomenclature charts, samples, brochures and other data prepared by the Contractor or any subcontractor, manufacturer, supplier, fabricator, or distributor and which illustrate some portion of the Project.
- B. Submittals by the Contractor are not a part of the Contract Documents.

#### 1.2 RELATED SECTIONS

- A. Section 01330 - Submittal Procedures.

#### 1.3 SUBMITTAL PROCEDURES

- A. Submittals shall be accompanied by a transmittal letter with the following information:
  - 1. Project name.
  - 2. Contractor's name.
  - 3. Date submitted.
  - 4. Description of items submitted; identify work and product by Specification Section.
  - 5. Number of drawings and other pertinent data.
- B. Provide blank space on each submittal for the Architect/Structural Engineer's review stamp.
- C. Submit one sepia and two prints of each shop drawing and three copies of other structural submittals.
- D. Contractor shall direct specific attention on the submittal to any deviation from the Contract Documents.
- E. Electronic submittals shall comply with the following standards:
  - 1. Structural submittals made in electronic format must be in a generally accepted format that can be viewed by Adobe Reader or similar, and capable of receiving comments and notations in Adobe Writer 7.0. When creating the file, no permissions should be restricted - All actions should be ALLOWED. Send electronic files to the following email address and copy the Structural Engineer: [shopdrawings@sdl-nash.com](mailto:shopdrawings@sdl-nash.com)
  - 2. All structural submittals made in electronic format with an original size that is larger than 8 1/2" x 11" must be accompanied by one (1) hard copy for review and use by the Structural Engineer.



#### 1.4 CONTRACTOR RESPONSIBILITY

- A. Contractor shall make all submittals in advance of installation or construction to allow the Architect/Structural Engineer sufficient time for review.
- B. Contractor shall stamp and sign each sheet of shop drawings and product data, and sign or initial each sample to certify compliance with requirements of Contract Documents. SUBMITTALS RECEIVED WITHOUT THE CONTRACTOR'S STAMP OF REVIEW WILL BE RETURNED TO THE CONTRACTOR FOR REVIEW AND RESUBMITTAL.
- C. Contractor shall understand that the submittal of the required documents does not constitute compliance with the requirements of the Contract Documents; only submittals reviewed by the Architect/Structural Engineer constitute compliance.
- D. It is the Contractor's responsibility to furnish equipment, materials, and labor for the Project which meets the requirements of the codes and authorities quoted as well as the Contract Documents. Proprietary items specified herein only establish a minimum functional and aesthetic standard and it is incumbent upon the Contractor to ascertain conformance of these proprietary items or any proposed substitution with the codes and authorities.
- E. By reviewing, approving and submitting shop drawings, product data, or samples, Contractor thereby represents that he has determined and verified all field measurements, field construction criteria, materials, member sizes catalog numbers, and similar data and that he has checked and coordinated shop drawings with the requirements of the Project and of the Contract Documents.
- F. Work requiring shop drawings, whether called for by the Contract Documents or requested by the Contractor, shall not commence until the submission has been reviewed by the Architect/Structural Engineer. Work may commence if the Contractor verifies the accuracy of the Architect/Structural Engineer's corrections and notations and complies with them without exception and without requesting change in Contract Sum or Contract Time.

#### 1.5 ARCHITECT/STRUCTURAL ENGINEER REVIEW

- A. Architect/Structural Engineer will review submittals with reasonable promptness. For scheduling purposes, allow 10 business days in Structural Engineer's office exclusive of delivery time.
- B. Architect/Structural Engineer's review or corrections refer only to the general arrangement and conformance of the subject of the submittals with the design concept of the project and with the information given in the Contract Documents. Under no conditions should the Contractor consider the review to include the dimensions, quantities, and details of the items nor the approval of an assembly in which the item functions.
- C. Architect/Structural Engineer's review shall not relieve the Contractor from responsibility for errors or omissions in the submittals.

- D. Architect/Structural Engineer's review of submittals shall not relieve the Contractor of responsibility for any deviation from the requirements of the Contract Documents unless the Contractor has directed specific attention to the deviation at the time of submission and the Architect/Structural Engineer has given written approval to the specific deviation.
- E. Architect/Structural Engineer's review of submittals shall not be construed as authorizing any change in the Contract Sum or Contract Time.

#### 1.6 SHOP DRAWINGS

- A. Present in a clear and thorough manner. Title each drawing with Project name and number; identify each element of drawings by reference to sheet number and detail of Contract Documents.
- B. All shop drawings shall list the Contract Documents used in their production (date, title, revision number, etc.).
- C. Reproduction of Structural Drawings for shop drawings is not permitted.
- D. Identify field dimensions; show relationship to adjacent or critical features of Work or products.
- E. Electronic shop drawings submitted shall meet the requirements of Section 1.03.
- F. A copy of the marked structural shop drawings with the Architect/Structural Engineer's review stamp is to be maintained at the job site. If electronic shop drawings are being used, a hard copy with all final markups is to be maintained at the job site.

#### 1.7 PRODUCT DATA

- A. Submit only pages which are pertinent; mark each copy of standard printed data to identify pertinent products, referenced to Specification Section and Article number. Show reference standards, performance characteristics, and capacities; wiring and piping diagrams and controls; component parts; finishes; dimensions; and required clearances.
- B. Modify manufacturer's standard schematic drawings and diagrams to supplement standard information and to provide information specifically applicable to the work. Delete information which is not applicable.
- C. Provide manufacturer's preparation, assembly, and installation instructions.

#### 1.8 SAMPLES

- A. Submit full range of manufacturer's standard finishes except where more restrictive requirements are specified, indicating colors, textures, and patterns.
- B. Submit samples to illustrate functional characteristics of products, including parts and attachments as required by Architect/Structural Engineer.
- C. Approved samples which are of proper size may be incorporated in Work.
- D. Label each sample with identification.

- E. Field Finishes: Provide full samples at Project, at location acceptable to Architect/Structural Engineer, as required by individual Specification Section. Install each sample complete and finished. Acceptable finishes in place may be retained in completed work.

#### 1.9 RESUBMITTALS

- A. When submittals are returned to the Contractor with the Architect/Structural Engineer's corrections the Contractor shall make the required corrections. Upon request, resubmit one corrected set.
- B. Contractor shall direct specific attention on the resubmittal to all revisions including those requested by the Architect/Structural Engineer on previous submission.

#### 1.10 DISTRIBUTION

- A. Distribute reproductions of shop drawings, copies of product data, and samples which bear the Architect/Structural Engineer's review stamp to job site file, Record Documents file, subcontractors, suppliers, other affected contractors, and other entities requiring information.
- B. Only reviewed shop drawings are considered acceptable for use during construction.

#### 1.11 SEISMIC INFORMATION

- A. Submit seismic data in accordance with the Seismic Submittal Information given in Appendix I.

#### PART 2 - PRODUCTS

Not Used.

#### PART 3 - EXECUTION

Not Used.

END OF SECTION 01335

APPENDIX I  
SEISMIC SUBMITTAL INFORMATION

1.1 PREFACE

A. Items of equipment incorporated in, and installed in or on the building shall be fabricated and installed to resist vertical loads and lateral forces stated in the Uniform Building Code, 1997 Edition.

B. Project has the following Seismic Coefficients:

Seismic Zone:	3
Seismic Importance Factor:	1.0
C(v):	0.54
C(a):	0.36

1.2 SUBMITTAL DATA REQUIRED

A. In order to provide adequate information to the Owner for proper review and evaluation of adequacy of equipment and non-structural items, submit the following information with shop drawings and product data.

1. Certificate from the manufacturers stating that the items furnished by them will maintain unit integrity by resisting lateral forces using the appropriate code required coefficients.
2. Dimensions and details of each piece of equipment, weight of each piece, and its approximate center of gravity.
3. Size and dimensions of supporting assembly structures and the identification of each of its members including secondary elements used as stiffeners and connectors.
4. Calculations prepared and signed by a licensed structural engineer in the Project state to indicate the adequacy of the structures to resist the code mandated vertical loads and lateral forces.

1.3 POSSIBLE BACK CHARGES TO CONTRACTOR

A. If the submittals for equipment and non-structural elements do not contain the data required, they will be returned without action for resubmission with required data. If the submittals are returned to Owner with incomplete or insufficient data which may cause extra work to the Owner or his consultants, the Owner will charge the Contractor for such extra work at the rate of 2.5 times direct personnel expense plus the cost of direct expenses.

END OF APPENDIX I



## SECTION 01400 - QUALITY REQUIREMENTS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
  - 1. Specific quality-control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
  - 2. Specified tests, inspections, and related actions do not limit Contractor's quality-control procedures that facilitate compliance with the Contract Document requirements.
  - 3. Requirements for Contractor to provide quality-control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.
- C. Related Sections include the following:
  - 1. Division 1 Section "Cutting and Patching" for repair and restoration of construction disturbed by testing and inspecting activities.
  - 2. Divisions 2 through 16 Sections for specific test and inspection requirements.

#### 1.3 DEFINITIONS

- A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and ensure that proposed construction complies with requirements.
- B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that completed construction complies with requirements. Services do not include contract enforcement activities performed by Architect.
- C. Mockups: Full-size, physical example assemblies to illustrate finishes and materials. Mockups are used to verify selections made under Sample submittals, to demonstrate aesthetic effects and, where indicated, qualities of materials and execution, and to review construction, coordination, testing, or operation; they are not Samples. Mockups establish the standard by which the Work will be judged.

- D. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.

#### 1.4 DELEGATED DESIGN

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
  - 1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.

#### 1.5 SUBMITTALS

- A. Delegated-Design Submittal: In addition to Shop Drawings, Product Data, and other required submittals, submit a statement, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional, indicating that the products and systems are in compliance with performance and design criteria indicated. Include list of codes, loads, and other factors used in performing these services.
- B. Reports: Prepare and submit certified written reports that include the following:
  - 1. Date of issue.
  - 2. Project title and number.
  - 3. Name, address, and telephone number of testing agency.
  - 4. Dates and locations of samples and tests or inspections.
  - 5. Names of individuals making tests and inspections.
  - 6. Description of the Work and test and inspection method.
  - 7. Identification of product and Specification Section.
  - 8. Complete test or inspection data.
  - 9. Test and inspection results and an interpretation of test results.
  - 10. Ambient conditions at time of sample taking and testing and inspecting.
  - 11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
  - 12. Name and signature of laboratory inspector.
  - 13. Recommendations on retesting and reinspecting.
- C. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

#### 1.6 QUALITY ASSURANCE

- A. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

- B. **Factory-Authorized Service Representative Qualifications:** An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- C. **Installer Qualifications:** A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
- D. **Professional Engineer Qualifications:** A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar to those indicated for this Project in material, design, and extent.
- E. **Mockups:** Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:
  - 1. Build mockups in location and of size indicated or, if not indicated, as directed by Architect. .
  - 2. Notify Architect seven days in advance of dates and times when mockups will be constructed.
  - 3. Demonstrate the proposed range of aesthetic effects and workmanship.
  - 4. Obtain Architect's approval of mockups before starting work, fabrication, or construction.
  - 5. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
  - 6. Demolish and remove mockups when directed, unless otherwise indicated.

## 1.7 QUALITY CONTROL

- A. **Contractor Responsibilities:** Quality-control services are indicated as Contractor's responsibility, Contractor will engage a qualified testing agency to perform these services.
  - 1. Contractor will engage a testing agency and pay for quality-control testing.
  - 2. Contractor will furnish Owner with names, addresses, and telephone numbers of testing agencies engaged and a description of the types of testing and inspecting they are engaged to perform.
  - 3. Testing agency will notify Architect and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
  - 4. Testing agency will submit a certified written report of each test, inspection, and similar quality-control service to Architect with copy to Contractor and to Authorities Having Jurisdiction.
  - 5. Testing agency will submit a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
  - 6. Testing agency will interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.
  - 7. Testing agency will retest and reinspect corrected work.



- B. **Manufacturer's Field Services:** Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing.
- C. **Retesting/Reinspecting:** Provide quality-control services, including retesting and reinspecting, for construction that revised or replaced Work that failed to comply with requirements established by the Contract Documents.
- D. **Associated Services:** Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
  - 1. Access to the Work.
  - 2. Incidental labor and facilities necessary to facilitate tests and inspections.
  - 3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
  - 4. Facilities for storage and field-curing of test samples.
  - 5. Preliminary design mix proposed for use for material mixes that require control by testing agency.
  - 6. Security and protection for samples and for testing and inspecting equipment at Project site.
- E. **Coordination:** Coordinate sequence of activities to accommodate required quality-assurance and quality-control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
  - 1. Schedule times for tests, inspections, obtaining samples, and similar activities.

## PART 2 - PRODUCTS (Not Used)

## PART 3 - EXECUTION

### 3.1 REPAIR AND PROTECTION

- A. **General:** On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
  - 1. Provide materials and comply with installation requirements specified in other Sections of these Specifications. Restore patched areas and extend restoration into adjoining areas in a manner that eliminates evidence of patching.
  - 2. Comply with the Contract Document requirements for Division 1 Section "Cutting and Patching."
- B. Protect construction exposed by or for quality-control service activities.
- C. Repair and protection are indicated as Contractor's responsibility.

END OF SECTION 01400

## SECTION 01410 - STRUCTURAL TESTING/INSPECTION AGENCY SERVICES

### PART 1 - GENERAL

#### 1.1 SECTION INCLUDES

- A. Section summarizes the responsibility of the Contractor and the Structural Testing/Inspection Agency in the performance of the testing/inspection specified in the Contract Documents.
- B. Neither the observation of the Architect/Structural Engineer in the administration of the contract, nor tests/inspections by the Testing/Inspection Agency, nor approvals by persons other than the Architect/Structural Engineer shall relieve the Contractor from his obligation to perform the work in accordance with the Contract Documents.

#### 1.2 RELATED SECTIONS

- A. Section 01335 - Structural Submittals.
- B. Section 01400 - Quality Requirements.

#### 1.3 REFERENCES

- A. ASTM D3740 - Practice for Evaluation of Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.
- B. ASTM E329 - Recommended Practice for Inspection and Testing Agencies for Concrete, Steel, and Bituminous Materials as Used in Construction.
- C. American Council of Independent Laboratories - Recommended Requirements for Independent Laboratories Qualifications.

#### 1.4 SELECTION AND PAYMENT

- A. Contractor will employ and pay for the structural testing/inspection services that are required by the Contract Documents.
- B. Contractor shall pay for any additional structural testing/inspection required for work or materials not complying with Contract Documents due to negligence or nonconformance.
- C. Contractor shall pay for any additional structural testing/inspection required for his convenience.

## 1.5 CONTRACTOR SUBMITTALS

- A. Prior to start of work, submit name of Structural Testing/Inspection Agency, address, telephone number, fax number, and names and qualifications of technicians, inspectors, and engineers who will be working on this project.
- B. If multiple Structural Testing/Inspection Agencies are used, submit the information stated above for each firm along with a statement of the testing/inspection responsibilities for each firm.

## 1.6 STRUCTURAL TESTING/INSPECTION REQUIREMENT SUMMARY

- A. Specific structural testing/inspection requirements are given in the following specification sections:
  - Section 02221 - Excavating, Backfilling, and Compacting for Structures
  - Section 03200 - Concrete Reinforcement
  - Section 03300 - Cast-in-Place Concrete
  - Section 03600 - Non-Shrink Grout
  - Section 05100 - Structural Steel
  - Section 05300 - Steel Decking
  - Section 05400 - Cold-Formed Structural Steel

## 1.7 STRUCTURAL TESTING/INSPECTION AGENCY'S QUALIFICATIONS

- A. Provide personnel with a minimum of two years' experience and qualified to perform the structural testing/inspection required by the Contract Documents.
- B. Comply with the American Council of Independent Laboratories' recommended requirements.
- C. Comply with ASTM E329.
- D. Maintain properly calibrated equipment; calibrated within the past 12 months with devices of accuracy traceable to either National Bureau of Standards (NBS) Standards or accepted values of natural physical constants.

## PART 2 - MATERIALS

Not Used.

## PART 3 - EXECUTION

### 3.1 STRUCTURAL PRECONSTRUCTION MEETING

- A. A structural preconstruction meeting may be conducted at the construction site by the Structural Engineer to discuss quality issues. The parties involved may be the Architect, Contractor, Structural Testing/Inspection Agency, appropriate subcontractors, suppliers, and detailers.

### 3.2 STRUCTURAL TESTING/INSPECTION AGENCY'S RESPONSIBILITIES

- A. Cooperate with the Contractor and provide timely service.
- B. Upon arriving at the construction site, sign in and notify the Contractor of presence.
- C. Select the representative samples that are to be tested/inspected.
- D. Perform tests/inspections as outlined in Contract Documents, the applicable codes, and as directed by the Structural Engineer.
- E. Report work and materials not complying with Contract Documents immediately to the Contractor and Structural Engineer.
- F. Leave copies of field notes with the Contractor prior to leaving the construction site. Field notes shall include the message given to the Contractor, date, time of message, name of Contractor's representative informed, type and location of work or materials tested/inspected, whether the work or materials complies with Contract Documents and name of the Structural Testing/Inspection Agency's representative.
- G. Report and distribute results of tests/inspections promptly in the form of written reports. Copies of the reports for this project will be furnished to the Owner, Contractor, Architect, Structural Engineer, and the Local Building Authorities.
- H. Structural Testing/Inspection Agency shall not alter requirements of Contract Documents, approve or reject any portion of the work, or perform duties of the Contractor.

### 3.3 CONTRACTOR'S RESPONSIBILITIES

- A. Provide copy of Contract Documents to the Structural Testing/Inspection Agency.
- B. Arrange the preconstruction meeting to discuss quality issues.
- C. Notify the Structural Testing/Inspection Agency sufficiently in advance of operations to allow assignment of personnel and scheduling of tests.
- D. Cooperate with Structural Testing/Inspection Agency and provide access to work.
- E. Provide samples of materials to be tested in required quantities.
- F. Furnish copies of mill test reports when requested.
- G. Provide storage space for Structural Testing/Inspection Agency's exclusive use, such as for storing and curing concrete testing samples.
- H. Provide labor to assist the Structural Testing/Inspection Agency in performing tests/inspections.

END OF SECTION 01410



## SECTION 01420 - REFERENCES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 DEFINITIONS

- A. General: Basic Contract definitions are included in the Conditions of the Contract.
- B. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.
- C. "Directed": A command or instruction by Architect. Other terms including "requested," "authorized," "selected," "approved," "required," and "permitted" have the same meaning as "directed."
- D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."
- E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.
- F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- G. "Install": Operations at Project site including unloading, temporarily storing, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.
- H. "Provide": Furnish and install, complete and ready for the intended use.
- I. "Installer": Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.
  - 1. Using a term such as "carpentry" does not imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as "carpenter." It also does not imply that requirements specified apply exclusively to tradespeople of the corresponding generic name.

- J. "Experienced": When used with an entity, "experienced" means having successfully completed a minimum of five previous projects similar in size and scope to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.
- K. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

### 1.3 INDUSTRY STANDARDS

- A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.
- B. Publication Dates: Comply with standards in effect as of date of the Contract Documents, unless otherwise indicated.
- C. Conflicting Requirements: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer uncertainties and requirements that are different, but apparently equal, to Architect for a decision before proceeding.
  - 1. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.
- D. Copies of Standards: Each entity engaged in construction on Project must be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.
  - 1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source and make them available on request.

### 1.4 ABBREVIATIONS AND ACRONYMS

- A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities indicated in Gale Research's "Encyclopedia of Associations" or in Columbia Books' "National Trade & Professional Associations of the U.S."

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01420





## SECTION 01500 - TEMPORARY FACILITIES AND CONTROLS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes requirements for temporary facilities and controls, including temporary utilities, support facilities, and security and protection facilities.
- B. Temporary utilities include, but are not limited to, the following:
  - 1. Water service and distribution.
  - 2. Sanitary facilities, including toilets, wash facilities, and drinking-water facilities.
  - 3. Ventilation.
  - 4. Electric power service.
  - 5. Lighting.
  - 6. Telephone service.
- C. Support facilities include, but are not limited to, the following:
  - 1. Dewatering facilities and drains.
  - 2. Project identification and temporary signs.
  - 3. Waste disposal facilities.
  - 4. Field offices.
  - 5. Lifts and hoists.
  - 6. Construction aids and miscellaneous services and facilities.
- D. Security and protection facilities include, but are not limited to, the following:
  - 1. Environmental protection.
  - 2. Site enclosure fence.
  - 3. Security enclosure and lockup.
  - 4. Barricades, warning signs, and lights.
  - 5. Covered walkways.
  - 6. Temporary enclosures.
  - 7. Temporary partitions.
  - 8. Fire protection.
- E. Related Sections include the following:
  - 1. Division 1 Section "Execution Requirements" for progress cleaning requirements.
  - 2. Divisions 2 through 16 for temporary heat, ventilation, and humidity requirements for products in those Sections.

### 1.3 DEFINITIONS

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

### 1.4 USE CHARGES

- A. General: Cost or use charges for temporary facilities are not chargeable to Owner or Architect and shall be included in the Contract Sum. Allow other entities to use temporary services and facilities without cost, including, but not limited to, the following:
  - 1. Architect.
  - 2. Testing agencies.
  - 3. Personnel of Authorities Having Jurisdiction.
- B. Water Service: Engage appropriate local utility company to install temporary service or connect to Owner's existing water system. Metering and payment of use charges will be further discussed during Pre-Bid Conference scheduled for \_\_\_\_\_ January \_\_, 2011.
- C. Electric Power Service: Engage appropriate local utility company to install temporary service or connect to Owner's existing system. Metering and payment of use charges will be further discussed during Pre-Bid Conference scheduled for \_\_\_\_\_ January \_\_, 2011

### 1.5 QUALITY ASSURANCE

- A. Standards: Comply with ANSI A10.6, NECA's "Temporary Electrical Facilities," and NFPA 241.
  - 1. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.
- B. Tests and Inspections: Arrange for Authorities Having Jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

### 1.6 PROJECT CONDITIONS

- A. Temporary Use of Permanent Facilities: Installer of each permanent service shall assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.
- B. Conditions of Use: The following conditions apply to use of temporary services and facilities by all parties engaged in the Work:
  - 1. Keep temporary services and facilities clean and neat.
  - 2. Relocate temporary services and facilities as required by progress of the Work.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. General: Provide new materials. Undamaged, previously used materials in serviceable condition may be used if approved by Architect. Provide materials suitable for use intended.
- B. Chain-Link Fencing: Minimum 2-inch, 0.148-inch- thick, galvanized steel, chain-link fabric fencing; minimum 6 feet high with galvanized steel pipe posts; minimum 2-3/8-inch- OD line posts and 2-7/8-inch- OD corner and pull posts, with 1-5/8-inch- OD top rails.
- C. Gypsum Board: Minimum 5/8 inch thick by 48 inches wide by maximum available lengths; regular-type panels with tapered edges. Comply with ASTM C 36, Type X.
- D. Insulation: Unfaced mineral-fiber blanket, manufactured from glass, slag wool, or rock wool; with maximum flame-spread and smoke-developed indices of 25 and 50, respectively.
- E. Tarpaulins: Fire-resistive labeled with flame-spread rating of 15 or less.
- F. Water: Potable.

### 2.2 EQUIPMENT

- A. General: Provide equipment suitable for use intended.
- B. Field Offices and Toilet Units: To be determined during Pre-Bid Conference scheduled for \_\_\_\_\_ January \_\_, 2011.
- C. Fire Extinguishers: Hand carried, portable, UL rated. Provide class and extinguishing agent as indicated or a combination of extinguishers of NFPA-recommended classes for exposures.
  - 1. Comply with NFPA 10 and NFPA 241 for classification, extinguishing agent, and size required by location and class of fire exposure.
- D. Electrical Outlets: Properly configured, NEMA-polarized outlets to prevent insertion of 110- to 120-V plugs into higher-voltage outlets; equipped with ground-fault circuit interrupters, reset button, and pilot light.
- E. Power Distribution System Circuits: Where permitted and overhead and exposed for surveillance, wiring circuits, not exceeding 125-V ac, 20-A rating, and lighting circuits may be nonmetallic sheathed cable.

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work and Owner's operations.

- B. Relocate and modify facilities as required and as previously approved by Owner.
- C. Provide each facility ready for use when needed to avoid delay. Maintain and modify as required. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

### 3.2 TEMPORARY UTILITY INSTALLATION

- A. General: Engage appropriate local utility company to install temporary service or connect to existing service. Where utility company provides only part of the service, provide the remainder with matching, compatible materials and equipment. Comply with utility company recommendations.
  - 1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.
  - 2. Provide adequate capacity at each stage of construction. Before temporary utility is available, provide trucked-in services.
- B. Water Service: Use of Owner's existing water service facilities will be permitted, as long as facilities are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore these facilities to condition existing before initial use.
  - 1. Provide rubber hoses as necessary to serve Project site.
  - 2. As soon as water is required at each level, extend service to form a temporary water- and fire-protection standpipe. Provide distribution piping. Space outlets so water can be reached with a 100-foot hose. Provide one hose at each outlet.
  - 3. Provide pumps to supply a minimum of 30-psi static pressure at highest point. Equip pumps with surge and storage tanks and automatic controls to supply water uniformly at reasonable pressures.
- C. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking-water fixtures. Comply with regulations and health codes for type, number, location, operation, and maintenance of fixtures and facilities.
  - 1. Disposable Supplies: Provide toilet tissue, paper towels, paper cups, and similar disposable materials for each facility. Maintain adequate supply. Provide covered waste containers for disposal of used material.
  - 2. Toilets: Shield toilets to ensure privacy. Provide separate facilities for male and female personnel.
  - 3. Wash Facilities: Install wash facilities supplied with potable water at convenient locations for personnel who handle materials that require wash up. Dispose of drainage properly. Supply cleaning compounds appropriate for each type of material handled.
    - a. Provide safety showers, eyewash fountains, and similar facilities for convenience, safety, and sanitation of personnel.
  - 4. Drinking-Water Facilities: Provide bottled-water, drinking-water units.
  - 5. Locate toilets and drinking-water fixtures so personnel need not walk more than 200 feet (60 m) horizontally to facilities.

- D. Ventilation and Humidity Control: Provide temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity. Select equipment from that specified that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.
- E. Electric Power Service: Use of Owner's existing electric power service will be permitted, as long as equipment is maintained in a condition acceptable to Owner.
- F. Electric Distribution: Provide receptacle outlets adequate for connection of power tools and equipment.
1. Provide waterproof connectors to connect separate lengths of electrical power cords if single lengths will not reach areas where construction activities are in progress. Do not exceed safe length-voltage ratio.
  2. Provide warning signs at power outlets other than 110 to 120 V.
- G. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations and traffic conditions.
1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.
- H. Telephone Service: Provide temporary telephone service throughout construction period for common-use facilities used by all personnel engaged in construction activities.
1. Provide additional telephone lines for the following:
    - a. In field office with more than two occupants, install a telephone for each additional occupant or pair of occupants.
    - b. Provide a dedicated telephone line for each facsimile machine and computer with modem in each field office.
  2. At each telephone, post a list of important telephone numbers.
    - a. Police and fire departments.
    - b. Ambulance service.
    - c. Contractor's home office.
    - d. Architect's office.
    - e. Engineers' offices.
    - f. Owner's office.
    - g. Principal subcontractors' field and home offices.
  3. Provide an answering machine on superintendent's telephone.
  4. Furnish superintendent with portable two-way radio for use when away from field office.
  5. Provide a portable mobile telephone for superintendent's use in making and receiving telephone calls when away from field office.

### 3.3 SUPPORT FACILITIES INSTALLATION

- A. General: Comply with the following:
  - 1. Locate field offices, storage sheds, sanitary facilities, and other temporary construction and support facilities for easy access.
  - 2. Maintain support facilities until near Substantial Completion. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.
- B. Dewatering: Maintain Project site, excavations, and construction free of water.
  - 1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining property nor endanger permanent Work or temporary facilities.
- C. Project Identification and Temporary Signs: Prepare Project identification and other signs in sizes indicated. Install signs where indicated to inform public and persons seeking entrance to Project. Do not permit installation of unauthorized signs.
  - 1. Engage an experienced sign painter to apply graphics for Project identification signs. Comply with details indicated.
  - 2. Prepare temporary signs to provide directional information to construction personnel and visitors.
  - 3. Construct signs of exterior-type Grade B-B high-density concrete form overlay plywood in sizes and thicknesses indicated. Support on posts or framing of preservative-treated wood or steel.
  - 4. Paint sign panel and applied graphics with exterior-grade alkyd gloss enamel over exterior primer.
- D. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Containerize and clearly label hazardous, dangerous, or unsanitary waste materials separately from other waste. Comply with Division I Section "Execution Requirements" for progress cleaning requirements.
  - 1. If required by authorities having jurisdiction, provide separate containers, clearly labeled, for each type of waste material to be deposited.
- E. Common-Use Field Office: Provide an insulated, weathertight, air-conditioned field office for use as a common facility by all personnel engaged in construction activities; of sufficient size to accommodate required office personnel. Keep office clean and orderly.
- F. Lifts and Hoists: Provide facilities for hoisting materials and personnel. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.

### 3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction in ways and by methods that comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable

effects. Avoid using tools and equipment that produce harmful noise. Restrict use of noisemaking tools and equipment to hours that will minimize complaints from persons or firms near Project site.

- B. Stormwater Control: Provide earthen embankments and similar barriers in and around excavations and subgrade construction, sufficient to prevent flooding by runoff of stormwater from heavy rains.
- C. Site Enclosure Fence: Before construction operations begin, install enclosure fence with lockable entrance gates. Locate where indicated, enclosing Project site or portion determined sufficient to accommodate construction operations. Install in a manner that will prevent people, dogs, and other animals from easily entering site except by entrance gates.
  - 1. Provide gates in sizes and at locations necessary to accommodate delivery vehicles and other construction operations.
  - 2. Maintain security by limiting number of keys and restricting distribution to authorized personnel.
- D. Security Enclosure and Lockup: Install substantial temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security.
- E. Barricades, Warning Signs, and Lights: Comply with standards and code requirements for erecting structurally adequate barricades. Paint with appropriate colors, graphics, and warning signs to inform personnel and public of possible hazard. Where appropriate and needed, provide lighting, including flashing red or amber lights.
- F. Covered Walkway: Erect a structurally adequate, protective, covered walkway for passage of persons through construction areas. Comply with regulations of Authorities Having Jurisdiction.
  - 1. Provide wood-plank overhead decking, protective plywood enclosure walls, handrails, barricades, warning signs, lights, safe and well-drained walkways, and similar provisions for protection and safe passage.
- G. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities, as needed. Provide temporary weathertight enclosure for building exterior.
  - 1. Where air conditioning is needed and permanent enclosure is not complete, provide insulated temporary enclosures. Coordinate enclosure with ventilating and material drying or curing requirements to avoid dangerous conditions and effects.
  - 2. Vertical Openings: Close openings of 25 sq. ft. or less with plywood or similar materials.
  - 3. Horizontal Openings: Close openings in floor or roof decks and horizontal surfaces with load-bearing, wood-framed construction.
  - 4. Install tarpaulins securely using fire-retardant-treated wood framing and other materials.
- H. Temporary Partitions: Erect and maintain dustproof partitions and temporary enclosures to limit dust and dirt migration and to separate areas from fumes and noise, as needed.



- a. Construct a vestibule and airlock at each entrance to temporary enclosure with not less than 48 inches between doors. Maintain water-dampened foot mats in vestibule.
  - 2. Insulate partitions to provide noise protection to occupied areas.
  - 3. Seal joints and perimeter. Equip partitions with dustproof doors and security locks.
  - 4. Protect air-handling equipment.
  - 5. Weatherstrip openings.
- I. Temporary Fire Protection: Until fire-protection needs are supplied by permanent facilities, install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241.
  - 1. Provide fire extinguishers, installed on walls on mounting brackets, visible and accessible from space being served, with sign mounted above.
    - a. Field Offices: Class A stored-pressure water-type extinguishers.
    - b. Other Locations: Class ABC dry-chemical extinguishers or a combination of extinguishers of NFPA-recommended classes for exposures.
    - c. Locate fire extinguishers where convenient and effective for their intended purpose.
  - 2. Store combustible materials in containers in fire-safe locations.
  - 3. Maintain unobstructed access to fire extinguishers, fire hydrants, temporary fire-protection facilities, stairways, and other access routes for firefighting. Prohibit smoking in hazardous fire-exposure areas.
  - 4. Supervise welding operations and similar sources of fire ignition.
  - 5. Permanent Fire Protection: At earliest feasible date in each area of Project, complete installation of permanent fire-protection facility, including connected services, and place into operation and use. Instruct key personnel on use of facilities.
  - 6. Develop and supervise an overall fire-prevention and first-aid fire-protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
  - 7. Provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

### 3.5 OPERATION, TERMINATION, AND REMOVAL

- A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.
- B. Maintenance: Maintain facilities in good operating condition until removal. Protect from damage caused by weather and similar elements.

1. Maintain operation of temporary enclosures, air conditioning, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.
  2. Maintain markers for underground lines. Protect from damage during excavation operations.
- C. Temporary Facility Changeover: Except for using permanent fire protection as soon as available, do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.
- D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
1. Materials and facilities that constitute temporary facilities are the property of Contractor. Owner reserves right to take possession of Project identification signs.
  2. At Substantial Completion, clean and renovate permanent facilities used during construction period. Comply with final cleaning requirements in Division 1 Section "Closeout Procedures."

END OF SECTION 01500



## SECTION 01600 - PRODUCT REQUIREMENTS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes the following administrative and procedural requirements: selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; product substitutions; and comparable products.
- B. Related Sections include the following:
  - 1. Division 1 Section "References" for applicable industry standards for products specified.
  - 2. Division 1 Section "Closeout Procedures" for submitting warranties for contract closeout.
  - 3. Divisions 2 through 16 Sections for specific requirements for warranties on products and installations specified to be warranted.

#### 1.3 DEFINITIONS

- A. Products: Items purchased for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
  - 1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation, shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
  - 2. New Products: Items that have not previously been incorporated into another project or facility, except that products consisting of recycled-content materials are allowed, unless explicitly stated otherwise. Products salvaged or recycled from other projects are not considered new products.
  - 3. Comparable or Equivalent Product: Product that is demonstrated and approved through submittal process, or where indicated as a product substitution, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.
- B. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.
- C. Basis-of-Design Product Specification: Where a specific manufacturer's product is named and accompanied by the words "basis of design," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service

performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of other named manufacturers.

- D. **Manufacturer's Warranty:** Preprinted written warranty published by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
- E. **Special Warranty:** Written warranty required by or incorporated into the Contract Documents, either to extend time limit provided by manufacturer's warranty or to provide more rights for Owner.

#### 1.4 SUBMITTALS

- A. **Substitution Requests:** Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

1. **Substitution Request Form:** Use CSI Form 13.1A.
2. **Documentation:** Show compliance with requirements for substitutions and the following, as applicable:
  - a. Statement indicating why specified material or product cannot be provided.
  - b. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed substitution.
  - c. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
  - d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
  - e. Samples, where applicable or requested.
  - f. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.
  - g. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
  - h. Research/evaluation reports evidencing compliance with building code in effect for Project, from a model code organization acceptable to Authorities Having Jurisdiction.
  - i. Detailed comparison of Contractor's Construction Schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating lack of availability or delays in delivery.
  - j. Cost information, including a proposal of change, if any, in the Contract Sum.
  - k. Contractor's certification that proposed substitution complies with requirements in the Contract Documents and is appropriate for applications indicated.
  - l. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.

3. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within one week of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within 15 days of receipt of request, or 7 days of receipt of additional information or documentation, whichever is later.
  - a. Form of Acceptance: Written notification to Contractor.
  - b. Use product specified if Architect cannot make a decision on use of a proposed substitution within time allocated.
- B. Basis-of-Design Product Specification Submittal: Comply with requirements in Division 1 Section "Submittal Procedures." Show compliance with requirements.

## 1.5 QUALITY ASSURANCE

- A. Comply with requirements in Division 1 Section "Quality Requirements."

## 1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

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

## 1.7 PRODUCT WARRANTIES

- A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on

product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.

- B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution. Submit a draft for approval before final execution.
  - 1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
  - 2. Specified Form: Forms are included with the Specifications. Prepare a written document using appropriate form properly executed.
  - 3. Refer to Divisions 2 through 16 Sections for specific content requirements and particular requirements for submitting special warranties.
- C. Submittal Time: Comply with requirements in Division 1 Section "Closeout Procedures."

## PART 2 - PRODUCTS

### 2.1 PRODUCT OPTIONS

- A. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged, and unless otherwise indicated, that are new at time of installation.
  - 1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
  - 2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
  - 3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
  - 4. Where products are accompanied by the term "as selected," Architect will make selection.
  - 5. Where products are accompanied by the term "match sample," sample to be matched is Architect's.
  - 6. Descriptive, performance, and reference standard requirements in the Specifications establish "salient characteristics" of products.
  - 7. Or Architect Approved Equivalent: Where products are specified by name and accompanied by the term "or Architect Approved Equivalent," comply with provisions in "Comparable or Equivalent Products" Article to obtain approval for use of an unnamed product.
- B. Product Selection Procedures: Procedures for product selection include the following:
  - 1. Product: Where Specification paragraphs or subparagraphs titled "Product" name a single product and manufacturer, provide the product named.
    - a. Substitutions may be considered, unless otherwise indicated.

2. **Manufacturer/Source:** Where Specification paragraphs or subparagraphs titled "Manufacturer" or "Source" name single manufacturers or sources, provide a product by the manufacturer or from the source named that complies with requirements.
  - a. Substitutions may be considered, unless otherwise indicated.
3. **Products:** Where Specification paragraphs or subparagraphs titled "Products" introduce a list of names of both products and manufacturers, provide one of the products listed that complies with requirements.
  - a. Substitutions may be considered, unless otherwise indicated.
4. **Manufacturers:** Where Specification paragraphs or subparagraphs titled "Manufacturers" introduce a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements.
  - a. Substitutions may be considered, unless otherwise indicated.
5. **Basis-of-Design Products:** Where Specification paragraphs or subparagraphs titled "Basis-of-Design Product" are included and also introduce or refer to a list of manufacturers' names, provide either the specified product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with provisions in "Comparable Products" Article to obtain approval for use of an unnamed product.
  - a. Substitutions may be considered, unless otherwise indicated.
6. **Visual Matching Specification:** Where Specifications require matching an established Sample, select a product (and manufacturer) that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches satisfactorily.
  - a. If no product available within specified category matches satisfactorily and complies with other specified requirements, comply with provisions of the Contract Documents on "substitutions" for selection of a matching product.
7. **Visual Selection Specification:** Where Specifications include the phrase "as selected from manufacturer's colors, patterns, textures" or a similar phrase, select a product (and manufacturer) that complies with other specified requirements.
  - a. **Standard Range:** Where Specifications include the phrase "standard range of colors, patterns, textures" or similar phrase, Architect will select color, pattern, or texture from manufacturer's product line that does not include premium items.
  - b. **Full Range:** Where Specifications include the phrase "full range of colors, patterns, textures" or similar phrase, Architect will select color, pattern, or texture from manufacturer's product line that includes both standard and premium items.



## 2.2 PRODUCT SUBSTITUTIONS

- A. Timing: Architect will consider requests for substitution if received within 30 days after commencement of the Work. Requests received after that time may be considered or rejected at discretion of Architect.
- B. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
  - 1. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction and maintenance by Owner, and similar considerations.
  - 2. Requested substitution does not require extensive revisions to the Contract Documents.
  - 3. Requested substitution is consistent with the Contract Documents and will produce indicated results.
  - 4. Substitution request is fully documented and properly submitted.
  - 5. Requested substitution will not adversely affect Contractor's Construction Schedule.
  - 6. Requested substitution has received necessary approvals of Authorities Having Jurisdiction, if applicable.
  - 7. Requested substitution is compatible with other portions of the Work.
  - 8. Requested substitution has been coordinated with other portions of the Work.
  - 9. Requested substitution provides specified warranty.
  - 10. Requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all subcontractors involved.

## 2.3 EQUIVALENT PRODUCTS

- A. Where products or manufacturers are specified by name, submit the following, in addition to other required submittals, to obtain approval of an unnamed product:
  - 1. Evidence that the proposed product does not require extensive revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
  - 2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
  - 3. Evidence that proposed product provides specified warranty.
  - 4. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
  - 5. Samples, if requested.

PART 3 - EXECUTION (Not Used)

END OF SECTION 01600

## SECTION 01700 - EXECUTION REQUIREMENTS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes general procedural requirements governing execution of the Work including, but not limited to, the following:

1. Construction layout.
2. Field engineering and surveying.
3. General installation of products.
4. Coordination of Owner-installed products.
5. Progress cleaning.
6. Starting and adjusting.
7. Protection of installed construction.
8. Correction of the Work.

- B. Related Sections include the following:

1. Division 1 Section "Project Management and Coordination" for procedures for coordinating field engineering with other construction activities.
2. Division 1 Section "Cutting and Patching" for procedural requirements for cutting and patching necessary for the installation or performance of other components of the Work.

#### 1.3 QUALITY ASSURANCE

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

### PART 2 - PRODUCTS (Not Used)

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Existing Conditions: The existence and location of site improvements, utilities, and other construction indicated as existing are not guaranteed. Before beginning work, investigate and

verify the existence and location of mechanical and electrical systems and other construction affecting the Work.

1. Before construction, verify the location and points of connection of utility services.
- B. Existing Utilities: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning work, investigate and verify the existence and location of underground utilities and other construction affecting the Work.
1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; and underground electrical services.
  2. Furnish location data for work related to Project that must be performed by public utilities serving Project site, if any.
- C. Acceptance of Conditions: Examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
1. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:
    - a. Description of the Work.
    - b. List of detrimental conditions, including substrates.
    - c. List of unacceptable installation tolerances.
    - d. Recommended corrections.
  2. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
  3. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
  4. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
  5. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

### 3.2 PREPARATION

- A. Existing Utility Information: Furnish information to local utility that is necessary to adjust, move, or relocate existing utility structures located in or affected by construction. Coordinate with Authorities Having Jurisdiction.
- B. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
1. Notify Owner not less than 3 days in advance of proposed utility interruptions.
  2. Do not proceed with utility interruptions without Owner's written permission.

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

### 3.3 CONSTRUCTION LAYOUT

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

### 3.4 FIELD ENGINEERING

- A. Identification: Owner will identify existing benchmarks, control points, and property corners.

- B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.
  - 1. Do not change or relocate existing benchmarks or control points without prior written approval of Architect. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Architect before proceeding.
  - 2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.
- C. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with Authorities Having Jurisdiction for type and size of benchmark.
  - 1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
  - 2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
  - 3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.

### 3.5 INSTALLATION

- A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
  - 1. Make vertical work plumb and make horizontal work level.
  - 2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
  - 3. Conceal pipes, ducts, and wiring in finished areas, unless otherwise indicated.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.
- E. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.
- F. Anchors and Fasteners: Provide anchors and fasteners as required to anchor each component securely in place, accurately located and aligned with other portions of the Work.
  - 1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
  - 2. Allow for building movement, including thermal expansion and contraction.

- G. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect, as directed by Architect. Fit exposed connections together to form hairline joints.
- H. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

### 3.6 OWNER-INSTALLED PRODUCTS (if applicable)

- A. Site Access: Provide access to Project site for Owner's personnel, as needed.
- B. Coordination: Coordinate construction and operations of the Work with work performed by Owner's personnel.
  - 1. Construction Schedule: Inform Owner of Contractor's preferred construction schedule for Owner's portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify Owner if changes to schedule are required due to differences in actual construction progress.
  - 2. Preinstallation Conferences: Include Owner's personnel at preinstallation conferences covering portions of the Work that are to receive Owner's work. Attend preinstallation conferences conducted by Owner's personnel if portions of the Work depend on Owner's product installation process.

### 3.7 PROGRESS CLEANING

- A. General: Clean Project site and work areas daily, including common areas. Coordinate progress cleaning for joint-use areas where more than one installer has worked. Enforce requirements strictly. Dispose of materials lawfully.
  - 1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
  - 2. Do not hold materials more than 3 days if the temperature is expected to rise above 80 deg F.
  - 3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
- B. Site: Maintain Project site free of waste materials and debris.
- C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.
  - 1. Remove liquid spills promptly.
  - 2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
- D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.

- E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
- F. Exposed Surfaces: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- G. Cutting and Patching: Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, and similar materials.
  - 1. Thoroughly clean piping, conduit, and similar features before applying paint or other finishing materials. Restore damaged pipe covering to its original condition.
- H. Waste Disposal: Burying or burning waste materials on-site will not be permitted. Washing waste materials down sewers or into waterways will not be permitted.
- I. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
- J. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
- K. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

### 3.8 STARTING AND ADJUSTING

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

### 3.9 PROTECTION OF INSTALLED CONSTRUCTION

- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.
- B. Comply with manufacturer's written instructions for temperature and relative humidity.

3.10 CORRECTION OF THE WORK

- A. Repair or remove and replace defective construction. Restore damaged substrates and finishes. Comply with requirements in Division 1 Section "Cutting and Patching."
  - 1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.
- B. Restore permanent facilities used during construction to their specified condition.
- C. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.
- D. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.
- E. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION 01700





## SECTION 01731 - CUTTING AND PATCHING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes procedural requirements for cutting and patching.
- B. Related Sections include the following:
  - 1. Division 1 Section "Selective Demolition" for demolition of selected portions of the building for alterations.
  - 2. Divisions 2 through 16 Sections for specific requirements and limitations applicable to cutting and patching individual parts of the Work.

#### 1.3 DEFINITIONS

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

#### 1.4 SUBMITTALS

- A. Cutting and Patching Proposal: Submit a proposal describing procedures at least 10 days before the time cutting and patching will be performed, requesting approval to proceed. Include the following information:
  - 1. Dates: Indicate when cutting and patching will be performed.
  - 2. Utilities: List utilities that cutting and patching procedures will disturb or affect, if any. List utilities that will be relocated and those that will be temporarily out of service. Indicate how long service will be disrupted.
  - 3. Architect's Approval: Obtain approval of cutting and patching proposal before cutting and patching. Approval does not waive right to later require removal and replacement of unsatisfactory work.

## 1.5 QUALITY ASSURANCE

- A. Structural Elements: Do not cut and patch structural elements in a manner that could change their load-carrying capacity or load-deflection ratio.
- B. Operational Elements: Do not cut and patch the following operating elements and related components in a manner that results in: reducing their capacity to perform as intended, increasing maintenance or decreasing operational life and safety.
  - 1. Primary operational systems and equipment.
  - 2. Air or smoke barriers.
  - 3. Fire-protection systems.
  - 4. Control systems.
  - 5. Communication systems.
  - 6. Conveying systems.
  - 7. Electrical wiring systems.
- C. Miscellaneous Elements: Do not cut and patch the following elements or related components in a manner that could change their load-carrying capacity, that results in: reducing their capacity to perform as intended, increasing maintenance or decreasing operational life and safety.
  - 1. Water, moisture, or vapor barriers.
  - 2. Membranes and flashings.
  - 3. Exterior curtain-wall construction.
  - 4. Piping, ductwork, and equipment.
  - 5. Noise- and vibration-control elements and systems.
- D. Visual Requirements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch construction exposed on the exterior or in occupied spaces in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.
  - 1. If possible, retain original Installer or fabricator to cut and patch exposed Work listed below. If it is impossible to engage original Installer or fabricator, engage another recognized, experienced, and specialized firm.
    - a. Roofing.
    - b. Firestopping.
    - c. Curtain wall system.
    - d. Portland cement plaster.
    - e. Wall covering.
    - f. Multicolored interior coatings.
- E. Cutting and Patching Conference: Before proceeding, meet at Project site with parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

## 1.6 WARRANTY

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

## PART 2 - PRODUCTS

### 2.1 MATERIALS

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

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine surfaces to be cut and patched and conditions under which cutting and patching are to be performed.
  - 1. Compatibility: Before patching, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
  - 2. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

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

### 3.3 PERFORMANCE

- A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
1. Cut existing construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
- B. Cutting: Cut existing construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
  2. Existing Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
  3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
  4. Excavating and Backfilling: Comply with requirements in applicable Division 2 Sections where required by cutting and patching operations.
  5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
  6. Proceed with patching after construction operations requiring cutting are complete.
- C. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections of these Specifications.
1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.
  2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
  3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove existing floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
    - a. Where patching occurs in a painted surface, apply primer and intermediate paint coats over the patch and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.

4. Ceilings: Patch, repair, or rehang existing ceilings as necessary to provide an even-plane surface of uniform appearance.
5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition.
6. Sidewalk: Patch and repair existing sidewalk as required by demolition and new construction.

END OF SECTION 01731



## SECTION 01732 - SELECTIVE DEMOLITION

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract and Division 1 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Demolition and removal of selected portions of a building or structure.
- B. Related Sections include the following:
  - 1. Division 1 Section "Temporary Facilities and Controls" for temporary utilities, temporary construction and support facilities, temporary security and protection facilities, and environmental protection measures for selective demolition operations.
  - 2. Division 15 Drawings and Sections for demolishing, cutting, patching, or relocating mechanical items.
  - 3. Division 16 Drawings and Sections for demolishing, cutting, patching, or relocating electrical items.

#### 1.3 DESCRIPTION

- A. This work shall consist of the removal, wholly or in part, and satisfactory disposal of all foundations, fences, structures, old pavements, and any other obstructions which are not designated or allowed to remain, except for the obstructions to be removed and disposed of under other items in the Contract. It shall also include the salvaging of designated materials and backfilling the resulting trenches, holes, and pits.
- B. When the Contract does not include pay items for removal of structures and obstructions as described in this specification, such work will not be paid for directly, but shall be performed as a subsidiary obligation of the Contractor under other contract items.
- C. Regardless of the pay items included in the proposal schedule and shown on the plans, it is the Contractor's responsibility to determine the quantity and nature of structures and obstructions to be removed from within the project and to bid accordingly.

#### 1.4 DEFINITIONS

- A. Remove: Detach items from existing construction and legally dispose of them off-site, unless indicated to be removed and salvaged or removed and reinstalled.



- B. Remove and Salvage: Detach items from existing construction and deliver them to Owner.
- C. Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated.
- D. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

## 1.5 MATERIALS OWNERSHIP

Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain within Owner's property, demolished materials shall become Contractor's property and shall be removed from Project site.

## 1.6 SUBMITTALS

- A. Proposed Dust-Control and Noise-Control Measures: Submit statement or drawing that indicates the measures proposed for use, proposed locations, and proposed time frame for their operation. Identify options if proposed measures are later determined to be inadequate.
  - 1. Provision shall be made to control the amount of airborne dust resulting from demolition operations by wetting the debris and other materials and the immediate work area with appropriate spraying agents or other means acceptable to the Engineer.
- B. Schedule of Selective Demolition Activities: Indicate the following:
  - 1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's on-site operations are uninterrupted.
  - 2. Interruption of utility services.
  - 3. Coordination for shutoff, capping, and continuation of utility services.
- C. Inventory: After selective demolition is complete, submit a list of items that have been removed and salvaged.

## 1.7 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Standards: Comply with ANSI A10.6 and NFPA 241.

## 1.8 PROJECT CONDITIONS

- A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted. Provide not less than 72 hours' notice to Owner of activities that will affect Owner's operations.

- B. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities.
  - 1. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from Authorities Having Jurisdiction.
- C. Owner assumes no responsibility for condition of areas to be selectively demolished.
  - 1. Conditions existing at time of inspection for bidding purposes will be maintained by Owner as far as practical.
- D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
  - 1. Hazardous materials will be removed by Owner before start of the Work.
  - 2. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.
- E. Storage or sale of removed items or materials on-site will not be permitted.
- F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
  - 1. Maintain fire-protection facilities in service during selective demolition operations.

## PART 2 - PRODUCTS

### 2.1 REPAIR MATERIALS

- A. Use repair materials identical to existing materials.
  - 1. If identical materials are unavailable or cannot be used for exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible.
  - 2. Use materials whose installed performance equals or surpasses that of existing materials.
- B. Comply with material and installation requirements specified in individual Specification Sections.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped.
- B. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.

- C. Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged.
- D. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Architect.
- E. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.

### 3.2 UTILITY SERVICES

- A. Existing Utilities: Maintain services indicated to remain and protect them against damage during selective demolition operations.
- B. Do not interrupt existing utilities serving occupied or operating facilities unless authorized in writing by Owner and Authorities Having Jurisdiction. Provide temporary services during interruptions to existing utilities, as acceptable to Owner and to Authorities Having Jurisdiction.
  - 1. Provide at least 72 hours' notice to Owner if shutdown of service is required during changeover.
- C. Utility Requirements: Locate, identify, disconnect, and seal or cap off indicated utilities serving areas to be selectively demolished, if any.
  - 1. Arrange to shut off indicated utilities with utility companies.
  - 2. If utility services are required to be removed, relocated, or abandoned, before proceeding with selective demolition provide temporary utilities that bypass area of selective demolition and that maintain continuity of service to other parts of building.
  - 3. Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing.
  - 4. Refer to Division 15 and 16 Drawings and Specification Sections for shutting off, disconnecting, removing, and sealing or capping utilities. Do not start selective demolition work until utility disconnecting and sealing have been completed and verified in writing.

### 3.3 PREPARATION

- A. Dangerous Materials: Drain, purge, or otherwise remove, collect, and dispose of chemicals, gases, explosives, acids, flammables, or other dangerous materials before proceeding with selective demolition operations.
- B. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
  - 1. Do not close or obstruct streets, walks, walkways, or other adjacent occupied or used facilities without permission from Owner and Authorities Having Jurisdiction. Provide

- alternate routes around closed or obstructed traffic ways if required by governing regulations.
2. Erect temporary protection, such as walks, fences, railings, canopies, and covered passageways, where required by Authorities Having Jurisdiction.
  3. Protect existing site improvements, appurtenances, and landscaping to remain.
  4. Erect a plainly visible fence around drip line of individual trees or around perimeter drip line of groups of trees to remain.
- C. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
  2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
  3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
  4. Cover and protect equipment that have not been removed.
- D. Temporary Enclosures: Provide temporary enclosures for protection of existing building and construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.
- E. Temporary Partitions: Erect and maintain dustproof partitions and temporary enclosures to limit dust and dirt migration and to separate areas from fumes and noise.
- F. Temporary Shoring: Strengthen or add new supports when required during progress of selective demolition.

### 3.4 POLLUTION CONTROLS

- A. Rodent control: Prior to selective demolition in buildings located in urban areas, the Contractor shall exterminate rodents within the premises. The extermination shall be performed by an exterminator duly licensed by the Commercial Poisons Division of the Puerto Rico Department of Health and with at least five years experience in rodent extermination. The exterminator shall, upon request, present to the Architect, evidence of both the license and required experience.
1. The exterminating work shall be performed in a manner acceptable to the Architect and in accordance with the requirements of the Puerto Rico Department of Health. Normally, bait shall be placed at least 14 calendar days and not more than 30 calendar days before actual demolition is started.
- B. Disposal: Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

- C. Cleaning: Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

### 3.5 SELECTIVE DEMOLITION

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
2. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
3. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
4. Maintain adequate ventilation when using cutting torches.
5. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
6. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
7. Dispose of demolished items and materials promptly.
8. Return elements of construction and surfaces that are to remain to condition existing before selective demolition operations began.
9. Basements or cavities left by structure removal shall be filled with suitable material to the level of the surrounding ground and, if within the prism of construction, shall be compacted in accordance with Specification for Excavation, Backfilling and Compacting for Structures.

- B. Removed and Salvaged Items: Comply with the following:

1. Clean salvaged items.
2. Store items in a secure area until delivery to Owner.
3. Transport items to Owner's storage area.
4. Protect items from damage during transport and storage.

- C. Removed and Reinstalled Items: Comply with the following:

1. Clean and repair items to functional condition adequate for intended reuse. Paint equipment to match new equipment.
2. Pack or crate items after cleaning and repairing. Identify contents of containers.
3. Protect items from damage during transport and storage.

4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.
- D. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.
- E. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals, using power-driven saw, then remove concrete between saw cuts.
- F. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, then remove masonry between saw cuts.
- G. Pavement, Sidewalks, Curbs: All pavement, base course, sidewalks, curbs, gutters, etc. designated for removal shall be broken and disposed of in areas approved by the Architect.

### 3.6 PATCHING AND REPAIRS

- A. General: Promptly repair damage to adjacent construction caused by selective demolition operations.
- B. Patching: Comply with Division 1 Section "Cutting and Patching."
- C. Repairs: Where repairs to existing surfaces are required, patch to produce surfaces suitable for new materials.
- D. Finishes: Restore exposed finishes of patched areas and extend restoration into adjoining construction in a manner that eliminates evidence of patching and refinishing.
- E. Floors and Walls: Where walls or partitions that are demolished extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish color, texture, and appearance. Remove existing floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
  1. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections of these Specifications.
  2. Where patching occurs in a painted surface, apply primer and intermediate paint coats over patch and apply final paint coat over entire unbroken surface containing patch. Provide additional coats until patch blends with adjacent surfaces.
  3. Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.

### 3.7 DISPOSAL OF DEMOLISHED MATERIALS

- A. General: Promptly dispose of demolished materials. Do not allow demolished materials to accumulate on-site.
- B. Burning: Do not burn demolished materials.
- C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

END OF SECTION 01732

## SECTION 01770 - CLOSEOUT PROCEDURES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
  - 1. Inspection procedures.
  - 2. Project Record Documents.
  - 3. Operation and maintenance manuals.
  - 4. Warranties.
  - 5. Instruction of Owner's personnel.
  - 6. Final cleaning.
- B. Related Sections include the following:
  - 1. Division 1 Section "Payment Procedures" for requirements for Applications for Payment for Substantial and Final Completion.
  - 2. Division 1 Section "Execution Requirements" for progress cleaning of Project site.
  - 3. Divisions 2 through 16 Sections for specific closeout and special cleaning requirements for products of those Sections.

#### 1.3 SUBSTANTIAL COMPLETION

- A. Preliminary Procedures: Before requesting inspection for determining date of Substantial Completion, complete the following. List items below that are incomplete in request.
  - 1. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.
  - 2. Advise Owner of pending insurance changeover requirements.
  - 3. Submit specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
  - 4. Obtain and submit releases permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
  - 5. Prepare and submit Project Record Documents, operation and maintenance manuals and similar final record information.
  - 6. Deliver tools, spare parts, extra materials, and similar items to location designated by Owner. Label with manufacturer's name and model number where applicable.



7. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
  8. Complete startup testing of systems.
  9. Submit test/adjust/balance records.
  10. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
  11. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
  12. Complete final cleaning requirements, including touchup painting.
  13. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.
- B. Inspection: Submit a written request for inspection for Substantial Completion. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.
1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
  2. Results of completed inspection will form the basis of requirements for Final Completion.

#### 1.4 FINAL COMPLETION

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

## 1.5 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

- A. Preparation: Submit three copies of list. Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.
1. Organize list of spaces in sequential order.
  2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
  3. Include the following information at the top of each page:
    - a. Project name.
    - b. Date.
    - c. Name of Architect.
    - d. Name of Contractor.
    - e. Page number.

## 1.6 PROJECT RECORD DOCUMENTS

- A. General: Do not use Project Record Documents for construction purposes. Protect Project Record Documents from deterioration and loss. Provide access to Project Record Documents for Architect's reference during normal working hours.
- B. Record Drawings: Maintain and submit one set of blue- or black-line white prints of Contract Drawings and Shop Drawings.
1. Mark Record Prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to prepare the marked-up Record Prints.
    - a. Give particular attention to information on concealed elements that cannot be readily identified and recorded later.
    - b. Accurately record information in an understandable drawing technique.
    - c. Record data as soon as possible after obtaining it. Record and check the markup before enclosing concealed installations.
    - d. Mark Contract Drawings or Shop Drawings, whichever is most capable of showing actual physical conditions, completely and accurately. Where Shop Drawings are marked, show cross-reference on Contract Drawings.
  2. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at the same location.
  3. Mark important additional information that was either shown schematically or omitted from original Drawings.
  4. Note Construction Change Directive numbers, Change Order numbers, alternate numbers, and similar identification where applicable.
  5. Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location. Organize into manageable sets; bind each set with durable paper cover sheets. Include identification on cover sheets.

- C. Record Specifications: Submit one copy of Project's Specifications, including addenda and contract modifications. Mark copy to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.
  - 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
  - 2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
  - 3. Note related changes in the Work, Record Drawings, and Product Data, where applicable.
  
- D. Record Product Data: Submit one copy of each Product Data submittal. Mark one set to indicate the actual product installation where installation varies substantially from that indicated in Product Data.
  - 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
  - 2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
  - 3. Note related Change Orders, Record Drawings, and Record Specifications, where applicable.
  
- E. Miscellaneous Record Submittals: Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.

## 1.7 OPERATION AND MAINTENANCE MANUALS

- A. Assemble a complete set of operation and maintenance data indicating the operation and maintenance of each system, subsystem, and piece of equipment not part of a system. Include operation and maintenance data required in individual Specification Sections and as follows:
  - 1. Operation Data:
    - a. Emergency instructions and procedures.
    - b. System, subsystem, and equipment descriptions, including operating standards.
    - c. Operating procedures, including startup, shutdown, seasonal, and weekend operations.
    - d. Description of controls and sequence of operations.
    - e. Piping diagrams.
  
  - 2. Maintenance Data:
    - a. Manufacturer's information, including list of spare parts.
    - b. Name, address, and telephone number of Installer or supplier.
    - c. Maintenance procedures.
    - d. Maintenance and service schedules for preventive and routine maintenance.
    - e. Maintenance record forms.
    - f. Sources of spare parts and maintenance materials.
    - g. Copies of maintenance service agreements.

h. Copies of warranties and bonds.

- B. Organize operation and maintenance manuals into suitable sets of manageable size. Bind and index data in heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, with pocket inside the covers to receive folded oversized sheets. Identify each binder on front and spine with the printed title "OPERATION AND MAINTENANCE MANUAL," Project name, and subject matter of contents.

## 1.8 WARRANTIES

- A. Submittal Time: Submit written warranties on request of Architect for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated.
- B. Organize warranty documents into an orderly sequence based on the table of contents of the Project Manual.
1. Bind warranties and bonds in heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.
  2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
  3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.
- C. Provide additional copies of each warranty to include in operation and maintenance manuals.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

## PART 3 - EXECUTION

### 3.1 DEMONSTRATION AND TRAINING

- A. Instruction: Instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
1. Provide instructors experienced in operation and maintenance procedures.
  2. Provide instruction at mutually agreed-on times. For equipment that requires seasonal operation, provide similar instruction at the start of each season.

3. Schedule training with Owner with at least seven days' advance notice.
  4. Coordinate instructors, including providing notification of dates, times, length of instruction, and course content.
- B. Program Structure: Develop an instruction program that includes individual training for each system and equipment not part of a system, as required by individual Specification Sections. Include instruction for the following:
1. Operations.
  2. Adjustments.
  3. Troubleshooting.
  4. Maintenance.
  5. Repair.

### 3.2 FINAL CLEANING

- A. General: Provide final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.
- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average healthcare facility cleaning and maintenance program. Comply with manufacturer's written instructions.
1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a portion of Project:
    - a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
    - b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
    - c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
    - d. Remove tools, construction equipment, machinery, and surplus material from Project site.
    - e. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
    - f. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, and similar spaces.
    - g. Sweep concrete floors broom clean in unoccupied spaces.
    - h. Vacuum carpet and similar soft surfaces, removing debris and excess nap; shampoo if visible soil or stains remain.
    - i. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.
    - j. Remove labels that are not permanent.

- k. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.
    - 1) Do not paint over "UL" and similar labels, including mechanical and electrical nameplates.
  - l. Wipe surfaces of mechanical and electrical equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
  - m. Replace parts subject to unusual operating conditions.
  - n. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
  - o. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
  - p. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs, and those noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.
  - q. Leave Project clean and ready for occupancy.
- C. Comply with safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on Owner's property. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove waste materials from Project site and dispose of lawfully.

END OF SECTION 01770



SECTION 02080 - PIPED UTILITIES - BASIC 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.

1.2 SUMMARY

- A. This Section includes the following:
  - 1. Piping materials and installation instructions common to most piping systems.
  - 2. Transition fittings.
  - 3. Dielectric fittings.
  - 4. Sleeves.
  - 5. Identification devices.
  - 6. Grout.
  - 7. Piped utility demolition.
  - 8. Equipment installation requirements common to equipment sections.
  - 9. Painting and finishing.
  - 10. Concrete bases.
  - 11. Metal supports and anchorages.

1.3 DEFINITIONS

- A. Exposed Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions.
- B. Concealed 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.
- C. The following are industry abbreviations for plastic materials:
  - 1. ABS: Acrylonitrile-butadiene-styrene plastic.
  - 2. CPVC: Chlorinated polyvinyl chloride plastic.
  - 3. PE: Polyethylene plastic.
  - 4. PVC: Polyvinyl chloride plastic.

1.4 SUBMITTALS

- A. Product Data: For the following:
  - 1. Dielectric fittings.



2. Identification devices.

- B. Samples of color, lettering style, and other graphic representation required for each identification material and device.
- C. Welding certificates.

1.5 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 Piped Utility 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.
- D. Comply with ASME A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.

1.6 DELIVERY, STORAGE, AND HANDLING

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

1.7 COORDINATION

- A. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- B. Coordinate installation of identifying devices after completing covering and painting if devices are applied to surfaces.

## PART 2 - PRODUCTS

## 2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.
  2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

## 2.2 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 2 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 2 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 (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; and 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; and 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.

2.4 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.
  - 1. Manufacturers:
    - a. Cascade Waterworks Mfg. Co.
    - b. Dresser Industries, Inc.; DMD Div.
    - c. Ford Meter Box Company, Incorporated (The); Pipe Products Div.
    - d. JCM Industries.
    - e. Smith-Blair, Inc.
    - f. Viking Johnson.
  - 2. Underground Piping NPS 1-1/2 (DN 40) and Smaller: Manufactured fitting or coupling.
  - 3. Underground Piping NPS 2 (DN 50) and Larger: AWWA C219, metal sleeve-type coupling.
  - 4. Aboveground Pressure Piping: Pipe fitting.
- B. Plastic-to-Metal Transition Fittings: CPVC and PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
  - 1. Manufacturers:
    - a. Eslon Thermoplastics.
- C. Plastic-to-Metal Transition Unions: MSS SP-107, CPVC and PVC 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.
- D. 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.

1. Manufacturers:
  - a. Cascade Waterworks Mfg. Co.
  - b. Fernco, Inc.
  - c. Mission Rubber Company.
  - d. Plastic Oddities, Inc.

2.5 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. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig (1725-kPa) minimum working pressure at 180 deg F (82 deg C).

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.

- D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig (1035- or 2070-kPa) 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.

- E. 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.

1. Manufacturers:
  - a. Advance Products & Systems, Inc.
  - b. Calpico, Inc.
  - c. Central Plastics Company.
  - d. Pipeline Seal and Insulator, Inc.

2. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig (1035- or 2070-kPa) minimum working pressure where required to suit system pressures.

- F. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).
  - 1. Manufacturers:
    - a. Calpico, Inc.
    - b. Lochinvar Corp.
  
- G. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).
  - 1. Manufacturers:
    - a. Perfection Corp.
    - b. Precision Plumbing Products, Inc.
    - c. Sioux Chief Manufacturing Co., Inc.
    - d. Victaulic Co. of America.

2.6 SLEEVES

- A. Mechanical sleeve seals for pipe penetrations are specified in Division 15 Section "Basic Mechanical Materials and Methods."
- B. Galvanized-Steel Sheet: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.
- C. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- D. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.
- F. PVC Pipe: ASTM D 1785, Schedule 40.
- G. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

2.7 IDENTIFICATION DEVICES

- A. General: Products specified are for applications referenced in other Division 2 Sections. If more than single type is specified for listed applications, selection is Installer's option.
- B. Equipment Nameplates: Metal permanently fastened to equipment with data engraved or stamped.
  - 1. Data: Manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances, and essential data.

2. Location: Accessible and visible.
- C. Stencils: Standard stencils prepared with letter sizes complying with recommendations in ASME A13.1. Minimum letter height is 1-1/4 inches (30 mm) for ducts, and 3/4 inch (20 mm) for access door signs and similar operational instructions.
1. Material: Brass.
  2. Stencil Paint: Exterior, oil-based, alkyd-gloss black enamel, unless otherwise indicated. Paint may be in pressurized spray-can form.
  3. Identification Paint: Exterior, oil-based, alkyd enamel in colors according to ASME A13.1, unless otherwise indicated.
- D. Snap-on Plastic Pipe Markers: Manufacturer's standard preprinted, semirigid, snap-on type. Include color-coding according to ASME A13.1, unless otherwise indicated.
- E. Pressure-Sensitive Pipe Markers: Manufacturer's standard preprinted, color-coded, pressure-sensitive vinyl type with permanent adhesive.
- F. Pipes with OD, Including Insulation, Less Than 6 Inches (150 mm): Full-band pipe markers, extending 360 degrees around pipe at each location.
- G. 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.
- H. Lettering: Use piping system terms indicated and abbreviate only as necessary for each application length.
1. Arrows: Either integrally with piping system service lettering to accommodate both directions of flow, or as separate unit on each pipe marker to indicate direction of flow.
- I. Plastic Duct Markers: Manufacturer's standard laminated plastic, in the following color codes:
1. Green: Cold-air supply.
  2. Yellow: Hot-air supply.
  3. Blue: Exhaust, outside, return, and mixed air.
  4. Hazardous Material Exhausts: Use colors and designs recommended by ASME A13.1.
  5. Terminology: Include direction of airflow; duct service such as supply, return, and exhaust; duct origin; duct destination; and design flow.
- J. Plastic Tape: Manufacturer's standard color-coded, pressure-sensitive, self-adhesive vinyl tape, at least 3 mils (0.08 mm) thick.
1. Width: 1-1/2 inches (40 mm) on pipes with OD, including insulation, less than 6 inches (150 mm); 2-1/2 inches (65 mm) for larger pipes.
  2. Color: Comply with ASME A13.1, unless otherwise indicated.
- K. Valve Tags: Stamped or engraved with 1/4-inch (6.4-mm) letters for piping system abbreviation and 1/2-inch (13-mm) sequenced numbers. Include 5/32-inch (4-mm) hole for fastener.
1. Material: 0.0375-inch- (1-mm-) thick stainless steel.
  2. Material: Valve manufacturer's standard solid plastic.

3. Size: 1-1/2 inches (40 mm) in diameter, unless otherwise indicated.
  4. Shape: As indicated for each piping system.
- L. Valve Tag Fasteners: Brass, wire-link or beaded chain; or brass S-hooks.
- M. Engraved Plastic-Laminate Signs: ASTM D 709, Type I, cellulose, paper-base, phenolic-resin-laminate engraving stock; Grade ES-2, black surface, black phenolic core, with white melamine subcore, unless otherwise indicated. Fabricate in sizes required for message. Provide holes for mechanical fastening.
1. Engraving: Engraver's standard letter style, of sizes and with terms to match equipment identification.
  2. Thickness: 1/16 inch (1.6 mm), for units up to 20 sq. in. (130 sq. cm) or 8 inches (200 mm) in length, and 1/8 inch (3 mm) for larger units.
  3. Fasteners: Self-tapping, stainless-steel screws or contact-type permanent adhesive.
- N. Plastic Equipment Markers: Manufacturer's standard laminated plastic, in the following color codes:
1. Green: Cooling equipment and components.
  2. Yellow: Heating equipment and components.
  3. Brown: Energy reclamation equipment and components.
  4. Blue: Equipment and components that do not meet criteria above.
  5. Hazardous Equipment: Use colors and designs recommended by ASME A13.1.
  6. Terminology: Match schedules as closely as possible. Include the following:
    - a. Name and plan number.
    - b. Equipment service.
    - c. Design capacity.
    - d. Other design parameters such as pressure drop, entering and leaving conditions, and speed.
  7. Size: 2-1/2 by 4 inches (65 by 100 mm) for control devices, dampers, and valves; 4-1/2 by 6 inches (115 by 150 mm) for equipment.
- O. Plasticized Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with mat finish suitable for writing.
1. Size: 3-1/4 by 5-5/8 inches (85 by 145 mm).
  2. Fasteners: Brass grommets and wire.
  3. Nomenclature: Large-size primary caption such as DANGER, CAUTION, or DO NOT OPERATE.
- P. Lettering and Graphics: Coordinate names, abbreviations, and other designations used in piped utility identification with corresponding designations indicated. Use numbers, letters, and terms indicated for proper identification, operation, and maintenance of piped utility systems and equipment.
1. Multiple Systems: Identify individual system number and service if multiple systems of same name are indicated.

## 2.8 GROUT

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
  - 1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
  - 2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
  - 3. Packaging: Premixed and factory packaged.

## PART 3 - EXECUTION

## 3.1 PIPED UTILITY DEMOLITION

- A. Refer to Division 1 Sections "Cutting and Patching" and "Selective Demolition" for general demolition requirements and procedures.
- B. Disconnect, demolish, and remove piped utility systems, equipment, and components indicated to be removed.
  - 1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
  - 2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
  - 3. Equipment to Be Removed: Disconnect and cap services and remove equipment.
  - 4. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make operational.
  - 5. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
- C. 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.

## 3.2 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 2 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 indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping to permit valve servicing.



- E. Install piping at indicated slopes.
- F. Install piping free of sags and bends.
- G. Install fittings for changes in direction and branch connections.
- H. Select system components with pressure rating equal to or greater than system operating pressure.
- I. Sleeves are not required for core-drilled holes.
- J. Permanent sleeves are not required for holes formed by removable PE sleeves.
- K. Install sleeves for pipes passing through concrete and masonry walls 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 equipment areas or other wet areas 2 inches (50 mm) above finished floor level.
  - 2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
    - a. Steel Pipe Sleeves: For pipes smaller than NPS 6 (DN 150).
    - b. Steel Sheet Sleeves: For pipes NPS 6 (DN 150) and larger, penetrating gypsum-board partitions.
- L. Verify final equipment locations for roughing-in.
- M. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

### 3.3 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 2 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.
- J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.
- K. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.
- L. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
1. Plain-End Pipe and Fittings: Use butt fusion.
  2. Plain-End Pipe and Socket Fittings: Use socket fusion.
- M. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

### 3.4 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
1. Install unions, in piping NPS 2 (DN 50) and smaller, adjacent to each valve and at final connection to each piece of equipment.
  2. Install flanges, in piping NPS 2-1/2 (DN 65) and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

### 3.5 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment level and plumb, unless otherwise indicated.
- B. Install equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference with other installations. Extend grease fittings to an accessible location.
- C. Install equipment to allow right of way to piping systems installed at required slope.

### 3.6 PAINTING

- A. Painting of piped utility systems, equipment, and components is specified in Division 9 Section "Painting (Professional Line Products)."
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

### 3.7 IDENTIFICATION

- A. Piping Systems: Install pipe markers on each system. Include arrows showing normal direction of flow.
  1. Stenciled Markers: According to ASME A13.1.
  2. Plastic markers, with application systems. Install on insulation segment if required for hot noninsulated piping.
  3. Locate pipe markers on exposed piping according to the following:
    - a. Near each valve and control device.
    - b. Near each branch, excluding short takeoffs for equipment and terminal units. Mark each pipe at branch if flow pattern is not obvious.
    - c. Near locations where pipes pass through walls or floors or enter inaccessible enclosures.
    - d. At manholes and similar access points that permit view of concealed piping.
    - e. Near major equipment items and other points of origination and termination.
- B. Equipment: Install engraved plastic-laminate sign or equipment marker on or near each major item of equipment.
  1. Lettering Size: Minimum 1/4 inch (6.4 mm) high for name of unit if viewing distance is less than 24 inches (610 mm), 1/2 inch (13 mm) high for distances up to 72 inches (1800 mm), and proportionately larger lettering for greater distances. Provide secondary lettering two-thirds to three-fourths of size of principal lettering.

2. Text of Signs: Provide name of identified unit. Include text to distinguish among multiple units, inform user of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.
- C. Adjusting: Relocate identifying devices that become visually blocked by work of this or other Divisions.

### 3.8 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
1. Construct concrete bases of dimensions indicated, but not less than 4 inches (100 mm) larger in both directions than supported unit.
  2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of the base.
  3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
  4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  5. Install anchor bolts to elevations required for proper attachment to supported equipment.
  6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
  7. Use 3000-psi (20.7-MPa), 28-day compressive-strength concrete and reinforcement as specified in Division 3 Section "Cast-in-Place Concrete."

### 3.9 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 5 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor piped utility materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

### 3.10 GROUTING

- A. Mix and install grout for 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 02080

## SECTION 02100 - SITE PREPARATION

### PART 1 GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
1. Cleaning site of debris, grass, trees and other plant life in preparation for excavation work.
  2. Protection of trees or vegetation indicated on the Contract Documents to remain.
  3. Stripping topsoil from areas that are to be incorporated into the limits of the project and where so indicated on the Construction Drawings.
  4. Removing existing fill and preparing existing subgrade as required to install new concrete floor slab.
- B. Related Sections:
1. Section 02200 – Earthwork
  2. Section 02221 - Excavation, Backfilling and Compacting for Structures
  3. Section 02361 – Termite Control

#### 1.2 SUBMITTALS

- A. Section 01330 - Submittal Procedures.

Product Data: Submit data for herbicide. Indicate compliance with applicable codes for environmental protection.

#### 1.3 QUALITY ASSURANCE

Conform to applicable code for environmental requirements.

1. The General Contractor must construct temporary erosion control systems, as directed by the Architect and discussed during the Pre-Bid Conference, to protect adjacent properties and water resources from erosion and sedimentation.

#### 1.4 JOB CONDITIONS

- A. Owner will maintain conditions existing at time of inspection for bidding purposes in so far as practical.
- B. Variations to conditions or discrepancy in actual conditions as they apply to site preparation operations are to be brought to the attention of the Owner prior to the commencement of any site work.

- C. Existing Utilities: Locate, disconnect, cap and remove any existing utilities within the project site. Make arrangements as required to relocate/re-route those utilities serving others off-site.

## PART 2 PRODUCTS

### 2.1 MATERIALS

- A. Herbicide: Type as approved by Authority Having Jurisdiction.

## PART 3 EXECUTION

### 3.1 PREPARATION

- A. Verify that existing plant life and clearing limits are clearly tagged, identified and marked throughout construction operations.

### 3.2 PROTECTION

- A. Locate and identify existing utilities that are to remain and protect them from damage.
- B. Protect trees, plant growth and features designated to remain as final landscape.
- C. Conduct operations with minimum interferences to public or private accesses and facilities. Maintain access and egress at all times and clean or sweep any roadways daily or as required by the governing authority. At such times as deemed necessary by the Owner, dust control shall be provided with sprinkling systems or equipment provided by the Contractor.
- D. Protect benchmarks; property corners and all other survey monuments from damage or displacement. If a marker needs to be removed it shall be referenced by a licensed land surveyor and replaced, as necessary, by the same.
- E. Provide traffic control as required, in accordance with US Department of Transportation "Manual of Uniform Traffic Control Devices" and the state highway department requirements.

### 3.3 SITE CLEARING

- A. Clear areas required for access to site and execution of Work.
- B. Remove grass, trees, plant life, stumps and all other construction debris from the site to a dump site that is suitable for handling such material according to state law and regulations.

- C. Removal of Improvements: Remove existing above-grade and below grade improvements necessary to allow construction including existing fill, foundations, and any abandoned underground piping or conduits interfering with construction.
- D. Clear undergrowth and deadwood, without disturbing subsoil.
- E. Fill depressions caused by clearing and grubbing operations with satisfactory soil material, unless further excavation or earthwork is indicated.
- F. Apply herbicide to remaining stumps to inhibit growth.

#### 3.4 REMOVAL

- A. Remove debris, rock, and extracted plant life from site.
- B. Remove existing concrete retaining wall and footing in its entirety, as indicated on Drawings.
- C. Remove existing concrete curbs partially or entirely, as indicated on Drawings.
- D. Continuously clean-up and remove waste materials from site. Do not allow materials to accumulate on site.
- E. Do not burn or bury materials on site. Leave site in clean condition.

#### 3.5 TOPSOIL EXCAVATION

- A. Excavate existing fill and topsoil from areas that are to be excavated, filled and re-graded to such a depth that it prevents intermingling with underlying or questionable material and without mixing with foreign materials for use in finish grading.
- B. Do not excavate wet topsoil.
- C. Cut heavy growths of grass from areas before stripping and remove the rest of the cleared vegetative material.
- D. Topsoil shall consist of organic superficial soil found in depth of not less than 6". Satisfactory topsoil is reasonably free of subsoil, clay lumps, stones and other objects over 2" in diameter, weeds, roots, and other objectionable material.
- E. Stockpile topsoil in storage piles in areas shown or where directed by Owner. Construct storage piles to freely drain surface water. Cover storage piles as required to prevent windblown dust. Dispose of unsuitable topsoil as specified for waste material, unless



otherwise specified by Owner. Excess topsoil shall be removed from the site by the Contractor unless specifically noted otherwise on the Drawings.

END OF SECTION 02100

## SECTION 02200 - EARTHWORK

### PART 1 GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Protection, modification and/or installation of utilities as Work progresses paying particular attention to grade changes and any necessary staging of Work.
2. Cutting, filling and grading to required lines, dimensions, contours and proposed elevations for proposed improvements.
3. Scarifying, compaction, drying and removal of unsuitable material to ensure proper preparation of areas for fills or proposed improvements.

##### B. Related Sections:

1. Section 01732 - Selective Demolition.
2. Section 02100 - Site Preparation.
3. Section 02221 - Excavation, backfilling and Compacting for Structures.

#### 1.2 REFERENCES

##### A. American Society for Testing and Materials (ASTM) latest edition.

D422	Method for Particle Size Analysis of Soils
D698	Test for Moisture-Density Relations of Soils using 5.5 lb Rammer and 12-inch Drop (Standard Proctor)
D1556	Test for Density of Soil Place by the Sand Cone Method
D1557	Test for Moisture-Density Relations of Soils Using 10-lb
D1559	Test Method for Resistance to Plastic Flow of Bituminous Mixtures using Marshall Apparatus
D2167	Test for Density of Soil in Place by the Rubber Balloon Method
D2216	Laboratory Determination of Moisture Content of Soil
D2487	Classification of Soils for Engineering Purposes
D2922	Tests for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
D3017	Test for Moisture Content of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)

D4318	Test for Plastic Limit, Liquid Limit and Plasticity Index of Soils
C25	Chemical Analysis of Limestone, Quicklime and Hydrated Lime
C110	Physical Testing for Quicklime and Hydrated Lime, Wet Sieve Method
C977	Quicklime and Hydrated Lime for Soil Stabilization

A. American Association of State Highway and Transportation Officials latest edition.

T88	Mechanical Analysis of Soils
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### 1.3 ENVIRONMENTAL REQUIREMENTS

A. Construct temporary erosion control systems, as directed by the Architect and discussed during the Pre-Bid Conference, to protect adjacent properties and water resources from erosion and sedimentation. Construct temporary erosion control systems as directed

### 1.4 SUBMITTALS

- A. Submit a sample of each type of off-site fill material to be used at the site, in an air tight, 10 lb container for the testing laboratory.
- B. Submit the name of each material supplier and specific type and source of each material. Any change in source throughout the job requires approval of the Owner or Architect.
- C. Fabrics or geogrids shall be submitted for approval of the Architect.

### 1.5 QUALITY ASSURANCE

- A. Independent Testing Laboratory selected and paid by Contractor, shall be retained to perform construction testing on site based on the following:
  - 1. Areas of Construction exclusive of building subgrade: In cut areas, not less than one compaction test for every 10,000 square feet. In fill areas, same rate of testing for each 8" lift (measured loose).
- B. If compaction requirements are not complied with at any time during construction process, remove and re-compact deficient areas until proper compaction is obtained at no additional expense to Owner.
- C. In all areas to receive pavement, a CBR or (LBR) test shall be performed for each type of material imported from off-site.

- D. Independent Testing Laboratory shall prepare test reports that indicate test location, elevation data, and test results. Owner, Architect, and Contractor shall be provided with copies of reports within 96 hours of time test was performed. In the event that any test performed fails to meet these Specifications, Owner and Contractor shall be notified immediately by Independent Testing Laboratory.
- E. The Contractor at no additional expense shall pay for all costs related to retesting due to failures to the Owner. Contractor shall provide free access to site for testing activities.

## PART 2 PRODUCTS

### 2.1 MATERIALS

- A. Excavated and re-used material for subsoil fill as specified herein.
- B. Imported subsoil material approved by the Owner and specified herein.
- C. Topsoil fill as specified in Section 02100 – Soil Preparation.
- D. Acceptable stabilization fabrics as Geogrids:
  - 1. Mirafi 500X or 600X
  - 2. Phillips 66 Supac 6WS
  - 3. Dupont Typar 3401 and 3601
  - 4. Trevira S1114 and S1120
  - 5. Tensar SS-1 and SS-2
  - 6. Exxon GTF-200 or 350
- E. Acceptable filter/drainage Fabrics:
  - 1. Mirafi 140NS
  - 2. Phillips 66 Supac 4NP
  - 3. Dupont Typar 3341

## PART 3 EXECUTION

### 3.1 PREPARATION

- A. Identify required lines, levels, contours and datum.
- B. Locate and identify existing utilities that are to remain and protect them from damage.
- C. Notify utility companies to remove and/or relocate any utilities that are in conflict with the proposed improvement.
- D. Protect plant life, lawns, fences, existing structures, sidewalks, paving and curbs indicated to remain, from excavating equipment and vehicular traffic.

- E. Protect benchmarks, property corners and all other survey monuments from damage displacement. If a marker needs to be removed it shall be referenced by a licensed surveyor and replaced, as necessary, by the same.
- F. Remove from site material encountered in grading operations that, in opinion of Owner or Owner's Representative, is unsuitable or undesirable for backfilling, subgrade or foundation purposes. Dispose of it in a manner satisfactory to Owner. Backfill areas with layers of suitable material and compact as specified.

### 3.2 EXCAVATION FOR FILLING AND GRADING

- A. Classification of Excavation: Contractor by submitting bid acknowledges that he has investigated site to determine type, quantity, quality, and character of excavation work to be performed.
- B. Perform excavation using capable, well-maintained equipment and methods acceptable to Owner and governing agencies.
- C. Excavated material containing rock or stone greater than 6" in largest dimension is unacceptable as fill within the proposed building area.

Refer to Section 02221 - Excavation, Backfilling and Compacting for Structures.

### 3.3 FILLING AND SUBGRADE PREPARATION

- A. Refer to Section 02221 - Excavation, Backfilling and Compacting for Structures.

### 3.4 MAINTENANCE OF SUBGRADE

- A. Finished subgrades shall be verified to ensure proper elevation and conditions for construction above subgrade.
- B. Remove areas of finished subgrade found to have insufficient compaction density to depth necessary and replace in a manner that will comply with compaction requirements by use of material equal to or better than best subgrade material on site. Surface of subgrade after compaction shall be hard, uniform, smooth, stable, and true to grade and cross-section.

### 3.5 FINISH GRADING

- A. Correct all settlement and eroded areas within one year after date of completion at no additional expense to Owner. Bring grades to proper elevation. Replant or replace any grass, shrubs, bushes, or other vegetation disturbed by construction using corrective measures.

END OF SECTION 02200

## SECTION 02221 - EXCAVATING, BACKFILLING, AND COMPACTING FOR STRUCTURES

### PART 1 - GENERAL

#### 1.1 SECTION INCLUDES

- A. Section includes the excavation, backfilling and compacting required for the structures shown in the Contract Drawings.

#### 1.2 REFERENCES

- A. ASTM D422 - Standard Test Method for Particle-Size Analysis of Soils.
- B. ASTM D1557 - Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft<sup>3</sup>).
- C. ASTM D1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method.
- E. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).
- F. ASTM D4318 - Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

#### 1.3 DEFINITIONS

- A. Granular sub-base: Granular fill directly beneath slabs-on-grade.
- B. Backfill: Fill immediately behind foundation elements or retaining walls.
- C. Structural fill: Fill under the structure other than the granular sub-base.

#### 1.4 SUBMITTALS

- A. Upon request, submit soil test reports performed by the Structural Testing/Inspection Agency.

#### 1.5 QUALITY ASSURANCE

- A. Structural Testing/Inspection Agency shall perform the following quality related items:
  - 1. Verify structural fill complies with specifications.
  - 2. Determine particle size, liquid limit, plastic limit, plasticity index and maximum density of each type of soil.
  - 3. Observe proofrolling.

4. Perform a sufficient number of field density tests to verify compaction of structural fill. As a minimum, perform one test per lift for every 2500 square feet of fill placed.
5. Verify foundation bearing capacity.
6. Verify quantities of material removed and quantities of material placed where Unit Prices are involved.

#### 1.6 SURVEY

- A. Prior to construction, have structure location staked and certified by a licensed surveyor. If discrepancies between actual lines and elevations exist, notify Architect/Structural Engineer before proceeding with layout of structure.

#### 1.7 SUBSURFACE CONDITIONS

- A. Copies of a subsurface investigation of the site will be made available upon request. The data is not intended as a representation or warranty of the continuity of such conditions. Owner will not be responsible for interpretation or conclusions drawn therefrom by the Contractor. The data is made available for the convenience of the Contractor and is not guaranteed to represent all conditions that may be encountered.
- B. Contractor may examine the site and make his own subsurface explorations at no additional cost to the Owner. Notify Owner prior to making any subsurface explorations.

#### 1.8 EXISTING UTILITIES

- A. Locate existing underground utilities by careful hand excavation. If utilities are to remain in place, provide protection from damage during construction operations.
- B. Cooperate with Owner and utility companies in keeping respective services and facilities in operation. Do not interrupt existing utility service facilities occupied and used by Owner or others, unless written permission is given by the Architect and then only after temporary utility services have been provided.
- C. Should uncharted or incorrectly charted piping or other utilities be encountered during excavation, consult the Architect immediately for directions.
- D. Repair damaged utilities to satisfaction of utility owner.

#### 1.9 NOTICE

- A. Notify the Architect/Structural Engineer 48 hours prior to the beginning of any excavation work.

## PART 2 - PRODUCTS

### 2.1 GRANULAR SUBBASE

- A. Granular sub-base shall be sound and free-draining, such as sand, gravel or crushed stone with less than 10% passing the 200 sieve. Maximum diameter shall be 1-1/2 inches.

### 2.2 BACKFILL

- A. Backfill shall meet the requirements of the granular sub-base.

### 2.3 STRUCTURAL FILL

- A. Structural fill shall consist of granular material. Granular material shall consist of either sand or gravel or a combination of both. Fill material shall be clean, reasonably well graded, non-plastic (zero PI) with less than 15% passing the 200 sieve and less than 30% passing the 100 sieve. No clayey material or dirt will be allowed.
- B. Structural fill shall be free of organics, debris and deleterious materials.

## PART 3 - EXECUTION

### 3.1 STRIPPING

- A. Strip vegetation, topsoil, roots, and other unsuitable material to a depth determined by the Structural Testing/Inspection Agency but not less than one foot, nor less than 10 feet outside the perimeter of the structure.
- B. Stockpile sufficient amounts of topsoil as required to cover areas to be landscaped with a minimum of six inches of material.

### 3.2 EXCAVATION

- A. Excavation shall be considered unclassified.
- B. Perform excavation to the depths and limits on the Drawings and as specified herein.
- C. Ground water may be encountered during the foundation excavation. Provide a system for controlling the ground water to a level at least three feet below the lowest point of the excavation.
- D. Keep excavations dry by sloping ground away from holes and trenches.



### 3.3 PROOFROLLING

- A. After stripping or excavation and before any fill placement, fill areas shall be proofrolled with a minimum of two coverages of a loaded dump truck or scraper in each of two perpendicular directions.
- B. Areas found to be soft or pumping shall have the soft soil removed and replaced with structural fill and compacted as outlined herein.

### 3.4 PLACEMENT OF STRUCTURAL FILL

- A. Do not place structural fill on subgrade that contains mud.
- B. Structural fill shall be placed and compacted in 8-inch thick loose layers.
- C. Compact structural fill to 95 percent of the maximum dry density as measured by Modified Proctor, ASTM D1557.

### 3.5 PLACEMENT OF GRANULAR SUB-BASE

- A. Do not place granular sub-base on subgrade that contains mud.
- B. Compact granular sub-base to 90 percent of the maximum dry density as measured by Modified Proctor, ASTM D1557.

### 3.6 PLACEMENT OF BACKFILL

- A. Backfill behind wall shall be placed in layers of six inches.
- B. Compact backfill behind walls to 90 percent of the maximum dry density as measured by Modified Proctor, ASTM D1557.

### 3.7 CLEAN UP

- A. Remove excess excavated materials from job site and upon completion leave site in clean condition.

END OF SECTION 02221

## SECTION 02361 - TERMITE CONTROL

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Soil treatment below slab-in-grade for subterranean insects.
  - 2. Soil treatment at foundation perimeter, for subterranean insects.
- B. Related Sections:
  - 1. Section 02221- Excavation, Backfilling and Compacting for Structures.

#### 1.3 PERFORMANCE REQUIREMENTS

- A. Service Life of Soil Treatment: Soil treatment by use of a termiticide that is effective for not less than five years against infestation of subterranean termites.

#### 1.4 SUBMITTALS

- A. Product Data: For termiticide.
  - 1. Submit product data under provisions of Section 01300 - Submittal Procedures.
  - 2. Include the EPA-Registered Label for termiticide products.
- B. Soil Treatment Application Report: After application of termiticide is completed, submit report for Owner's record information, including the following:
  - 1. Date and time of application.
  - 2. Moisture content of soil before application.
  - 3. Brand name and manufacturer of termiticide.
  - 4. Quantity of undiluted termiticide used.
  - 5. Dilutions, methods, volumes, and rates of application used.
  - 6. Areas of application.
  - 7. Water source for application.
- C. Warranty: Special warranty specified in this Section.

## 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: A specialist with at least one year documented experience who is licensed according to regulations of Authorities Having Jurisdiction to apply termite control treatment and products in jurisdiction where Project is located.
- B. Regulatory Requirements: Formulate and apply termiticides according to the EPA-Registered Label.
  - 1. EPA – Federal Insecticide, Fungicide and Rodenticide Act.
- C. Source Limitations: Obtain termite control products through one source.
- D. Material Packaging: Manufacturer’s labels and seals identifying content.
- E. Preinstallation Conference: Conduct conference at Project site to schedule application of termiticide products.

## 1.6 PROJECT CONDITIONS

- A. Environmental Limitations: To ensure penetration, do not treat soil that is water saturated. Do not treat soil while precipitation is occurring. Comply with requirements of the EPA-Registered Label and requirements of Authorities having Jurisdiction.

## 1.7 COORDINATION

- A. Coordinate soil treatment application with excavating, filling, grading, and concreting operations. Treat soil under footings and ground-supported slabs before construction.

## 1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form, signed by Applicator and Contractor certifying that termite control work, consisting of applied soil termiticide treatment, will prevent infestation of subterranean termites. If subterranean termite activity or damage is discovered during warranty period, re-treat soil and repair or replace damage caused by termite infestation.
  - 1. Warranty Period: Five years from date of Substantial Completion.
  - 2. Coverage: Against invasion or propagation of subterranean termites, damage to building or building contents caused by termites; repairs to building or building contents so caused.
- B. Inspect work annually and report in writing to Owner.
- C. Owner reserves the right to renew warranty for an additional five years.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Toxicant Chemical: Water based emulsion, uniform composition, synthetic dye to permit visual identification of treated soil, of the chemical Dursban or other chemical acceptable under Federal and Local regulations of the Authorities Having Jurisdiction.
- B. Dilute and mix toxicant chemical according to manufacturer's instructions.

### 2.2 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Termiticides:
    - a. Bayer Corporation; Premise 75.
    - b. FMC Corporation, Agricultural Products Group; Prevail FT.
    - c. Syngenta; Prelude.

### 2.3 SOIL TREATMENT

- A. Termiticide: Provide an EPA-registered termiticide complying with requirements of Authorities Having Jurisdiction, in an aqueous solution formulated to prevent termite infestation. Provide quantity required for application at the label volume and rate for the maximum termiticide concentration allowed for each specific use, according to product's EPA-Registered Label.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for moisture content of soil, interfaces with earthwork, slab and foundation work, landscaping, and other conditions affecting performance of termite control.
  - 1. Proceed with application only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. General: Comply with the most stringent requirements of Authorities Having Jurisdiction and with manufacturer's written instructions for preparation before beginning application of termite control treatment. Remove all extraneous sources of wood cellulose and other edible materials such as wood debris, tree stumps and roots, stakes, formwork, and construction waste wood from soil within and around foundations.

- B. Soil Treatment Preparation: Remove foreign matter and impermeable soil materials that could decrease treatment effectiveness on areas to be treated. Loosen, rake, and level soil to be treated except previously compacted areas under slabs and footings. Termiticides may be applied before placing compacted fill under slabs if recommended in writing by termiticide manufacturer.
  - 1. Fit filling hose connected to water source at the site with a backflow preventer, complying with requirements of Authorities Having Jurisdiction.

### 3.3 APPLICATION, GENERAL

- A. General: Comply with the most stringent requirements of Authorities Having Jurisdiction and with manufacturer's EPA-Registered Label for products.

### 3.4 APPLYING SOIL TREATMENT

- A. Application: Mix soil treatment termiticide solution to a uniform consistency. Provide quantity required for application at the label volume and rate for the maximum specified concentration of termiticide, according to manufacturer's EPA-Registered Label, to the following so that a continuous horizontal and vertical termiticidal barrier or treated zone is established around and under building construction. Distribute treatment evenly.
  - 1. Slabs-on-Grade: Under ground-supported slab construction, including footings, building slabs, and attached slabs as an overall treatment. Treat soil materials before concrete footings and slabs are placed.
  - 2. Foundations: Adjacent soil including soil along the entire inside perimeter of foundation walls, around plumbing pipes and electric conduit penetrating the slab, and around interior column footers, also along the entire outside perimeter. Avoid soil washout around footings.
  - 3. Penetrations: At expansion joints, control joints, and areas where slabs will be penetrated.
- B. Apply toxicant as a coarse spray to ensure uniform distribution, 12 hours prior to installation of vapor barrier under slab-on-grade or finish grading outside foundation walls.
- C. Apply toxicant to soil at the following rates, using metered applicator:
  - 1. Under floor slab-on-grade: One gallon per 10 sq.ft.
- D. Avoid disturbance of treated soil after application. Keep off treated areas until completely dry.
- E. Protect termiticide solution, dispersed in treated soils and fills, from being diluted until ground-supported slabs are installed. Use waterproof barrier according to EPA-Registered Label instructions.
- F. Post warning signs in areas of application.
- G. Reapply soil treatment solution to areas disturbed by subsequent excavation, grading, landscaping, or other construction activities following application.

- H. If inspection identifies the presence of termites, retreat soil and retest.
- I. Use same toxicant as for original treatment.

END OF SECTION 02361



## SECTION 02721 - AGGREGATE BASE COURSE

### PART 1 GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Granular Sub-Base.
- B. Related Sections:
  - 1. Section 02100 - Site Preparation.
  - 2. Section 02200 - Earthwork.

#### 1.2 REFERENCES

- A. ASTM International:
  - 1. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft<sup>3</sup> (600 kN-m/m<sup>3  - 2. ASTM D1556 - Standard Test Method for Density of Soil in Place by the Sand-Cone Method.
  - 3. ASTM D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (6,000 ft-lbf/ft<sup>3</sup> (2,700 kN-m/m<sup>3  - 4. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
  - 5. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
  - 6. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).</sup></sup>

#### 1.3 SUBMITTALS

- A. Section 01330 - Submittal Procedures.

### PART 2 PRODUCTS

#### 2.1 FILL MATERIALS

- A. Submit materials certificate to on-site Independent Testing Laboratory, which is signed by material producer and Contractor, certifying that materials comply with, or exceed, the requirements herein.



## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify substrate has been inspected, gradients and elevations are correct, and dry.

### 3.2 PREPARATION

- A. Correct irregularities in substrate gradient and elevation by scarifying, reshaping, and re-compacting, as necessary.
- B. Do not place fill on soft or muddy surfaces.

### 3.3 AGGREGATE PLACEMENT

- A. Perform base course construction in a manner that will drain surface properly at all times and at the same time prevent runoff from adjacent areas from draining onto base course construction.
- B. Compact base material to not less than 98% of optimum density as determined by ASTM D698 or 95% of optimum density, as determined by ASTM D1557, unless otherwise indicated on the Drawings.
- C. Granular Base: Construct to thickness indicated on Drawings. Apply in lifts or layers not exceeding 8", measured loose.

### 3.4 FIELD QUALITY CONTROL

- A. An Independent Testing Laboratory, selected and paid by Contractor, shall be retained to perform construction testing of in-place base courses for compliance with requirements for thickness and tolerance. Aggregate base course tolerance shall be verified (by rod and level readings on no more than fifty-foot centers) to +0.05' of design elevation that allow for required thickness as shown in the Drawings. Contractor shall provide instruments and suitable benchmark.
- B. The following test shall be performed on each type of material used as base course material:
  - 1. Moisture and Density Relationship: ASTM D698 or ASTM D1557
- C. Field density tests for in-place materials shall be performed according to one of the following standards as part of construction testing requirements:
  - 1. Sand Cone Method: ASTM D1556
  - 2. Balloon Method: ASTM D2167
  - 3. Nuclear Method: ASTM D2922, Method B (Direct Transmission)
- C. Independent Testing Laboratory shall prepare test reports that indicate test location, elevation data, and test results. The Owner, Architect, and Contractor shall be provided with copies of reports within 96 hours of time tests were performed. In event that any test

performed fails to meet these Specifications, Independent Testing Laboratory shall notify Owner and Contractor immediately. Contractor shall provide free access to site for testing activities.

END OF SECTION 02721



## SECTION 02730 - SANITARY SEWER SYSTEM

### PART 1 GENERAL

#### 1.1 SUMMARY

- A. Furnish labor, materials, services and equipment required for the construction of the sanitary systems. These shall include, but are not limited to the following:
  - 1. Sanitary sewer drainage piping, fittings and accessories, cleanouts and bedding.
- B. Set lines, elevations, and grades for sanitary sewer system work and control system for duration of work, including careful maintenance of benchmarks, property corners, monuments or other reference points.

#### 1.2 RELATED REQUIREMENTS

- A. Construction Drawings.
- B. Local Authorities Having Jurisdiction and Code Requirements.
- C. Construction Permits and Endorsements.

#### 1.3 REFERENCES

- A. ASTM International:
  - 1. ASTM C443 - Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.
  - 2. ASTM D3034 - Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

#### 1.4 DEFINITIONS

- A. Bedding: Fill placed under, beside and directly over pipe, prior to subsequent backfill operations.

#### 1.5 SUBMITTALS

- A. Section 01330 - Submittal Procedures.
- B. Product Data: Provide catalog materials indicating pipe, accessories, and fittings.
- C. Manufacturer's Installation Instructions: Indicate special procedures required to install Products specified.
- D. Manufacturer's Certificate: Certify that products meet or exceed ASTM designations.

## PART 2 PRODUCTS

### 2.1 SEWER PIPE MATERIALS

- A. Polyvinyl Chloride Sanitary Sewer
  - 1. Pipe and fittings shall comply with ASTM D3034, rated SDR 35. Pipe shall be continually marked with manufacturer's name, pipe size, cell classification, SDR rating and ASTM D3034 classification.
  - 2. Pipe joints shall be integrally molded bell ends per ASTM D3034, Table 2, with factory supplied elastomeric gaskets and lubricant.
  - 3. Corrugated Polyvinyl Chloride sewer pipe and fittings shall comply with ASTM F949. Pipe must be marked with manufacturer's name, pipe size, cell classification, SDR rating and ASTM F949 classification. Pipe must be installed per the manufacturer's installation requirements.
  
- B. Concrete Sanitary Sewer
  - 1. Concrete Pipe: ANSI/ASTM C14, Class 1, 2 or 3 as specified on Drawings; unreinforced; inside nominal diameter as specified, bell and spigot end joints.
  - 2. Concrete Pipe Joint Devices: ANSI/ASTM C443, rubber compression gasket joint.
  
- C. Reinforced Concrete Sanitary Sewer
  - 1. Reinforced Concrete Pipe: ANSI/ASTM C76, Class I, II, III, IV, or V as specified on Drawings, with wall type A, B, or C; mesh reinforcement; inside nominal diameter as specified, bell and spigot end joints.
  - 2. Reinforced Concrete Pipe Joints Device: ANSI/ASTM C443, rubber compression gasket joint.

### 2.2 PIPE ACCESSORIES

- A. Pipe Joints: Mechanical clamp ring type, stainless steel expanding and contracting sleeve, neoprene ribbed gasket or positive seal.
  
- B. Fittings: Same material as pipe molded or formed to suit pipe size and end design, in required tee, bends, elbows, cleanouts, reducers, traps and other configurations required.

### 2.3 CLEANOUTS

- A. Lid and Frame: heavy duty cast iron construction.
  
- B. Shaft Construction: Cast iron shaft of internal diameter as specified on Drawings with 2500 psi concrete collar for cleanouts located in paved areas.
  
- C. Base Pad: Cast-in-place concrete, 2500 psi leveled top surface to receive cast iron shaft sections, sleeved to receive sanitary sewer pipe sections.

## PART 3 EXECUTION

### 3.1 PREPARATION

- A. Hand trim excavations to required elevations. Correct over excavation with fine aggregate.
- B. Remove large stones or other hard matter which could damage pipe or impede consistent backfilling or compaction.

### 3.2 BEDDING

- A. Hand trim excavation for accurate placement of pipe to elevations indicated.
- B. Place bedding material at trench bottom, level materials in continuous layer not exceeding 8 inches compacted, depth, compact to 95%.
- C. Maintain optimum moisture content of bedding material to attain required compaction density.

### 3.3 PIPE INSTALLATION

- A. Install pipe, fittings, and accessories in accordance with ASTM C12, ASTM C14 and/or manufacturer's instructions. Seal joints watertight.
- B. Lay pipe to slope gradients noted on Drawings; with maximum variation from true slope of 1/8 inch in 10 feet.
- C. Install bedding at side and over top of pipe to minimum compacted thickness of 12 inches compact to 95%.
- D. Do not display or damage pipe when compacting.
- E. Connect to building sanitary sewer outlet and PRASA sewer system installed sleeves.

### 3.4 CLEANOUT INSTALLATION

- A. Form bottom of excavation clean and smooth to correct elevation.
- B. Form and place cast-in-place concrete base pad, with provision for sanitary sewer pipe end section, as indicated in Drawings.
- C. Mount lid and frame level in grout, secure the top cone section to elevation indicated.

### 3.5 FIELD QUALITY CONTROL

- A. Compaction testing will be performed in accordance with ANSI-ASTM D698, ASTM D2922 or ASTM D3017.

- B. If tests indicate work does not meet specified requirements, remove work, replace and retest at no cost to the Owner.
- C. If the deflection test is to be run using a rigid ball or mandrel, it shall have a diameter equal to 95% of the inside diameter of the pipe. The test shall be performed without mechanical pulling devices.

### 3.6 PROTECTION OF FINISHED WORK

- A. Section 01700 - Execution Requirements.
- B. Protect pipe and aggregate cover from damage or displacement until backfilling operation is in progress.

END OF SECTION 02730

## SECTION 02770 - SIDEWALKS

### PART 1 GENERAL

#### 1.1 SUMMARY

- A. This work shall consist of the construction and reconstruction of concrete sidewalks, in accordance with these specifications and in conformity with the lines and grades shown on Drawings or established by the Architect.

#### 1.2 MATERIALS

- A. Portland Cement concrete for sidewalks shall be Class B unless otherwise indicated.
- B. All materials will be subject to inspection for acceptance as to condition at the latest practicable time the Owner's Representative has the opportunity to check for compliance prior to or during incorporation of materials in the work.

#### 1.3 CONSTRUCTION REQUIREMENTS

- A. Portland Cement Concrete Sidewalks
  - 1. Excavation: Excavation shall be made to the required depth and to a width that will permit the installation and bracing of the forms. The foundation shall be shaped and compacted to a firm even surface. All soft and unsuitable material shall be removed and replaced with bed course material.
  - 2. Forms: Forms shall be of wood, metal or other approved material and should extend for the full depth of the concrete. All forms shall be straight, free from warps and of sufficient strength to resist the pressure of the concrete without springing. Bracing and staking of forms shall be such that the forms remain in both horizontal and vertical alignment until their removal.
  - 3. Reinforcement: Unless otherwise shown on Drawings, the reinforcement shall be embedded at mid-depth in the slab.
  - 4. Handling and Placing: The foundation shall be thoroughly moistened immediately prior to the placing of the concrete. The concrete shall be placed in one course to full depth.
  - 5. Finishing: The concrete shall be finished with a wooden float to produce a smooth surface and then broomed in a transverse direction to a uniform texture. All outside edges of the slab and all joints shall be finished with an edging tool having a 1/4" radius.
  - 6. Curing: No traffic shall be allowed on the sidewalks during the curing period.

#### 1.4 SUBMITTALS

- A. Section 01330 - Submittal Procedures.



## PART 2 EXECUTION

### 2.1 PREPARATION

- A. Moisten base to minimize absorption of water from fresh concrete.
- B. Notify Architect/Engineer minimum 24 hours prior to commencement of concreting operations.

### 2.2 FORMING

- A. Place and secure forms to correct location, dimension, profile, and gradient.
- B. Assemble formwork to permit easy stripping and dismantling without damaging concrete.
- C. Place joint filler vertical in position, in straight lines, as needed. Secure to formwork during concrete placement.

### 2.3 REINFORCEMENT

- A. Place reinforcement as indicated.
- B. Interrupt reinforcement at joints.
- C. Place reinforcement to achieve pavement and curb alignment.

### 2.4 PLACING CONCRETE

- A. Place concrete in accordance with Section 03300: Cast-in-Place Concrete and with Public Work's standards.
- B. Place concrete using the slip form technique.
- C. Ensure reinforcement, inserts, embedded parts and formed joints are not disturbed during concrete placement.
- D. Place concrete continuously over the full width of the panel and between predetermined construction joints. Do not break or interrupt successive pours such that cold joints occur.

### 2.5 JOINTS

- A. Place joints at intervals according to existing pattern. Align curb, gutter, and sidewalk joints.
- B. Place joint filler between paving components and building or other appurtenances, as needed.
- C. Provide keyed joints as indicated.

## 2.6 FINISHING

- A. Sidewalk Paving: Wood float.
- B. Curbs and Gutters: Light broom.
- C. Direction of Texturing: Transverse to pavement direction.

## 2.7 JOINT SEALING

- A. Separate pavement from vertical surfaces with joint filler, as needed.
- B. Place joint filler in pavement pattern placement sequence. Set top to required elevations. Secure to resist movement by wet concrete.

## 2.8 FIELD QUALITY CONTROL

- A. Section 01400 - Quality Requirements.
- B. Testing Laboratory will take cylinders and perform slump tests in accordance with ACI 301.
- C. Maintain records of placed concrete items. Record date, location of pour, quantity, air temperature, and test samples taken.

## 2.9 PROTECTION

- A. Immediately after placement, protect pavement from premature drying, excessive hot temperatures, and mechanical injury.
- B. Do not allow pedestrian traffic over pavement 7 days minimum after finishing.

END OF SECTION 02770



## SECTION 03100 - CONCRETE FORMWORK

### PART 1 - GENERAL

#### 1.1 SECTION INCLUDES

- A. Section includes the design and erection of formwork, shoring and reshoring for cast-in-place concrete and accessories.

#### 1.2 RELATED SECTIONS

- A. Section 01335 - Structural Submittals.
- B. Section 03200 - Concrete Reinforcement.
- C. Section 03300 - Cast-in-Place Concrete.

#### 1.3 REFERENCES

- A. ACI 117 - Standard Specifications for Tolerances for Concrete Construction and Materials.
- B. ACI 301 - Standard Specifications for Structural Concrete.
- C. ACI 318 - Building Code Requirements for Structural Concrete.
- D. ACI 347 - Recommended Practice for Concrete Formwork.
- E. ASTM E1643-09 - Standard Practice For Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact With Earth or Granular Fill Under Concrete Slabs.
- F. ASTM E1745-09 - Standard Specification for Water Vapor Retarders Used in Contact with Soil or Granular Fill Under Concrete Slabs.

#### 1.4 DESIGN OF FORMWORK

- A. Design of formwork, shoring, and reshoring and its removal is the sole responsibility of the Contractor.
- B. Design of formwork, shoring, and reshoring shall conform to ACI 117, ACI 301, ACI 318, and ACI 347.
- C. Design formwork in a manner such that existing or new construction is not overloaded.
- D. Formwork shall be designed by an engineer licensed in the Commonwealth of Puerto Rico.

- E. Do not remove shores or reshores earlier than recommended by ACI 301 and ACI 347.

## PART 2 - PRODUCTS

### 2.1 FORM MATERIALS

- A. Construct forms with wood, plywood, metal, fiberglass or a combination of these.
- B. Form materials shall have sufficient strength to prevent distortion.

### 2.2 FORMWORK ACCESSORIES

- A. Formwork accessories that are embedded in concrete, including ties and hangers, shall be commercially manufactured products. Do not use nonfabricated wire form ties.

### 2.3 FORM RELEASE AGENT

- A. Form release agent shall not bond with, stain, nor adversely affect concrete surfaces.

### 2.4 VAPOR RETARDER

- A. Vapor retarder shall consist of a material having a permeance rating of 0.100 perm or less, when tested in accordance with ASTM E1745, and not less than ten mils thick.
- B. For areas to receive seamless flooring, provide a waterproof and vaporproof membrane with a permeance rating of 0.010 perm or less, when tested in accordance with ASTM E1745, and not less than fifteen mils thick. Refer to the Architectural floor plan and finish schedule for location.

### 2.5 EXPANSION JOINT FILLER

- A. Asphalt impregnated premolded fiberboard expansion joint filler shall conform with ASTM D1751 and be 1/2-inch thick by full thickness of slab or joint, unless indicated otherwise on the Drawings.

### 2.6 CONSTRUCTION JOINTS

- A. Provide key type steel forms by Vulcan screed joints, Burke Keyed Kold joint form or approved equal.

### 2.7 EMBEDDED PLATE ASSEMBLIES

- A. Embedded steel plates, angles, and channels shall conform to ASTM A36, 36 ksi minimum yield strength, unless noted otherwise on the contract drawings.

- B. Headed steel studs and their attachment to steel shall conform to the requirements of AWS D1.1.
- C. Provide 3/4-inch diameter headed steel studs with 6-inch minimum embedment, unless noted otherwise.
- D. Provide heat-resistant ceramic arc shields with studs.

## PART 3 - EXECUTION

### 3.1 GENERAL

- A. Erect formwork in accordance with ACI 301, ACI 318, and ACI 347.
- B. Maintain formwork and shoring to support loads until such loads can be supported by concrete structure.

### 3.2 TOLERANCES

- A. Finished work shall comply with ACI 117 tolerances.

### 3.3 SURFACE PREPARATION

- A. For concrete exposed to view, seal form joints to prevent leakage.
- B. Before reinforcement is placed, coat contact surfaces of form with form release agent in accordance with manufacturer's recommendations. Do not allow excess form release agent to accumulate in forms or come in contact with concrete surfaces against which fresh concrete will be placed.

### 3.4 CHAMFERS

- A. Provide 3/4-inch chamfer at all formed corners.
- B. Chamfers are not required for concrete tie-beams and tie-columns embedded in CMU walls.

### 3.5 FOUNDATION ELEMENTS

- A. Form foundation elements if soil or other conditions are such that earth trench forms are unsuitable.
- B. Sides of exterior grade beams, foundation walls, and turned-down slabs shall be formed.
- C. Maintain minimum coverage of reinforcing steel as indicated on Structural Drawings.

### 3.6 INSERTS

- A. Install and secure in position required inserts, hangers, sleeves, anchors, and nailers.
- B. Locate anchor bolts by using templates with two nuts to secure in position.

### 3.7 EMBEDS

- A. Set and secure embedded plates, bearing plates, and anchor bolts in accordance with approved setting drawings and in such a manner to prevent displacement during placement of concrete.

### 3.8 VAPOR RETARDER

- A. Install Vapor Retarder to resist the transmission of water vapor through the exterior envelope.
- B. Where indicated on Drawings, place vapor retarder over sewer and piping, but below conduits and ducts, and behind insulation and expansion joints at sidewalls.
- C. Place, protect and repair vapor retarder in accordance with ASTM E1643. Lap vapor retarder six inches minimum at splices, sealing joints as required by the manufacturer with adhesive or pressure sensitive tape or both.
- D. Do not puncture vapor retarder.
- E. Install waterproof and vaporproof membrane in accordance with manufacturer's recommendations.
- F. Vapor Retarder shall be installed below granular sub-base.

### 3.9 FORM REMOVAL

- A. Remove forms carefully in such manner and at such time as to ensure complete safety of structure. Do not remove forms shoring, or reshoring until members have acquired sufficient strength to support their weight and the load thereon safely.

### 3.10 PROVISIONS FOR OTHER TRADES

- A. Provide openings in concrete formwork to accommodate work of other trades. Determine size and location of openings and recesses from trades providing such items.
- B. Accurately place and securely support items built into forms. Obtain approval for openings not shown on Drawings.

### 3.11 CLEANING

- A. Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt or other debris just before concrete is placed.

### 3.12 FORM SURFACES

- A. Coat contact surfaces of forms with a formcoating compound before reinforcement is placed. Apply in accordance with manufacturer's recommendations. Rust-stained steel formwork is not acceptable.

### 3.13 CONSTRUCTION JOINTS

- A. Provide construction joints in accordance with ACI 318.
- B. Obtain Architect/Structural Engineer's prior approval for use and location of joints.
- C. Provide 1-1/2 inch deep key type construction joints at end of each placement for slabs, beams, walls, and footings. Bevel forms for easy removal.
- D. Remove loose particles and latency from surface prior to placing the next lift. Chip the surface to a depth sufficient to expose sound concrete.

END OF SECTION 03100





## SECTION 03200 - CONCRETE REINFORCEMENT

### PART 1 - GENERAL

#### 1.1 RELATED SECTIONS

- A. Section 01335 - Structural Submittals.
- B. Section 01410 - Structural Testing/Inspection Agency Services.
- C. Section 03100 - Concrete Formwork.
- D. Section 03300 - Cast-in-Place Concrete.

#### 1.2 REFERENCES

- A. ACI 117 - Standard Specifications for Tolerances for Concrete Construction and Materials.
- B. ACI 301 - Standard Specifications for Structural Concrete.
- C. ACI 315 - Details and Detailing of Concrete Reinforcement.
- D. ACI 318 - Building Code Requirements for Structural Concrete.
- E. ASTM A185 - Standard Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement.
- F. ASTM A615 - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
- G. ASTM A706 - Standard Specification for Low-Alloy Steel Deformed Bars for Concrete Reinforcement.
- H. AWS D12.1 - Recommended Practices for Welding Reinforcing Steel Metal Inserts, and Connections in Reinforced Concrete Construction.
- I. AWS D1.4 - Structural Weld Code - Reinforcing Steel.
- J. CRSI - Manual of Practice, and Documents 63 and 65.

#### 1.3 SUBMITTALS

- A. Submit shop drawings as follows:
  - 1. Notify Structural Engineer prior to detailing reinforcing steel shop drawings.

2. Indicate size, spacings, locations and quantities of reinforcing steel and wire fabric, bending and cutting schedules, splice lengths, stirrup spacing, supporting and spacing devices. Detail reinforcing steel in accordance with ACI 315 and CRSI Standards.
  3. Written description of reinforcement without adequate sections, elevations, and details is not acceptable.
  4. Reproduction of Structural Drawings for shop drawings is not permitted.
- B. Submit, for information only, a certification from each manufacturer or supplier stating that materials meet the requirements of the ASTM and ACI standards referenced.
- C. Submit, for information only, mill test reports.
- D. Submit manufacturer's data for tensile and compressive splicers.

#### 1.4 QUALITY ASSURANCE

- A. Coordinate and schedule in a timely manner with the Structural Testing/Inspection Agency the following quality related items:
1. Verify reinforcing steel for quantity, size, location, and support.
  2. Verify proper reinforcing steel concrete coverage.

#### 1.5 STORAGE AND PROTECTING

- A. Store reinforcing steel above ground so that it remains clean. Maintain steel surfaces free from materials and coatings which might impair bond.

### PART 2 - PRODUCTS

#### 2.1 MATERIALS

- A. Deformed reinforcing steel shall conform to ASTM A615, refer to Structural Drawings for grade (Grade 60 minimum).
- B. Welded steel wire fabric shall conform to ASTM A185.

#### 2.2 ACCESSORY MATERIALS

- A. Annealed steel tie wire shall be 16-1/2 gage minimum.
- B. Bar supports shall be plastic-tipped steel Class I bar supports conforming to CRSI Specifications. Concrete brick may be used to support reinforcement to obtain proper clearance from earth.

## 2.3 SPLICERS

- A. Tensile splicers shall be capable of developing 125% of the reinforcing steel ASTM specified minimum yield strength.
- B. Compression splicers shall be the mechanical type such that the compression stress is transmitted by end bearing held in concentric contact.

## 2.4 DOWEL ADHESIVE

- A. Adhesive for dowels in existing concrete shall be either EPCON System Ceramic 6 Epoxy adhesive supplied by ITW Ramset/Red Head, HIT HY150 injection adhesive supplied by Hilti Fastening Systems, Power-Fast epoxy injection gel supplied by Powers Fastening Company, Acrylic-Tie adhesive supplied by Simpson Strong-Tie Co., or approved equal.

## PART 3 - EXECUTION

### 3.1 FABRICATION

- A. Fabricate steel in accordance with ACI 318 and CRSI standards.
- B. Bend bars cold. Do not heat or flame cut bars. No field bending of bars partially embedded in concrete is permitted, unless specifically approved by Structural Engineer and checked by Testing and Inspection Agency for cracks.
- C. Weld only as indicated. Perform welding in accordance with AWS D12.1 and or AWS D1.4.
- D. Tag reinforcing steel for easy identification.

### 3.2 INSTALLATION

- A. Before placing concrete, clean reinforcement of foreign particles and coatings.
- B. Place, support, and secure reinforcement against displacement in accordance with ACI 318 and CRSI standards. Do not deviate from alignment or measurement.
- C. Place concrete beam reinforcement support parallel to main reinforcement.
- D. Locate welded wire fabric in the top third of slabs. Overlap mesh one lap plus two inches at side and end joints.
- E. Furnish and install dowels or mechanical splices at intersections of walls, columns and piers to permit continuous reinforcement or development lengths at such intersections.
- F. Maintain cover and tolerances in accordance with ACI and CRSI Specifications, unless indicated otherwise on Structural Drawings.

### 3.3 SPLICES

- A. Do not splice reinforcement except as indicated on Structural Drawings.
- B. Tension couplers may be used and installed in accordance with manufacturer's specifications.

### 3.4 DOWELS IN EXISTING CONCRETE

- A. Install dowels and dowel adhesive in accordance with manufacturer's recommendations.
- B. Minimum embedment length shall be 12 bar diameters, unless noted otherwise.

END OF SECTION 03200

## SECTION 03300 - CAST-IN-PLACE CONCRETE

### PART 1 - GENERAL

#### 1.1 SECTION INCLUDES

- A. Section includes cast-in-place concrete work indicated in the Contract Documents or otherwise required for proper completion of the work.

#### 1.2 RELATED SECTIONS

- A. Section 01335 - Structural Submittals.
- B. Section 01410 - Structural Testing/Inspection Agency Services.
- C. Section 03100 - Concrete Formwork.
- D. Section 03200 - Concrete Reinforcement.
- E. Section 03600 - Non-Shrink Grout.
- F. Section 05100 - Structural Steel.
- G. Division 9 - Flooring and Finishes.

#### 1.3 REFERENCES

- A. ACI 214 - Recommended Practice for Evaluation of Strength Test Results of Concrete.
- B. ACI 224.3R - Joints in Concrete Construction.
- C. ACI 233R - Ground Granulated Blast-Furnace Slag as a Cementitious Constituent in Concrete.
- D. ACI 301 - Specifications for Structural Concrete for Buildings.
- E. ACI 302.1 - Guide for Concrete Floor and Slab Construction.
- F. ACI 304 - Guide for Measuring, Mixing, Transporting and Placing Concrete.
- G. ACI 305 - Hot Weather Concreting.
- H. ACI 306 - Cold Weather Concreting.
- I. ACI 308 - Standard Practice for Curing Concrete.
- J. ACI 309 - Guide for Consolidation of Concrete.
- K. ACI 318 - Building Code Requirements for Structural Concrete.

- L. ASTM C31 - Standard Practice for Making and Curing Concrete Test Specimens in the Field.
- M. ASTM C33 - Standard Specification for Concrete Aggregates.
- N. ASTM C39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
- O. ASTM C78 - 08 Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)
- P. ASTM C94 - Standard Specification for Ready-Mixed Concrete.
- Q. ASTM C138 - Standard Test Method for Unit Weight, Yield, and Air Content (Gravimetric) of Concrete.
- R. ASTM C143 - Standard Test Method for Slump of Hydraulic Cement Concrete.
- S. ASTM C150 - Standard Specification for Portland Cement.
- T. ASTM C172 - Standard Practice for Sampling Freshly Mixed Concrete.
- U. ASTM C173 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.
- V. ASTM C230 - Standard Specification for Flow Table or Use in Tests of Hydraulic Cement.
- W. ASTM C260 - Standard Specification for Air-Entraining Admixtures for Concrete.
- X. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
- Y. ASTM C330 - Standard Specification for Lightweight Aggregates for Structural Concrete.
- Z. ASTM C494 - Standard Specification for Chemical Admixtures for Concrete.
- AA. ASTM C495 - Standard Test Method for Compressive Strength of Lightweight Insulating Concrete.
- BB. ASTM C567 - Standard Test Method for Unit Weight of Structural Lightweight Concrete.
- CC. ASTM C618 - Standard Specification for Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete.
- DD. ASTM E1155 - Standard Test Method for Determining Floor Flatness and Levelness Using the F-Number System.

#### 1.4 NOTICE

- A. Notify Architect/Structural Engineer and Structural Testing/Inspection Agency not less than 48 hours prior to placing concrete.

#### 1.5 QUALITY ASSURANCE

- A. Structural Testing/Inspection Agency shall perform the following quality related items:

1. Examine concrete in truck to verify that concrete appears properly mixed.
2. Perform a slump test as deemed necessary for each concrete load. Record if water or admixtures are added to the concrete at the job site. Perform additional slump tests after job site adjustments.
3. Casting and curing of test specimens shall be in accordance with ASTM C31.
4. Mold four specimens per set for compressive strength testing; one set for each 75 cubic yards of each mix design placed in any one day. At a minimum, one set of specimens must be taken every day and one set for every 5,000 square feet of surface area for slabs or walls. For each set molded, record:

- a. Slump
- b. Air content
- c. Unit weight
- d. Temperature, ambient and concrete
- e. Location of placement
- f. Any pertinent information, such as addition of water, addition of admixtures, etc.

Perform one 7-day and two 28-day cylinder breaks; the average of the two 28-day cylinder breaks will yield one compressive strength test. (Use one as a spare to be broken as directed by the Structural Engineer if compressive strengths do not appear adequate.) The strength level shall be considered satisfactory for a class of concrete if both of the following are met: Every average of any three consecutive tests equals or exceeds  $f'c$  AND no strength test falls below  $f'c$  by more than 500 psi (or by more than  $0.10 f'c$  when  $f'c$  is more than 5,000 psi).

5. Verify the dry weight of the lightweight aggregates and the five-day saturated weight of the aggregate, and verify that aggregates are being properly presoaked prior to batching concrete.
6. Monitor placement of structural lightweight concrete placed by pumping.
7. Report in writing, as directed by the Architect/Structural Engineer, on the same day that tests are performed. Reports of compressive strength tests shall contain the project identification name and number, date of concrete placement, name of concrete testing agency, concrete design compressive strength, location of concrete placement in structure, concrete mix proportions and materials, compressive breaking strength and type of break.
8. Test concrete slabs for specified flatness and levelness in accordance with ASTM E1155. As a minimum, test three placements: the first placement and two additional placements as directed by the Structural Engineer. If the tested placement does not meet the specified overall values, test the next placement.

- B. The ready-mixed concrete plant shall be certified for conformance with the requirements of the National Ready Mix Concrete Association.



## 1.6 CONCRETE MIX DESIGN

- A. Establish concrete mix design proportions in accordance with ACI 318, Chapter 5.
- B. Submit concrete mix designs. Include the following:
  - 1. Type and quantities of materials
  - 2. Slump
  - 3. Air content
  - 4. Fresh unit weight
  - 5. Aggregates sieve analysis
  - 6. Design compressive strength
  - 7. Location of placement in structure
  - 8. Method of placement
  - 9. Method of curing
  - 10. Seven-day and 28-day compressive strengths
  - 11. Waterproofing Admixture
- C. Concrete supplier shall submit certifications that the materials used meet applicable ASTM Specifications. Mix designs not conforming to the above will be rejected.
- D. Submit verification from the concrete admixture supplier that the concrete mix conforms to their requirements for the waterproofing admixture. Concrete supplier shall coordinate the mix design with the waterproofing admixture supplier prior to the concrete mix submittal.

## 1.7 STRUCTURAL LIGHTWEIGHT CONCRETE

- A. Design structural lightweight concrete mixes suitable for pumping.

## 1.8 SLUMP

- A. Design concrete with a maximum slump of five inches.
- B. If a slump greater than five inches is desired it shall be achieved with a high-range water reducer. The maximum slump after high-range water reducers are added shall be eight inches.

## 1.9 FRESH UNIT WEIGHT

- A. Normal weight concrete shall have a fresh unit weight of 140 to 152 pcf.
- B. Structural lightweight concrete shall have a fresh unit weight of 110 to 120 pcf, and an air-dried unit weight of 107-116 pcf (113 pcf for 6 ¼" slab max).

## 1.10 AIR CONTENT

- A. Structural concrete in Non-Aggressive Environment:
  - 1. Normal Weight Concrete: No air is required.

2. Lightweight Concrete: Entrained air content shall be between 4 and 7 percent.
- B. Structural concrete in Aggressive Environment (see definition):
1. Normal Weight Concrete: Entrained air content shall be provided in accordance with Section 4.2.1 of ACI 318-05.
  2. Lightweight Concrete: Entrained air content shall be provided in accordance with Section 4.2.1 of ACI 318-05 with a minimum air content of 4 percent.

#### 1.11 WATER/CEMENT RATIO

- A. Concrete elements shall have a maximum water cement ratio of the following, unless noted otherwise.

<u>Compressive Strength</u>	<u>W/C</u>
3000 psi	0.55 UNO
4000 psi	0.50 UNO
5000 psi or greater	0.48 UNO

- B. Concrete elements within an aggressive environment shall have a maximum water/cement ratio of the following, unless noted otherwise.

<u>Compressive Strength</u>	<u>W/C</u>
4000 psi	0.45
5000 psi or greater	0.40

- C. For slabs on grade, provide a maximum water/cement ratio of 0.45.

### PART 2 - PRODUCTS

#### 2.1 MATERIALS

- A. Materials designated by specific manufacturer's trade names are approved, subject to compliance with the quality and performance indicated by the manufacturer. Instructions and specifications, published by the manufacturer of such materials are included in and are a part of these specifications. Upon request, provide certification from manufacturer or supplier that materials designated by reference to ASTM and ACI standards meet the requirements of these standards.

#### 2.2 CONCRETE STRENGTH

- A. Provide concrete strengths indicated on the Structural Drawings.

#### 2.3 CEMENT

- A. Portland cement shall conform to ASTM C150, Type I, unless noted otherwise. Use one brand only.

### 2.3 AGGREGATE

- A. Fine aggregate shall conform to ASTM C33.
- B. Coarse aggregate of gravel or crushed stone shall conform to ASTM C33. Size coarse aggregate in accordance with ACI 318.
- C. Lightweight coarse aggregate shall conform to ASTM C330. Do not blend lightweight coarse aggregates with normal weight coarse aggregates for structural lightweight concrete.

### 2.4 WATER

- A. Water shall be potable and free of deleterious substances in accordance with ACI 318.

### 2.5 AIR ENTRAINING AGENT

- A. Air entraining agent shall conform to ASTM C260.

### 2.6 WATER REDUCER

- A. Water reducing agent shall conform to ASTM C494.

### 2.7 HIGH-RANGE WATER REDUCER

- A. High-range water reducers (superplasticizers) shall conform to ASTM C494.

### 2.8 CHLORIDE

- A. Use no chlorides of any form in concrete.

### 2.9 CURING COMPOUND

- A. An acrylic, water based, "odorless" cure compound may be used at the Contractor's option in accordance with ASTM C309, and in compliance with these specifications.

### 2.10 FLY ASH

- A. Fly ash shall be Class F fly ash with a loss on ignition of less than five percent or Class C fly ash with a loss on ignition of less than one percent in accordance with ASTM C618.
- B. Maximum fly ash content shall be limited to 20% of the total cementitious material weight.

## 2.11 GROUND GRANULATED BLAST-FURNACE SLAG (GGBFS).

- A. Ground Granulated Blast-Furnace Slag (GGBFS) shall conform to ACI 233.
- B. Maximum GGBFS content shall be limited to 50% of the total cementitious material weight. Maximum total combined GGBFS plus Fly ash shall be limited to 50% of the total cementitious material weight.

## 2.12 ACCELERATORS

- A. Non-chloride accelerators shall conform to ASTM C494.

## 2.13 RETARDERS

- A. Retarders shall conform to ASTM C494.

## PART 3 - EXECUTION

### 3.1 HIGH-RANGE WATER REDUCERS

- A. High-range water reducers are to be added at dosage recommended by the manufacturer. The slump of the concrete shall be one to four inches at the time the high-range water reducers are added. Do not permit fresh concrete containing superplasticizers to come in contact with fresh concrete not containing superplasticizers.

### 3.2 COARSE LIGHTWEIGHT AGGREGATE

- A. Presoak coarse lightweight aggregate a minimum of 72 hours prior to batching. Maintain the moisture content indicated by the five day saturated weight.

### 3.3 ADDITION OF WATER AT JOB SITE

- A. Water may be added to the batch only if neither the maximum permissible water/cement ratio nor the maximum slump is exceeded.
- B. The superintendent or his designated representative may only add water to the concrete batch if the batching plant has noted on the trip ticket the maximum amount of water that may be added on site.

### 3.4 PLACEMENT OF CONCRETE

- A. Deposit concrete as near as practical to final position. Maximum free fall shall be six feet.
- B. Do no flowing of concrete with vibrators.
- C. Place floors and slabs in accordance with ACI 302.

- D. Place thickened slabs for partitions integral with floor slabs.
- E. Prepare place of deposit, mix, convey, place, and cure concrete in accordance with ACI 301, ACI 304, and ACI 318. Wet forms before placing concrete.

### 3.5 TIME LIMIT

- A. Deposit concrete within one and one-half hours after batching.

### 3.6 VIBRATION

- A. Consolidate concrete in accordance with ACI 301 and ACI 309.

### 3.7 CURING

- A. Begin curing procedures immediately following the commencement of the finishing operation.
- B. Cure concrete in accordance with ACI 308. Keep the concrete surface moist. If an acrylic curing compound is used, apply in accordance with manufacturer's recommendations to surfaces of concrete not protected for five days by formwork. Do not use curing compounds in areas to receive material that does not adhere to concrete cured with a curing compound unless the curing compound is water soluble.

### 3.8 SLAB ON GRADE

- A. Concrete used in slabs on grade shall exhibit ultimate shrinkage strain no more than 0.05 percent. If tests were required to meet this criteria, concrete shrinkage tests shall be performed in accordance with ASTM C 157 on specimens moist-cured for one day. Tests shall be performed by an ACI certified technician in an ACI certified laboratory.

### 3.9 ENVIRONMENTAL PROVISIONS

- A. Perform hot weather concreting in accordance with ACI 305.
- B. Protect concrete from drying and excessive temperature for the first seven days.
- C. Protect fresh concrete from wind.

### 3.10 CONTRACTION JOINTS

- A. Obtain Architect/Structural Engineer's approval for location of contraction joints.
- B. Do not place contraction joints in framed floors or composite slabs.

- C. Place contraction joints in slabs-on-grade with a maximum spacing of approximately 15' to form a regular grid. The long dimension of the grid shall not exceed 1.5 times the short dimension of the grid. Contraction joints may be saw cut if cut within 8 hours after placement of concrete. Saw cuts shall be a depth equal to one-fourth the slab thickness by one-eighth inch wide. Alternately, in areas to receive carpeting or wood flooring contraction joints may be provided by preformed plastic strip inserts.
- D. Provide contraction joints in concrete walls at approximately 20-foot centers; coordinate location with Architect and Engineer. Contraction joints shall be formed as a V-groove on both faces of the wall, 3/4-inch minimum depth.
- E. Remove dirt and debris from joints. Joints shall be dry and free from all substances that inhibit bond. Install sealant to prevent three-sided bonding. Coordinate sealant installation with the application of the flooring and Division 9 specifications.

### 3.11 CUTTING CONCRETE

- A. Obtain Architect/Structural Engineer's written approval prior to cutting concrete for installation of other work.

### 3.12 PATCHWORK AND REPAIRS

- A. Notify Architect/Structural Engineer of any defective areas in concrete to be patched or repaired. Repair and patch defective areas with non-shrink grout. Cut out defective areas over two inches in diameter to solid concrete, but not less than a depth of one inch. Make edges of cuts perpendicular to the concrete surface.

### 3.13 DEFICIENT CONCRETE COMPRESSIVE STRENGTH

- A. In the event that concrete tests indicate a 3-day, 7-day, or 28-day strength below that which was expected or specified, the Contractor with the agreement of the Architect/Engineer shall have the mix adjusted so that subsequent concrete will comply with the minimum strength requirements. The Owner may require core specimens to be taken and tested, at the Contractor's expense. If core tests fall below minimum requirements, as determined by the Architect/Engineer, the concrete in place will be deemed to be defective. This concrete shall be removed and replaced or strengthened in a manner acceptable to the Owner and Architect/ Engineer, at the Contractor's expense. Any demolition or repair of other materials or systems as a result of repair or replacement of defective concrete shall be at the Contractor's expense.

### 3.14 CONCRETE FINISHES

- A. Finish concrete in accordance with ACI 301, ACI 117, and ACI 302.1.
- B. Finish concrete slabs to flatness and levelness tolerances which correspond to  $F_F 25/F_L 20$  minimum overall for composite of all measured values per placement and  $F_F 17/F_L 15$  minimum for any individual floor section.

- C. For concrete slabs to receive owner furnished equipment, finish to floor flatness and floor levelness tolerances stated in the equipment manufacturer's recommended guidelines.
- D. Slabs which do not meet the flatness and levelness criteria shall be repaired or replaced.

END OF SECTION 03300

## SECTION 03600 - NON-SHRINK GROUT

### PART 1 - GENERAL

#### 1.1 SECTION INCLUDES

- A. Section includes non-shrink grout under base plates, bearing plates, handrail pockets, and where specified in Contract Documents.

#### 1.2 RELATED SECTIONS

- A. Section 01335 - Structural Submittals.
- B. Section 01410 - Structural Testing/Inspection Agency Services.

#### 1.3 REFERENCES

- A. ASTM C109 - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or 50-mm Cube Specimens).
- B. ASTM C1107 - Standard Specification For Packaged Dry, Hydraulic-Cement Grout (Non-Shrink).

#### 1.4 QUALITY ASSURANCE

- A. Structural Testing/Inspection Agency shall perform the following quality related items:
  - 1. Perform compressive strength tests in accordance with ASTM C109 with 2-inch x 2-inch cubes. Test one cube at three days, two cubes at seven days and three cubes at 28 days. Perform one compressive strength test for each ten bags of grout used and/or perform one test minimum for each day of grouting, whichever is more frequent.

#### 1.5 SUBMITTALS

- A. Submit product data sheets for review.

### PART 2 - PRODUCTS

#### 2.1 GROUT

- A. Provide a non-shrink, non-metallic grout that complies with ASTM C1107.
- B. Grout shall have a minimum compressive strength of 5000 psi at 28 days.



- C. Grout placed in exterior exposed conditions or areas subject to moisture shall be free of gypsum. Grout shall be SikaGrout 212 by Sika, General-Purpose by Symons Dayton Superior, or approved equal.

## 2.2 WATER

- A. Provide clean, potable water.

## PART 3 - EXECUTION

### 3.1 HANDLING

- A. Store and protect non-shrink grout from moisture and contamination.

### 3.2 PREPARATION

- A. Remove mud, dirt and other foreign materials from areas to be grouted.
- B. Apply grout to rough concrete surface; roughen concrete as necessary prior to placing grout.

### 3.3 MIXING

- A. Mix grout to its fluid, self-leveling consistency in accordance with manufacturer's recommendations. Do not retemper grout. Do not exceed manufacturer's maximum limit on water content or use at a consistency which produces free bleeding. Mix grout in a paddle-type mortar mixer. Do not mix by hand.

### 3.4 PLACEMENT

- A. Consolidate grout to provide uniformity. Do not vibrate grout.
- B. Use forms to contain grout.

### 3.5 PROTECTION

- A. Protect grout and areas to be grouted from excessive heat and cold in accordance with manufacturer's specifications. Protect grout from excessive drying shrinkage resulting from wind or direct sunlight. Protect areas grouted from excessive vibrations for three days.

END OF SECTION 03600

## SECTION 04 70 00 - MANUFACTURED MASONRY VENEER

### PART 1 - GENERAL

#### 1.01 SUMMARY

- A. Section Includes: Portland cement based manufactured stone veneer and trim.
- B. Related Sections:
  - 1. 07620 – Sheet Metal Flashing and Trim
  - 2. 07920 – Joint Sealants.

#### 1.02 SUBMITTALS

- A. Reference Section 01330 –Submittal Procedures; submit following items:
  - 1. Product Data.  
Samples: Submit sample board using the selected stone and mortar materials; minimum sample size: 3 by 3 feet (1 by 1 m).
  - 2. Quality Assurance/Control Submittals:
    - a. Qualifications:
      - 1) Proof of manufacturer qualifications.
      - 2) Proof of installer qualifications.
    - b. Veneer manufacturer's installation instructions.

#### 1.03 QUALITY ASSURANCE

- A. Qualifications:
  - 1. Manufacturer Qualifications.
  - 2. Installer Qualifications: Experienced mason familiar with installation procedures for manufactured veneer.
- B. Field Sample:
  - 1. Prepare sample at a location on the structure as selected by the Architect. Use approved selection sample materials and colors.
  - 2. Obtain Architect's approval.
  - 3. Protect and retain sample as a basis for approval of completed manufactured stone work. Approved sample may be incorporated into completed work.

#### 1.04 DELIVERY, STORAGE, AND HANDLING

- A. Follow manufacturer's instructions.

#### 1.05 WARRANTY

- A. Special Warranty: Manufacturer's standard warranty coverage against defects in materials when installed in accordance with manufacturer's installation instructions.

### PART 2 - PRODUCTS

#### 2.01 MANUFACTURER

- A. Eldorado Stone, LLC or Architect's approved equivalent.
- B. Product: Veneer types as shown on Drawings.

## 2.02 MATERIALS

- A. Stone Veneer:
  - 1. Color: Eldorado Stone Pearl White or Architect's approved equivalent.
  - 2. Include matching corner pieces.
- B. Veneer Unit properties: Precast veneer units consisting of Portland cement, lightweight aggregates, and mineral oxide pigments.
  - 1. Compressive Strength: ASTM C 192 and ASTM C 39, 5 sample average: greater than 1,800 psi (12.4MPa).
  - 2. Shear Bond: ASTM C 482: 50 psi (345kPa).
  - 3. Water Absorption: UBC Standard 15-5: Less than 22 percent.
  - 4. Thermal Resistance: ASTM C 177: 0.473 at 1.387 inches thick
- C. Reinforcing: ASTM C 847, 2.5lb/yd<sup>2</sup> (1.4kg/m<sup>2</sup>) galvanized expanded metal complying with code agency requirements for the type of substrate over which stone veneer is installed.
- D. Mortar:
  - 1. Cement: Any cement complying with ASTM C 270.
  - 2. Lime: ASTM C 207.
  - 3. Sand: ASTM C 144, natural or manufactured sand.
  - 4. Color Pigment: ASTM C 979, mineral oxide pigments.
  - 5. Water: Potable.
  - 6. Pre-Packaged Latex-Portland Cement Mortar: ANSI A118.4.
- E. Bonding Agent: Exterior integral bonding agent.
- F. Sealer: Water based silane or siloxane masonry sealer, clear.

## 2.03 MORTAR MIXES

- A. Standard Installation (Grouted Joints):
  - 1. Mix mortar in accordance with manufacturer's mortar preparation instructions.
    - a. Add color pigment in grout joint mortar in accordance with pigment manufacturer's instructions.

## PART 3 - EXECUTION

### 3.01 EXAMINATION

- A. Examine substrates upon which work will be installed.
- B. Coordinate with responsible entity to perform corrective work on unsatisfactory substrates.
- C. Commencement of work by installer is acceptance of substrate.

### 3.02 PREPARATION

- A. Protection: Protect adjacent work from contact with mortar.
- B. Surface Preparation: Prepare substrate in accordance with manufacturer's installation instructions for the type of substrate being covered.

### 3.03 INSTALLATION

- A. Install and clean stone in accordance with manufacturer's installation instructions for Standard Installation (Grouted Joint) as specified above.
- B. Apply sealer in accordance with sealer manufacturer's installation instructions.

### 3.04 FIELD QUALITY CONTROL

- A. Manufacturer's Field Services: Manufacturer's Field Service Representative shall make periodic site visits for installation consultation and inspection as requested by Owner.

### 3.05 CLEANING

- A. Remove protective coverings from adjacent work.
- B. Cleaning Veneer Units:
  - 1. Wash with soft bristle brush and water/granulated detergent solution.
  - 2. Rinse immediately with clean water.
- C. Removing Efflorescence:
  - 1. Allow veneer to dry thoroughly.
  - 2. Scrub with soft bristle brush and clean water.
  - 3. Rinse immediately with clean water; allow to dry
  - 4. If efflorescence is still visible, repeat above procedure using a solution of 1 part household vinegar and 5 parts water.
  - 5. Rinse immediately with clean water.

END OF SECTION 04700



## SECTION 05100 - STRUCTURAL STEEL

### PART 1 - GENERAL

#### 1.1 SECTION INCLUDES

- A. Section includes fabrication and erection of structural steel indicated in the Contract Documents or otherwise required for proper completion of the work.

#### 1.2 RELATED SECTIONS

- A. Section 01335 - Structural Submittals.
- B. Section 01410 - Structural Testing/Inspection Agency Services.
- C. Section 05300 - Steel Decking.

#### 1.3 REFERENCES (Current edition adopted by the building code used for the project design as listed in the Structural Drawings)

- A. AISC (American Institute of Steel Construction)
  - 1. Specification For Structural Joints Using ASTM A325 or A490 Bolts
  - 2. Code of Standard Practice For Steel Buildings and Bridges
  - 3. Manual of Steel Construction
  - 4. LRFD Specification for Structural Steel Buildings
- B. AWS (American Welding Society)
  - 1. A5.1 - Specification for Carbon Steel Electrodes for Shield Metal Arc Welding
  - 2. A5.17 - Specification for Carbon Steel Electrodes and Fluxes for Submerged Arc Welding
  - 3. A5.20 - Specification for Carbon Steel Electrodes for Flux Cored Arc Welding
  - 4. A5.5 - Specification for Low-Alloy Steel Covered Arc Welding Electrodes
  - 5. D1.1 - Structural Welding Code
- C. ASTM (American Society for Testing and Materials)
  - 1. Structural Shapes Plates and Bars
    - a. A1 - Standard Specification for Carbon Steel Tee Rails
    - b. A6 - Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling
    - c. A27 - Standard Specification for Steel Castings, Carbon, for General Application
    - d. A29 - Standard Specification for Steel Bars, Carbon and Alloy, Hot-Wrought, General Requirements for
    - e. A36 - Standard Specification for Structural Steel

- f. A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
- g. A216 - Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service
- h. A500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Tubing in Rounds and Shapes
- i. A501 - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
- j. A572 - Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Steels of Structural Quality
- k. A668 - Standard Specification for Steel Forgings, Carbon and Alloy, for General Industrial Use
- l. A913 - Standard Specification for High-Strength Low-Alloy Steel Shapes of Structural Quality, Produced by Quenching and Self-Tempering Process
- m. A992 - Standard Specification for Steel for Structural Shapes for Use in Building Framing
- n. A759 - Standard Specification for Carbon Steel Crane Rails
- o. A1011 - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability

2. Structural Fasteners

- a. A108 - Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished
- b. A307 - Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
- c. A325 - Standard Specification for Structural Bolts, Heat Treated, 120/105 ksi Minimum Tensile Strength
- d. A490 - Standard Specification for Heat-Treated Steel Structural Bolts, 150 ksi Minimum Tensile Strength
- e. A563 - Standard Specification for Carbon and Alloy Steel Nuts
- f. F436 - Standard Specification for Hardened Steel Washers
- g. F844 - Standard Specification for Washers, Steel, Plain (Flat), Unhardened for General Use
- h. F959 - Standard Specification for Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners
- i. F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength
- j. F1852 - Standard Specification for Twist Off Type Tension Control Structural Bolt/Nut/Washer Assemblies, Steel, Heat Treated, 120/105 ksi

3. Other

- a. A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
- b. A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
- c. A673 - Standard Specification for Sampling Procedure for Impact Testing of Structural Steel
- d. A780 - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings

- e. A786 - Standard Specification for Hot-Rolled Carbon, Low-Alloy, High-Strength Low-Alloy, and Alloy Steel Floor Plates
- D. SSPC - Steel Structures Painting Manual.
- E. Research Council on Structural Connections (RCSC) – Specification for Structural Joints Using ASTM A325 or A490 Bolts.

#### 1.4 SUBMITTALS

- A. Contact Structural Engineer's Construction Administration Division prior to detailing structural steel shop drawings.
- B. Reproduction of Structural Drawings for shop drawings is not permitted.
- C. Submit shop drawings for review.
- D. Shop drawings shall clearly indicate the profiles, sizes, ASTM Grade, spacings and locations of all structural steel members, including connections, attachments, anchorage's, framed openings, sizes and types of fasteners, method of tightening fasteners, cambers, and the number, type and spacing of the headed shear connectors.
- E. For record only, submit written Welding Procedure Specifications (WPS) for each type of welded joint used in accordance with AWS D1.1.
- F. Maintain at construction office mill certification that the steel supplied meets the specifications.
- G. Maintain at construction office certification that high strength bolts supplied meet the specifications.
- H. Submit certification that the fabricator meets the required qualifications and ultrasonic testing reports for complete penetration welds. If fabricator has to have an independent testing agency to inspect fabrication as required by these specifications, submit the name and qualifications of the independent testing agency.
- I. Submit certification that the erector meets the required qualifications.
- J. Upon request, submit the erection sequence and procedures to be used by the steel erector.
- K. Upon request, submit shop measurements for camber.

#### 1.5 QUALITY ASSURANCE

- A. Structural Testing/Inspection Agency shall perform the following quality related items:
  - 1. Inspection of work performed at Fabricator's Shop
  - 2. Anchor Bolts (Rods)



- a. Anchor Bolt (Rod) size, grade, configuration, and embedment shall be verified prior to placement of concrete.

3. Welded Connections

- a. Inspection shall be in accordance with AWS Structural Welding Code.
- b. Monitoring of the welds shall be periodic or continuous as indicated below and shall include:
  - 1) Visual inspection of all field-welded connections.
  - 2) Visual inspection of steel fitup prior to weld.
  - 3) Review of approved welding procedure specifications and verification that the welding procedure specifications are being adhered to during field welding.
  - 4) Verification of welder qualifications.
- c. Complete penetration groove welds
  - 1) Ultrasonically inspect 100% of the field welds. If the complete joint penetration weld is less than 5/16" thick, a magnetic particle test of the weld may be performed.

4. Bolted Connections

- a. Inspection and testing shall be in accordance with AISC Specifications for Structural Joints using ASTM A325 or A490 Bolts.
- b. The inspector shall verify (at a minimum) that bolts, nuts, washers, paint on faying surfaces, bolted parts, installation, and tightening are in accordance with the plans and specifications.
- c. The inspector shall verify that all plies of connected materials have been drawn together and properly snugged.
- d. The inspector shall verify that bolt tensioning techniques are in accordance with the AISC Specifications for Structural Joints using ASTM A325 or A490 Bolts.
- e. Connections with Fully Tensioned Bolts:
  - 1) Prior to visual and physical testing, tension testing using a calibration device (Skidmore-Wilhelm) must indicate tensions at least 5% in excess of the AISC minimum. Structural steel erector shall supply the tension calibration device. The inspector shall observe the pre-installation testing and calibration procedures.
  - 2) The inspector shall perform periodic inspection (including a minimum of 10% of the connections) of bolt installation for

tensioning when the turn-of-nut method with match marking techniques, the direct tension indicator, or the alternate design fastener (twist-off bolt) methods are used.

- 3) The inspector shall perform continuous inspection (including 100% of the connections) of bolt installation for tensioning when the calibrated wrench or the turn-of-nut method without match marking methods are used.

f. Connections with Snug Tight Bolts:

- 1) The inspector shall perform periodic inspection (including a minimum of 10% of the connections) of connections with snug tight bolts.

5. Headed Studs

- a. Headed stud bases shall be qualified through an Application Qualification Test (AQT) in accordance with AWS D1.1, Section 7.6 and Annex G. In lieu of an AQT, the manufacturer's Qualification Test (QTD) data may be used. Equipment settings from AQT, or QTD, as applicable, shall serve as the basis for the field production setups.
- b. Pre-production testing and operator qualification shall be performed in accordance with Section 7.7 of AWS D1.1, except that a minimum of three studs shall be tested for each start, and shift, as defined by AWS D1.1 Section 7.7.1. Pre-production testing for each operator is required if more than one.
- c. All production (fabrication) studs shall be visually inspected in accordance with Section 7.8 of AWS D1.1.
- d. All production (fabrication) studs shall be subjected to a hammer ping test. Studs with a hollow ping shall be subjected to a bend test.
- e. Additionally, two studs shall undergo a bend test (torque test for a threaded stud) for every 110 studs installed within each set-up. These tests shall be performed as described in Section 7.8 of AWS D1.1 to insure that significant deviation from the initial set-up did not take place. The frequency of these additional tests may be increased as directed by the engineer of record depending on failure rates.
- f. Two additional tests per AWS D1.1 Sections 7.8 shall be performed at the start of any welding of studs through deck onto painted surfaces in order to qualify the procedure and the welder for this condition. These additional tests are not required if the paint has been removed from the welding surface. However, in no instance shall the weld occur through the coating which would be in any manner injurious to the strength and quality of the weld.
- g. Production studs not passing the visual test and bent at 15 degrees shall be left bent. All other studs bent at 30 degrees shall also be left bent.

6. Material Verification

- a. The inspector shall conduct periodic inspections to verify high-strength bolts, nuts, and washers:
  - 1) Verify that the identification markings conform to the ASTM standards, specified in the approved construction documents.
  - 2) Verify the manufacturer's certificate of compliance.
- b. The inspector shall conduct periodic inspections to verify the structural steel:
  - 1) Verify that the identification markings conform to the ASTM standards, specified in the approved construction documents.
  - 2) Verify the manufacturer's certified mill test reports.
- c. The inspector shall conduct periodic inspections to verify the weld filler materials:
  - 1) Verify that the identification markings conform to the AWS specification, specified in the approved construction documents.
  - 2) Verify the manufacturer's certificate of compliance.

7. Details

- a. The inspector shall conduct periodic inspections of the steel frame to verify compliance with the details shown on the approved construction documents, such as bracing, stiffening, member locations and proper application of joint details at each connection.

8. Expansion Anchors

- a. The inspector shall verify proper installation in accordance with manufacturer recommendations and ICC-ES Code Report requirements. This includes; but is not limited to, verifying the location of the anchor including any edge distance and spacing requirements, drill bit type and size, hole depth, hole cleaning technique (if applicable), anchor type, size, embedment and installation procedure.

9. Adhesive Anchors

- a. The inspector shall verify proper installation in accordance with manufacturer recommendations and ICC-ES Code Report requirements. This includes; but is not limited to, verifying the location of the anchor, any edge distance and spacing requirements, drill bit type and size, hole depth, hole cleaning technique (very important), anchor type, size, embedment and installation procedure including adhesive expiration date and proper dispensing.

1.6 ERECTOR'S QUALIFICATION

- A. Erector shall be experienced in erecting structural systems similar in complexity to this project as evidenced by 10 completed projects.
- B. Erector shall have a minimum of 5 years experience in the erection of structural steel.

1.7 STORAGE

- A. Store materials off ground to permit easy access for inspection and identification. Store steel members and packaged items in a manner that provides protection against contact with deleterious materials.

PART 2 - PRODUCTS

2.1 ANCHOR RODS

- A. Anchor rods shall be threaded rods conforming to ASTM F1554 Gr. 36 unless noted otherwise on the drawings. The anchor rods shall be threaded at both ends.
- B. Provide a heavy hexagonal nut threaded and tack welded to the bottom of each rod unless noted otherwise on the structural documents. The nut shall conform to ASTM A563 Grade A or DH.
- C. Provide heavy hexagonal nut and plain steel washer at the top of each rod. The nut shall conform to ASTM A563 Grade A or DH and washer shall conform to ASTM F844. Leveling nuts and washers shall be provided as deemed necessary by the contractor for erection.
- D. Provide square plate washers conforming to A36 with standard holes in lieu of top steel washers on base plates with oversize holes. Oversized holes are defined as any hole that is larger than a standard hole as defined in Chapter J of the AISC Specification. Recommended maximum base plate holes as given in the AISC Manual are considered oversized holes and should not be exceeded. Plate washers shall conform to the minimum size and thickness limits provided in the table below.

Anchor Rod Diameter (inches)	Minimum Washer Width (inches)	Minimum Washer Thickness (inches)
3/4	3	3/8
7/8	3	3/8
1	3	3/8
1 1/4	3	1/2
1 1/2	3 1/2	1/2
1 3/4	4	5/8
2	5	3/4
2 1/2	5 1/2	7/8

2.2 ROLLED STEEL SHAPES, PLATES, AND BARS

- A. Rolled steel W shapes shall conform to ASTM A992, 50 ksi minimum yield strength, unless noted otherwise on the contract drawings.
- B. Rolled steel M, S, HP, C, MC, and L shapes shall conform to ASTM A36, 36 ksi minimum yield strength, unless noted otherwise on the contract drawings.
- C. Plates and Bars shall conform to ASTM A36, 36 ksi minimum yield strength, unless noted otherwise on the contract drawings.

### 2.3 CRANE RAILS

- A. Crane rails shall conform to ASTM A759, ASTM A1, and/or manufacturer's specifications and tolerances.

### 2.4 SQUARE/RECTANGULAR HOLLOW STRUCTURAL STEEL SECTIONS

- A. Square/rectangular hollow structural steel sections shall conform to ASTM A500, Grade B, 46 ksi minimum yield strength.

### 2.5 ROUND HOLLOW STRUCTURAL STEEL SECTIONS

- A. Round hollow structural steel sections shall conform to ASTM A500, Grade B, 42 ksi minimum yield strength.

### 2.6 ROUND HOLLOW STEEL PIPE

- A. Round hollow steel pipe shall conform to ASTM A53, Grade B, 35 ksi minimum yield strength.

### 2.7 NON-HIGH-STRENGTH FASTENERS

- A. Non-high-strength bolts shall conform to ASTM A307, Grade A, 60 ksi minimum, where noted on the Structural Drawings.
- B. Hardened steel washers shall conform to ASTM F436.

### 2.8 HIGH-STRENGTH FASTENERS

- A. High-strength bolts shall conform to ASTM A325 or ASTM A490 as noted on the Structural Drawings.
- B. Provide 3/4-inch minimum diameter bolts, unless noted otherwise.
- C. Hardened steel washers shall conform to ASTM F436.
- D. Spline-type tension control bolts, plain hardened washers and suitable nuts are an acceptable alternate design bolt assembly.

- E. Do not use load indicating washers.

## 2.9 HEADED STUDS

- A. Headed steel studs shall conform to the requirements of AWS D1.1 and shall be Type B made from ASTM A108 material.
- B. Provide 3/4-inch diameter headed steel studs, unless noted otherwise.
- C. Provide heat-resistant ceramic arc shields with studs.

## 2.10 ROUND RODS

- A. Rods shall conform to ASTM, A36.
- B. The rods shall be threaded at each end.

## 2.11 POST-INSTALLED ANCHORS

- A. Post-installed anchors installed into structural concrete shall be ICC approved for use in cracked concrete as indicated in the structural concrete section of the anchor guide table provided on the Structural Drawings for the concrete type (normal or light weight) under consideration.

## 2.12 WELD ELECTRODES

- A. E-70 series low hydrogen electrodes shall conform to AWS A5.1, A5.5, A5.17, or A5.20.
- B. Properly store electrodes to maintain flux quality.

## 2.13 PRIMER

- A. Oxide primer shall conform to AISC Specifications, Code of Standard Practice, and SSPC Steel Structure Painting Manual, unless indicated otherwise.
- B. Paint primer shall be free of lead and chromate and shall comply with State and Federal volatile organic compound (VOC) requirements.
- C. Paint primer shall be compatible with finish coating.

## 2.14 GALVANIZING

- A. Galvanized coating shall conform to ASTM A123.
- B. Galvanize bolts, nuts, and washers in accordance with ASTM A153 when used to connect steel members that are specified to be galvanized.

- C. Expansion anchors or adhesive anchors specified to be galvanized shall be mechanically galvanized in accordance with ASTM B695, Class 65, Type I.

## PART 3 - EXECUTION

### 3.1 GENERAL

- A. Fabricate and erect structural steel in accordance with AISC Specifications and Code of Standard Practice.
- B. Notify Architect/Structural Engineer and Structural Testing/Inspection Agency at least 48 hours prior to structural steel fabrication and erection.

### 3.2 ANCHOR BOLT (ROD) SETTING

- A. Provide templates for setting anchor bolts (rods). Position anchor bolts (rods) by using templates with two nuts to secure in place prior to placement of concrete.
- B. Do not erect steel where anchor bolt (rod) nuts will not have full threads.

### 3.3 CONNECTIONS

- A. Provide a minimum of two fasteners at each bolted connection.
- B. Ensure fasteners are lubricated prior to installation.
- C. Provide high-strength bolted connections in accordance with AISC Specifications for Structural Joints using ASTM A325 or A490 Bolts.
- D. Provide connections for expansion and contraction where steel beams connect to concrete walls or concrete columns and at expansion joints. Secure nuts on bolts against loosening. (Dent threads with a chisel.)

### 3.4 FASTENER INSTALLATION

- A. Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
- B. High-strength bolts installed shall have a hardened washer under the element turned in tightening.

### 3.5 HEADED STUDS

- A. Headed studs shall be welded in accordance with AWS D1.1.
- B. Locate studs directly over the web of beams with flanges less than 0.3 inches thick.
- C. The minimum center spacing shall be 6 diameters along the longitudinal axis of the beam and 4 diameters transverse to the longitudinal axis of the beam.

- D. Where double rows of studs are required, begin double rows at each end of the beam.
- E. Remove shields after welding studs.
- F. Headed stud welding shall not take place when the temperature is below 0 Degree Fahrenheit, or when the welding surface is not dry.

### 3.6 EXPANSION ANCHOR INSTALLATION

- A. Install in accordance with manufacturer's recommendation.
- B. Minimum embedment shall be equal to 6 times the anchor diameter unless noted otherwise.

### 3.7 ADHESIVE ANCHOR INSTALLATION

- A. Install in accordance with manufacturer's recommendation.
- B. Minimum embedment shall be equal to 9 times the anchor diameter unless noted otherwise.

### 3.8 WELDING

- A. Comply with AWS Structural Welding Code. Use prequalified weld procedures.
- B. Provide end returns where fillet welds terminate at end or sides. Returns shall be continuous for a distance of not less than two times the nominal size of the weld.
- C. Complete penetration joints shall be backgouged to sound metal before the second side is welded or have 1/4-inch root opening with 3/16 x 1-inch backing bar. Access holes are required. Filling access holes is not required.
- D. Remove all slag and weld splatter from deposited weld metal.

### 3.9 SPLICING

- A. Splice members only where indicated unless authorized in writing by Structural Engineer.
- B. Provide shim plates at bottom flange splice at continuous beam splices with different depths.

### 3.10 CUTTING

- A. Do not use flame cutting to correct errors unless authorized in writing.
- B. Re-entrant corners shall have a minimum radius of one inch and be free of notches. Notches and gouges resulting from flame cutting shall be finished to a smooth appearance.



### 3.11 MILL SCALE

- A. Remove loose mill scale.

### 3.12 BOLT HOLES

- A. Cut, drill, or punch holes perpendicular to metal surfaces. Do not enlarge holes by burning. Drill or punch holes in bearing plates. Remove burrs.

### 3.13 PRIMING STEEL

- A. Prime steel that is not encased in concrete, plaster, or sprayed fireproofing. Do not shop prime in areas to be field welded, contact surfaces of slip critical connections, or areas to receive special finishes.
- B. Field prime, as required, steel that has been welded or that is not primed after connections have been tightened.
- C. Verify primer requirements with Architect for buildings without fireproofing.

### 3.14 GALVANIZING

- A. Galvanize shelf angles that support the exterior building veneer, for example brick shelf angles.
- B. Galvanize environmentally exposed steel; for example, mechanical equipment supports.
- C. Touch-up welds and abrasions in galvanized members in accordance with ASTM A780.

### 3.15 SEISMIC LOAD RESISTING SYSTEM CONNECTION DESIGN

- A. Bolted connections in the Seismic Load Resisting System shall meet the requirements of the ANSI/AISC Specification for Structural Steel Buildings and the AISC Specifications for Structural Joints using ASTM A325 or A490 Bolts except as modified below:
  - 1. All bolts shall be fully tensioned high-strength bolts.
  - 2. All faying surfaces shall be prepared as required for Class A or better slip-critical joints.
  - 3. The design shear strength of bolted joints is permitted to be calculated as that for bearing-type joints.
  - 4. Bolted joints shall not be designed to share load in combination with welds on the same faying surface.
  - 5. The bearing strength of bolted joints shall be provided using either standard holes or short-slotted holes with the slot perpendicular to the line of force.

6. Nominal bearing strength at bolts holes shall not be taken greater than  $2.4 d_t F_u$ .
7. Connections shall be configured such that a ductile limit-state either in the connection or in the member controls the design.

END OF SECTION 05100



## SECTION 05300 - STEEL DECKING

### PART 1 - GENERAL

#### 1.1 SECTION INCLUDES

- A. Section includes steel decking as indicated on Drawings, specified herein, and needed for a complete and proper installation.

#### 1.2 RELATED SECTIONS

- A. Section 01335 - Structural Submittals.
- B. Section 01410 - Structural Testing/Inspection Agency Services.
- C. Section 05100 - Structural Steel.

#### 1.3 REFERENCES

- A. AISI - Specifications for the Design of Cold-Formed Steel Structural Members.
- B. ANSI/AWS D1.1 - Structural Welding Code / Steel.
- C. ANSI/AWS D1.3 - Structural Welding Code / Sheet Steel.
- D. ANSI/AWS A5.5 - Specifications for Carbon Steel Electrodes for Shielded Metal Arc Welding.
- E. ANSI/SDI-RD1.0 Standard for Steel Roof Deck.
- F. ANSI/SDI-C1.0 Standard for Composite Steel Floor Deck.
- G. ANSI/SDI-NC1.0 Standard for Non-Composite Steel Floor Deck.
- H. ASTM A653 / A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
- I. ASTM A924 / A924M - Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
- J. ASTM A1008 / A1008M - Standard Specification for Steel, Sheet, Carbon, Cold-Rolled, Carbon, Structural, High-Strength Low Alloy and High Strength Low Alloy with Improved Formability.
- K. ASTM A780 - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.

- L. SDI Manual of Construction with Steel Deck (MOC2-2006).
- M. FS TT-P-664 Federal Specification for Primer Coating, Alkyd, Corrosion-Inhibiting, Lead and Chromate Free, VOC-Compliant.
- N. FS QQ-S-775D Federal Specification for Steel Sheets, Carbon, Zinc Coated.
- O. ANSI/ASSE A10.3 Safety Requirements for Powder Actuated Systems.
- P. SDI Diaphragm Design Manual, 3<sup>rd</sup> Edition.

#### 1.4 SUBMITTALS

- A. Notify the Structural Engineer prior to detailing shop drawings.
- B. Submit product data for each type of deck, accessory, and product indicated.
- C. Submit detailed shop drawings showing layout and types of deck panels, weld or mechanical fastener types and sizes, weld or mechanical fastener patterns, conditions requiring closure panels, supplementary framing, sump pans, cant strips, cut openings, special jointing or other accessories. Where variances in substrate thickness require the use of multiple mechanical fastener types, the layout locations of each fastener type must be clearly indicated in plan on the shop drawings. Include calculations and required information if not completely covered by load tables and products data.
- D. Mechanical fasteners shall be permitted to fasten deck to support framing where specifically indicated on the Drawings or in lieu of welding where approved by the Structural Engineer. Where mechanical fasteners are proposed in lieu of welds, include calculations in accordance with SDI Diaphragm Design Manual, 3<sup>rd</sup> Ed., indicating equivalent diaphragm strength to specified attachment pattern.
- E. Upon request, submit mill certification that the steel supplied meets the required specifications.
- F. Upon request, submit written welding procedures and certificates for welding personnel.
- G. Submit manufacturer's specifications, load tables and installation instructions for each type of decking and accessories. Include manufacturer's certifications to show compliance with supplementary framing, sump pans, cant strips, curb openings, special jointing and other accessories.
- H. Submit manufacturer's test reports, for record only, from a qualified testing agency indicating that each of the following complies with requirements, based on comprehensive testing of current products:
  - 1. Mechanical fasteners
  - 2. Acoustical roof deck

## 1.5 QUALITY ASSURANCE

- A. Steel deck installer shall have completed a minimum of five projects with similar steel deck material, design, and extent to that indicated for this project and whose work has resulted in construction with a record of successful in-service performance.
- B. Welding procedures and personnel shall be qualified in accordance with ASW D1.1 and AWS D1.3.
- C. Operators of Powder-actuated tools shall be certified in accordance with ANSI/ASSE A10.3.
- D. Structural Testing/Inspection Agency shall perform the following quality related items:
  - 1. Verify placement of deck for alignment and proper lap.
  - 2. Verify deck gage.
  - 3. The inspector shall verify welding procedures and welder qualifications prior to the start of work.
  - 4. Inspection of puddle welds and mechanical fasteners shall be considered to comply with the periodic inspection of floor and deck welds required by the schedule of special inspections section 1704.3e.

Welds: Visually inspect 100% of welded connections for proper size, quality, and pattern. Measure all weld sizes where adequacy is inconclusive based on a visual inspection. All welds with inadequate size or other deficiencies must be repaired.

Mechanical fasteners: Visually inspect 100% of connections for proper type, embedment, and spacing. Examine washer condition and ensure deck is clamped to the supporting steel framing. Measure all fastener embedments where adequacy is inconclusive based on a visual inspection. All deficient mechanical connectors must be corrected by replacing the deficient connector.

- 5. All personnel installing steel deck mechanical fasteners shall be trained on-site by the connector manufacturer in proper installation procedures.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.
- B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

## PART 2 - PRODUCTS

### 2.1 GENERAL

- A. Provide steel deck sheets of three spans minimum wherever possible.

- B. Provide steel deck that has been approved under the applicable Underwriter’s Laboratory (UL) and / or Factory Mutual (FM) ratings applicable to the project.
- C. Structural properties of steel deck shall be calculated in accordance to AISI - Specifications for the Design of Cold-Formed Steel Structural Members.
- D. Provide steel deck type as indicated in the Contract Documents.
- E. Steel deck, closures, and accessory gages shall be determined by the steel deck supplier’s design engineer who is licensed in the project state. The design of the steel deck shall be the sole responsibility of the deck supplier and its design engineer. The deck shall be designed to resist the design loads provided in the Contract Documents. Deck gage shall not be less than the minimum gage indicated in the contract documents.

2.2 MATERIAL AND FINISH

- A. Galvanized Steel Sheet
  - 1. Steel Sheet shall conform to ASTM A653 and shall have a minimum yield strength of 33,000 pounds per square inch.
  - 2. Galvanizing shall conform to ASTM A653 with a minimum coating of G90 on both sides. The coating shall conform to Federal Specification QQ-S-775-d, Type I, Class E.

2.3 TOLERANCE

- A. Uncoated thickness shall not be less than thickness as listed below:

Gage No.	Design Thickness (inches)	Minimum Thickness (inches)
16	0.0598	0.057
17	0.0538	0.051
18	0.0474	0.045
19	0.0418	0.040
20	0.0358	0.034
21	0.0329	0.031
22	0.0295	0.028
24	0.0238	0.023
26	0.0179	0.017
28	0.0149	0.014

- B. Panel length shall be within plus or minus ½-inch of specified length.
- C. Panel cover width shall be no greater than minus 3/8-inch, plus ¾-inch.
- D. Panel camber and / or sweep shall be no greater than ¼-inch in 10 foot length.

- E. Panel end out of square shall not be greater than 1/8-inch per foot of panel width.

## 2.4 DECK ACCESSORIES

- A. Provide accessories, clips, and other items as required for deck installation. Sheet steel for accessories shall be of the same material and finish as steel deck.
- B. Provide Roof Sump pans when required by Architect. Fabricate sump pan from a single piece of 14 gage galvanized sheet steel with level bottoms and sloping sides to direct water flow to drain, unless otherwise shown. Provide sump pans of adequate size to receive roof drains and with bearing flanges not less than 3 inches wide. Recess pans not less than 1-1/2 inches below roof deck surface, unless otherwise shown or required by deck configuration. Holes for drains will be cut in the field.
- C. Provide Cant Strips when required by Architect. Fabricate cant strips from 20 gage sheet steel. Bend to form a 45 degree cant not less than 5 inches wide with top and bottom flanges not less than 2 inches wide, unless otherwise shown.
- D. At all concrete filled deck (insulating, light-weight structural, and normal-weight structural) provide closures for columns, girders, where panels change direction, and end closures for panels not closed by bent plates or other means. Closures shall be fabricated of steel sheet of the same material and finish as the concrete filled deck.
- E. Flexible Closure Strips shall be Vulcanized, closed-cell, synthetic rubber.
- F. Galvanizing Repair Paint shall meet ASTM A780 with dry film containing a minimum of 94 percent zinc dust by weight.
- G. Repair Paint shall be lead- and chromate-free rust-inhibitive primer complying with performance requirements of FS TT-P-664.

## 2.5 DECK ATTACHMENT

- A. Welds
  - 1. Use E-60 series electrodes conforming to AWS A5.1.
  - 2. Welding washers shall be fabricated from sheet steel shaped to fit the deck rib, shall be a minimum thickness of 0.0598-inches, and shall have a factory punched nominal 3/8-inch diameter hole.
- B. Mechanical Fasteners
  - 1. Approved Manufacturers and Types:  
  
Mechanical fasteners shall be one of the following types or approved equal. Approved equal shall be determined by the Structural Engineer based on submittal of appropriate manufacturer's diaphragm shear and tension test data



and design recommendations. Products shall be chosen based on the actual thickness of substrate within the limits indicated below.

Hilti:

- X-EDNK22 (substrate thickness: 0.125 in. to 0.25 in.)
- X-EDN19 (substrate thickness: 0.187 in. to 0.375 in.)
- X-ENP-19 L15 (substrate thickness: 0.25 in. or thicker)

Pneutek:

- SDK63-series (substrate thickness: 0.155 in. to 0.25 in.)
- K64-series (substrate thickness: 0.187 in. to 0.312 in.)
- K66-series (substrate thickness: 0.28 in. or thicker)

2. Where fasteners are exposed to the elements in their final condition, an AISI 304 stainless steel sealing cap with bonded neoprene washer shall be installed over each fastener. Alternately, fasteners with coatings that have met the requirements of ASTM G85 Annex E for 140 cycles are permitted.

C. Sidelap Fasteners:

1. Seam Welds: 1-1/2 in. long fillet welds in accordance with AWS D1.3 procedures.
2. Mechanical Sidelap Connectors: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel, No. 10 minimum diameter screws.

## 2.6 NONCOMPOSITE FORM DECK

- A. Noncomposite Form Deck shall comply with ANSI/SDI-NC1.0 Standard For Non-Composite Steel Floor Deck except as modified by the contract documents.
- B. Provide vented deck if required by lightweight insulating concrete system. Percent venting shall be determined by the supplier based on project conditions and insulating concrete system to be used.
- C. Deck shall be designed in accordance with ANSI/SDI-NC1.0 Standard For Non-Composite Steel Floor Deck Section 2.4.A.1 through Section 2.4.A.5.
  1. Fresh unit weight of normal weight concrete shall be assumed to be 145 pcf. Fresh unit weight of structural-lightweight concrete shall be assumed to be 120 pcf.
  2. Deck as a form design shall include an additional 5 pounds per square foot to account for concrete ponding.
  3. Deck shall be designed for a total load of 80 pounds per square foot and a live load of 50 pounds a square foot.

## PART 3 - EXECUTION

### 3.1 GENERAL

- A. Load conditions shall not exceed SDI sequential loading formulas.
- B. Installer must examine the areas and conditions under which steel decking is to be installed and notify the Contractor in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the Installer.
- C. Deck panels and accessories shall be installed according to the SDI Manual of Construction with Steel Deck, placement plans, and requirements of this Section.
- D. Deck panels shall be placed on structural supports and adjusted to final position with ends aligned, and attached securely to the supports immediately after final positioning.
- E. Place deck in straight alignment for the entire length of the run of the sheets.
- F. Do not weld deck in place until all bolted and welded connections for the structural frame are complete. A minimum of one floor over the area to be decked is to be bolted and welded prior to welding deck in place.
- G. Deck ends over supports shall be installed with a minimum end bearing of 1-1/2-inches.
- H. Deck shall be protected by planking or other approved means to avoid overloading and / or damage from construction loading.
- I. Accessories (including closures) shall be anchored to supporting members by arc spot welds or self drilling screws at 12-inch max spacing.
- J. Deck bundles shall be located to prevent overloading of supporting members and deck panels shall only be placed on concrete that has reached a minimum of 75% of its specified design strength.
- K. Install roof sump pans over openings provided in roof decking and weld flanges to top of deck. Space welds not more than 12-inches apart with at least 1 weld at each corner.

### 3.2 CONCENTRATED LOADS

- A. Do not hang concentrated loads exceeding 50 pounds from the deck.

### 3.3 CUTTING

- A. Cut holes in deck indicated by the Drawings. Other holes required shall be supplied by those requiring them. Obtain written authorization for additional holes and cutting not indicated on erection drawings.

- B. Cut holes in deck after concrete is in place, has reached 75% of its design strength, and after a minimum of 7 days.

### 3.4 WELDING

- A. All welding of deck shall be in accordance with ANSI/AWS D1.3, Structural Welding Code – Sheet Steel. Each welder shall demonstrate an ability to produce satisfactory welds using a procedure such as shown in the SDI Manual of Construction with Steel Deck and as described in ANSI/AWS D1.3.
- B. Provide weld washers for deck thinner than 22 gage.
- C. Weld metal shall penetrate all layers of deck material at end laps and shall have good fusion to the supporting members.
- D. Where two panels butt, fasten each deck unit with separate welds.

### 3.5 MECHANICAL FASTENING

- A. Gauge powder-actuated tool systems to the base material steel type, steel deck type and thickness prior to final installation. Confirm appropriate power regulation and powder-actuated cartridge type prior to final installation.
- B. Verify axis of fastener is within +/- 10 degrees of perpendicular to the deck prior to driving.
- C. Where two panels butt, fasten each deck unit with separate fasteners.

### 3.6 SHORING

- A. Contractor may elect to shore deck to reduce deflection and overrun of concrete.
- B. Shoring shall be in place before deck erection begins.
- C. Shoring shall be left in place until the slab attains 75% of the specified design strength and a minimum of 7 days.
- D. Do not shore structural beams or girders unless indicated on Drawings or authorized in writing by Structural Engineer.

### 3.7 NONCOMPOSITE FORM DECK

- A. Deck ends shall be lapped a minimum of 2-inches at supports.

### 3.8 NONCONFORMING WORK AND REPAIRS

- A. Work not conforming with the contract documents shall be repaired or replaced at the Contractor's expense.
- B. Additional testing and inspection required to determine compliance of corrected work shall be at the Contractor's expense.
- C. Repair damaged galvanized coatings on both surfaces of the deck with galvanized repair paint according to ASTM A780 and manufacturer's written instructions.
- D. Repair damaged paint coatings on painted sides of the deck with repair paint.
  - 1. Wire brush and clean rust spots, welds, and abraded areas.
  - 2. Repair paint shall be of same color as shop-primed deck where exposed to view.
- E. Replace or supplement under-driven and over driven mechanical fasteners with adjacent, properly installed fasteners.

END OF SECTION 05300



## SECTION 05400 - COLD-FORMED STRUCTURAL STEEL

### PART 1 - GENERAL

#### 1.1 SECTION INCLUDES

- A. Section includes requirements for the materials and services for design and installation of the Cold-formed metal framing for load-bearing steel stud walls and steel stud roof joists, including anchorage and bracing. Design and provide steel stud framing capable of resisting all of the design loads indicated on the drawings. Framing system should include all bridging, bracing, clips and other accessories required for anchorage and bracing of complete structure.

#### 1.2 RELATED SECTIONS

- A. Section 01335 - Structural Submittals.
- B. Section 01410 - Structural Testing / Inspection Agency Services.
- C. Section 05300 - Steel Decking.

#### 1.3 REFERENCES

- A. ASTM A 780 - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
- B. ASTM A 1003 - Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members.
- C. ASTM A 653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
- D. ASTM C 955 - Standard Specification for Load-Bearing (Transverse and Axial) Steel Studs, Runners (Tracks), and Bracing or Bridging for Screw Application of Gypsum Panel Products and Metal Plaster Bases.
- E. ASTM C 1513 - Standard Specification for Steel Tapping Screws for Cold-Formed Steel Framing Connections.
- F. ASTM C1007 - Standard Specification for Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories.
- G. AISI - Standard for Cold-Formed Steel Framing General Provisions, 2004 Edition.
- H. AISI - North American Specification (NASPEC) for the Design of Cold-Formed Steel Structural Members, including 2004 Supplement.
- I. AISI - Header Design Standard, 2004 Edition.
- J. AISI - Wall Stud Design Standard, 2004 Edition.

- K. AISI - Lateral Design Standard, 2004 Edition.
- L. American Welding Society (AWS).a. AWS D1.1 "Structural Welding Code - Steel."b. AWS D1.3 "Structural Welding Code - Sheet Steel."

#### 1.4 DESIGN REQUIREMENTS

- A. Design steel in accordance with American Iron and Steel Institute Publication "Specification for the Design of Cold-Formed Steel Structural Members", except as otherwise shown or specified.
- B. Design loads: As indicated on the Structural Drawings.
- C. Design framing systems to withstand design loads without deflections greater than the following:
- D. Exterior Walls: Lateral deflection of:  $L/360$ .
- E. Interior Load-Bearing Walls: Lateral deflection of:  $L/360$ .
- F. Roof Joists:  $L/360$  Live Load  
 $L/360$  Dead Load  
 $L/240$  Total Load
- G. Design framing systems to provide for movement of framing members without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change (range) of 60 degrees F.
- H. Design framing system to accommodate deflection of primary building structure and construction tolerances.
- I. Design non-load-bearing wall framing to accommodate lateral deflection without regard to contribution of sheathing materials.

#### 1.5 SUBMITTALS

- A. Submit under provisions of Section 01335.
- B. Submit manufacturer's product literature and data sheets for specified products clearly describing quality, performance and finish for steel studs.
- C. Manufacturer's certification of product compliance with codes and standards.
- D. Shop Drawings: Submit shop drawings showing:
  - 1. Locations of framing members, wall framing sections and opening elevations.
  - 2. Sizes and spacing of framing members.
  - 3. Methods of fastening framing members to each other and to supporting systems.
  - 4. Details of vertical deflection connections to structures.
  - 5. Locations and spacing of lateral bracing and structural bracing systems.

6. Accessory products required for complete installation.
  7. Shop Drawings shall be signed and sealed by a registered PE (Professional Cold-Formed Specialty Engineer) registered in the Commonwealth of Puerto Rico.
- E. Structural Calculations: Submit structural calculations for approval.
1. Submittal shall be signed and sealed by a registered PE (Professional Cold-Formed Specialty Engineer) registered in the Commonwealth of Puerto Rico.
  2. Description of design criteria.
  3. Engineering analysis depicting stress and deflection (stiffness) requirements for each framing application.
  4. Selection of framing components, accessories, fasteners and welded connection requirements.
  5. Engineer shall have a minimum of 5 years experience with projects of similar scope.

## 1.6 QUALITY ASSURANCE

- A. Contractor shall provide effective, full time quality control over all fabrication and erection complying with the pertinent codes and regulations of government agencies having jurisdiction.
- B. Conduct pre-installation meeting to verify project requirements, substrate conditions, and manufacturer's installation instructions.
- C. Welding Standards: Comply with applicable provisions of AWS D1.1 "Structural Welding Code-Steel" and AWS D1.3 "Structural Welding Code-Sheet Steel."
- D. Qualify welding processes and welding operators in accordance with AWS "Standard Qualification Procedure".
- E. Manufacturer shall have a minimum of five years documented experience in the manufacturing of products required by the Contract Documents.
- F. Installer shall have a minimum of five years documented experience in the construction and installation of similar project scope.
- G. Coordinate the placement of components within the stud framing system.
- H. Structural Testing/Inspection Agency shall perform the following quality related items:
  1. To become familiar with and to keep the Architect/Engineer informed about the quality of work.
  2. To guard the Owner against defects and deficiencies in the work.
  3. To verify general compliance with the Contract Documents for the following items:
    - a. size and spacing of studs and fasteners.
    - b. size and location of header beams and supporting studs.



## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Notify manufacturer of damaged materials received prior to installing.
- B. Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- C. Store materials protected from exposure to rain, snow or other harmful weather conditions, at temperature and humidity conditions per the recommendations of ASTM C955.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Acceptable Manufacturers:

Dietrich Metal Framing, Inc., which is located at: 500 Grant Street, Suite 2226, Pittsburgh, PA 15219; Telephone: (412) 281-2805; Fax: (412) 281-2965; Email: [askforhelp@dietrichindustries.com](mailto:askforhelp@dietrichindustries.com); Web: [www.dietrichmetalframing.com](http://www.dietrichmetalframing.com) or equal.

- B. Requests for substitutions will be considered.
- C. All products to be manufactured by current members of the Steel Stud Manufacturers Association (SSMA).

### 2.2 COMPONENTS

- A. Structural studs, tracks, clips, flat strap x-bracing, flat strap bridging, gusset plates, and other accessories required for anchorage and bracing of complete structure.
- B. Fasteners: Self-drilling, self-tapping screws; complying with ASTM C 1513 - Standard Specification for Steel Tapping Screws for Cold-Formed Steel Framing Connections.
- C. Touch-Up Paint: Complying with ASTM A 780 - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.

### 2.3 MATERIALS

- A. Steel: Galvanized Steel meeting or exceeding the requirements of ASTM A 1003.
- B. Coating: Galvanized G60 coating minimum, complying with ASTM C 955.
- C. Stud Punch Outs: 12 inches (305mm) from base and every 24 inches (610mm) thereafter.

## PART 3 - EXECUTION

### 3.1 INSPECTION

- A. Inspect supporting substrates and structures for compliance of proper conditions for installation and performance of the cold-formed structural framing.

### 3.2 PREPARATION

- A. Prepare attachment surfaces so that they are plumb, level, and in proper alignment for accepting the cold-formed structural framing.

### 3.3 FABRICATION

- A. Prior to fabrication of framing, submit shop drawings to the architect and Structural Engineer-of-Record to obtain approval.
- B. Framing components may be preassembled into panels prior to erecting. Prefabricate panels so they are square, with components attached in a manner which prevents racking and minimizes distortion during lifting and transport.
- C. Cut all framing components square for attachment to perpendicular members or as required for an angular fit against abutting members.
- D. Plumb, align and securely attach studs to flanges of both upper and lower runners, except that in the case of interior, non-load bearing walls where studs need not be attached to upper or lower runners.
- E. In all doubled jamb studs and doubled headers not accessible to insulation contractors, provide insulation equal to that specified elsewhere.
- F. Splices in members other than top and bottom runner track are not permitted.
- G. Provide temporary bracing where required, until erection is complete.

### 3.4 INSTALLATION - AXIAL LOAD-BEARING WALLS

- A. Securely anchor runners to the supporting structure as shown on the drawings.
- B. Provide complete, uniform and level bearing support at the bottom runner.
- C. Include headers and supporting studs at wall openings as shown on the drawings.
- D. Provide diagonally braced stud walls, as indicated on the drawings at locations designated as "x-braced walls" for frame stability and lateral load resistance. Position additional studs when necessary or as indicated on the drawings to resist the vertical components.
- E. Splices in axially loaded studs are not permitted.

### 3.5 INSTALLATION - JOISTS

- A. Align joist bearing at foundation walls by means of shims and/or non-setting grout.
- B. Locate joists or a load distribution member directly over bearing studs at the top of bearing walls.
- C. Provide web stiffeners at reaction points and/or points of concentrated loads or where indicated on the drawings.
- D. Install joist bridging where required by design.
- E. Install additional joists under parallel partitions when the partition length exceeds one-half the joist span, also around all floor and roof openings, which interrupt one or more spanning members unless otherwise noted.
- F. Install end blocking where joist ends are not otherwise restrained from rotation.

END OF SECTION 05400

## SECTION 05500 - METAL FABRICATIONS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Steel framing and supports for overhead medical equipment.
  - 2. Metal nosings and thresholds.
  - 3. Steel lintels.
  - 4. Miscellaneous shop fabricated metal items.
- B. Related Sections include the following:
  - 1. Section 05100 - Structural Steel.
  - 2. Section 05521 - Pipe and Tube Railings.
  - 3. Section 03300 - Cast-in-Place Concrete.
  - 4. Section 09260 - Gypsum Board Assemblies.

#### 1.3 SUBMITTALS

- A. Section 01330 - Submittal Procedures.
- B. Product Data: For the following:
  - 1. Metal nosings and thresholds.
  - 2. Paint products.
- C. Shop Drawings: Show fabrication and installation details for metal fabrications.
  - 1. Include plans, elevations, sections, and details of metal fabrications and their connections.
  - 2. Provide drawings indicating required component locations, interface with adjacent materials, installation, anchorage, fastening and similar information.
- D. Certificates: Submit manufacturer's certificate that products meet or exceed specified requirements.

#### 1.4 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to the following:
  - 1. AWS D1.1, "Structural Welding Code--Steel."
- B. Installer Qualifications: Utilize an installer having demonstrated experience on projects of similar size and complexity.

#### 1.5 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication and indicate measurements on Shop Drawings.
  - 1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating metal fabrications without field measurements. Coordinate wall and other contiguous construction to ensure that actual dimensions correspond to established dimensions.
  - 2. Provide allowance for trimming and fitting at site.

### 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 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces, unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

#### 2.3 FERROUS METALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- B. Steel Tubing: ASTM A 500, cold-formed steel tubing.

## 2.4 FASTENERS

- A. General: Unless otherwise indicated, provide Type 304 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633, Class Fe/Zn 5, at exterior walls. Provide stainless-steel fasteners for fastening aluminum. Select fasteners for type, grade, and class required.
- B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A; with hex nuts, ASTM A 563; and, where indicated, flat washers.
- C. Machine Screws: ASME B18.6.3.
- D. Plain Washers: Round, ASME B18.22.1.
- E. Lock Washers: Helical, spring type, ASME B18.21.1.
- F. Expansion Anchors: Anchor bolt and sleeve assembly with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
  - 1. Material for Anchors in Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B 633, Class Fe/Zn 5.

## 2.5 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- B. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79.
  - 1. Use primer with a VOC content of 420 g/L (3.5 lb/gal.) or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.

## 2.6 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch, unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

- C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- D. Form exposed work true to line and level with accurate angles and surfaces and straight edges.
- E. Weld corners and seams continuously to comply with the following:
  1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  2. Obtain fusion without undercut or overlap.
  3. Remove welding flux immediately.
  4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts, unless otherwise indicated. Locate joints where least conspicuous.
- G. Fabricate seams and other connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive fasteners and similar items.
- I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

## 2.7 MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.
- B. Fabricate units from steel shapes, plates, and bars of welded construction, unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction retained by framing and supports. Cut, drill, and tap units to receive fasteners, hangers, and similar items.
- C. Fabricate supports for operable partitions from continuous steel beams of sizes indicated with attached bearing plates, anchors, and braces as indicated. Drill bottom flanges of beams to receive partition track hanger rods; locate holes where indicated on operable partition Shop Drawings.
- D. Galvanize miscellaneous framing and supports where indicated.

## 2.8 METAL NOSINGS

- A. Extruded Units: Aluminum, with abrasive filler consisting of aluminum oxide, silicon carbide, or a combination of both, in an epoxy-resin binder. Fabricate units in sizes and configurations indicated and in lengths necessary to accurately fit openings or conditions.

1. Manufacturers:
    - a. American Safety Tread Co., Inc.
    - b. Balco Inc.
    - c. Wooster Products Inc.
  2. Provide ribbed units, with abrasive filler strips projecting 1/16 inch above aluminum extrusion.
  3. Nosings: Square-back units, 3 inches wide, for casting into concrete steps.
- B. Provide anchors for embedding units in concrete, either integral or applied to units, as standard with manufacturer.
- C. Apply clear lacquer to concealed bottoms, sides, and edges of extruded units set into concrete.

## 2.9 METAL THRESHOLDS

- A. Provide threshold and seal products which have been manufactured, fabricated and installed to meet the following design criteria:
1. Performance obtained from test procedures.
  2. Compliant with UL 410.
  3. Compliant with ADA standards.
- B. Manufacturer:
1. Pemko Manufacturing Company.
  2. Architect approved equivalent.
- C. Basis-of-Design: Pemko Half Saddle Threshold, Model 255A.
1. Material: Extruded tempered aluminum 6063-T6.
  2. Finish: Mill finished aluminum.
- D. Basis-of-Design: Pemko Saddle Threshold.
1. Material: Extruded tempered aluminum 6063-T6.
  2. Finish: Mill finished stainless steel.

## 2.10 STEEL LINTELS

- A. Lintels: Steel sections, size and configuration as indicated on Structural Drawings.
1. Interior Locations: Prime paint, one coat.

## 2.11 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Finish metal fabrications as indicated in Drawings.



## 2.12 STEEL AND IRON FINISHES

- A. Galvanizing: Hot-dip galvanize items as indicated to comply with applicable standard listed below:
  - 1. ASTM A 123/A 123M, for galvanizing steel and iron products.
  - 2. ASTM A 153/A 153M, for galvanizing steel and iron hardware.
- B. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with minimum requirements indicated below for SSPC surface preparation specifications and environmental exposure conditions of installed metal fabrications:
  - 1. Exteriors (SSPC Zone 1B): SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
  - 2. Interiors (SSPC Zone 1A): SSPC-SP 3, "Power Tool Cleaning."
- C. Shop Priming: Apply shop primer to uncoated surfaces of metal fabrications, except those with galvanized finishes and those to be embedded in concrete, sprayed-on fireproofing, or masonry, unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Site Verification of Conditions:
  - 1. Verify that site conditions are acceptable for installation.
  - 2. Do not proceed with installation until unacceptable conditions are corrected.

### 3.2 INSTALLATION, GENERAL

- A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- C. Field Welding: Comply with the following requirements:
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove welding flux immediately.
  - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

- D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

### 3.3 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.

### 3.4 INSTALLING NOSINGS

- A. Center nosings on tread widths.
- B. For nosings embedded in concrete steps or curbs, align nosings flush with riser faces and level with tread surfaces.

### 3.5 INSTALLING THRESHOLDS

- A. Mounting Location: comply with drawings and approved Shop Drawings.
- B. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
- C. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.

### 3.6 ADJUSTING AND CLEANING

- A. Remove any protective films and clean components as necessary following manufacturer's recommended procedures.
- B. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
  - 1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.
- C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.
- D. Perform adjustments required to ensure that thresholds function in compliance with manufacturer's performance criteria prior to acceptance by Owner's Representative.
- E. Protect installed work from damage due to subsequent construction activity on the site.

END OF SECTION 05500



## SECTION 05521 - PIPE AND TUBE RAILINGS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Steel pipe and tube railings.
- B. Related Sections include the following:
  - 1. Section 05500 - Metal Fabrications.

#### 1.3 PERFORMANCE REQUIREMENTS

- A. General: In engineering railings to withstand structural loads indicated, determine allowable design working stresses of railing materials based on the following:
  - 1. Steel: 72 percent of minimum yield strength.
- B. Structural Performance: Provide railings capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
  - 1. Handrails:
    - a. Uniform load of 50 lbf/ ft. applied in any direction.
    - b. Concentrated load of 200 lbf applied in any direction.
    - c. Uniform and concentrated loads need not be assumed to act concurrently.
  - 2. Top Rails of Guards:
    - a. Uniform load of 50 lbf/ ft. applied in any direction.
    - b. Concentrated load of 200 lbf applied in any direction.
    - c. Uniform and concentrated loads need not be assumed to act concurrently.
  - 3. Infill of Guards:
    - a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft.
    - b. Infill load and other loads need not be assumed to act concurrently.

- C. Thermal Movements: Provide exterior railings that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
  - 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.
- D. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

#### 1.4 SUBMITTALS

- A. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
  - 1. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- B. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, according to ASTM E 894 and ASTM E 935.

#### 1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of railing through one source from a single manufacturer.
- B. Welding: Qualify procedures and personnel according to the following:
  - 1. AWS D1.1, "Structural Welding Code--Steel."

#### 1.6 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with railings by field measurements before fabrication and indicate measurements on Shop Drawings.
  - 1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating railings without field measurements. Coordinate wall and other contiguous construction to ensure that actual dimensions correspond to established dimensions.
  - 2. Provide allowance for trimming and fitting at site.

#### 1.7 COORDINATION AND SCHEDULING

- A. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

- B. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not satisfy structural performance requirements.

## PART 2 - PRODUCTS

### 2.1 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.
- B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails, unless otherwise indicated.

### 2.2 STEEL AND IRON

- A. Pipe: ASTM A 53/A 53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.
  - 1. Provide galvanized finish for exterior installations and where indicated.
- B. Plates, Shapes, and Bars: ASTM A 36/A 36M.
- C. Castings: Either gray or malleable iron, unless otherwise indicated.
  - 1. Malleable Iron: ASTM A 47/A 47M.

### 2.3 FASTENERS

- A. General: Provide the following:
  - 1. Steel Railings: Plated steel fasteners complying with ASTM B 633, Class Fe/Zn 25 for electrodeposited zinc coating.
- B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.
- C. Anchors: Provide torque-controlled expansion anchors, fabricated from corrosion-resistant materials with capability to sustain, without failure, a load equal to four times the load imposed when installed in concrete, as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.

### 2.4 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

- B. Shop Primer for Galvanized Steel: Zinc-dust, zinc-oxide primer formulated for priming zinc-coated steel and for compatibility with finish paint systems indicated, and complying with SSPC-Paint 5.
- C. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.
- D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.
- E. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

## 2.5 FABRICATION

- A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.
- B. Assemble railings in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.
- C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch, unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- D. Form work true to line and level with accurate angles and surfaces.
- E. Fabricate connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- F. Cut, reinforce, drill, and tap as indicated to receive finish fasteners and similar items.
- G. Connections: Fabricate railings with welded connections, unless otherwise indicated.
- H. Welded Connections: Cope pipe components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove flux immediately.
  - 4. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.
- I. Form changes in direction as follows:
  - 1. By bending.

- J. Form simple and compound curves by bending members in jigs to produce uniform curvature for each repetitive configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.
- K. Close exposed ends of railing members with prefabricated end fittings.
- L. Provide wall returns at ends of wall-mounted handrails, unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inch or less.
- M. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work, unless otherwise indicated.
- N. For railing posts set in concrete, provide steel sleeves not less than 6 inches long with inside dimensions not less than 1/2 inch greater than outside dimensions of post, with steel plate forming bottom closure.

## 2.6 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

## 2.7 STEEL AND IRON FINISHES

- A. Galvanized Railings:
  - 1. Hot-dip galvanize exterior steel and iron railings, including hardware, after fabrication.
  - 2. Comply with ASTM A 123/A 123M for hot-dip galvanized railings.
  - 3. Comply with ASTM A 153/A 153M for hot-dip galvanized hardware.
- B. Fill vent and drain holes that will be exposed in the finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.
- C. For galvanized railings, provide hot-dip galvanized fittings, brackets, fasteners, sleeves, and other ferrous components.
- D. For nongalvanized steel railings, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves, except galvanize anchors to be embedded in exterior concrete or masonry.
- E. Preparation for Shop Priming: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with metallic-phosphate process.
- F. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with minimum requirements indicated below for SSPC surface preparation specifications and environmental exposure conditions of installed railings:
  - 1. Exterior Railings (SSPC Zone 1B): SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."



- G. Apply shop primer to prepared surfaces of railings, unless otherwise indicated. Comply with requirements in SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting. Primer need not be applied to surfaces to be embedded in concrete or masonry.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION, GENERAL

- A. Fit exposed connections together to form tight, hairline joints.
- B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.
  - 1. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet.
- C. Corrosion Protection: Coat concealed surfaces of aluminum that will be in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.
- D. Adjust railings before anchoring to ensure matching alignment at abutting joints.
- E. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

#### 3.2 RAILING CONNECTIONS

- A. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in Part 2 "Fabrication" Article whether welding is performed in the shop or in the field.

#### 3.3 ANCHORING RAILING ENDS

- A. Anchor railing ends to concrete and masonry with round flanges connected to railing ends and anchored to wall construction with anchors and bolts.

#### 3.4 ATTACHING HANDRAILS TO WALLS

- A. Attach handrails to wall with wall brackets. Provide brackets with 1-1/2-inch clearance from inside face of handrail and finished wall surface.
  - 1. Use type of bracket with flange tapped for concealed anchorage to threaded hanger bolt.
- B. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
- C. Secure wall brackets to building construction as follows:

1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.

### 3.5 ADJUSTING AND CLEANING

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

### 3.6 PROTECTION

- A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.
- B. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

END OF SECTION 05521



## SECTION 05700

### ORNAMENTAL METAL

#### PART 1 GENERAL

##### 1.1 SUMMARY

###### A. Section Includes:

1. Galvanized Wire Mesh Panels at openings in concrete wall.
2. Hot-Dipped Galvanized Bar Grating at outdoor area roof.
3. Steel fabrications to configure a structural frame for mesh panels at openings in concrete wall and grating at outdoor area roof.
4. Aluminum fabrications for fence and gate, as indicated in Drawings.

###### B. Related Sections:

1. Section 05400 - Cold-Formed Structural Steel.
2. Section 05500 - Metal Fabrications.
3. Section 07920 - Joint Sealants.

##### 1.2 DESIGN REQUIREMENTS

###### A. Roof Loads: Design to resist live and dead loads.

###### B. Wind Loads: Design and size components to withstand positive and negative wind loads acting normal to plane of wall, including increased loads at building corners.

1. Design Wind Load: As calculated in accordance with applicable code basic wind speed and exposure.

###### C. Seismic Loads: Design and size components to withstand seismic loads and sway displacement as calculated in accordance with applicable code.

###### D. Design attachments to resist forces as required by applicable code. Apply loads non-simultaneously to produce maximum stresses.

###### E. Exterior Components: Accommodate the following without damage to system, components or deterioration of seals.

1. Movement within system.
2. Movement between system and perimeter framing components.
3. Dynamic loading and release of loads.
4. Deflection of structural support framing.
5. Expansion and contraction from temperature range over a 12 hour period.

##### 1.3 SUBMITTALS

###### A. Section 01330 - Submittal Procedures: Requirements for submittals.

- B. Shop Drawings:
  - 1. Indicate ornamental metal profiles, patterns, sizes, connection attachments, anchorage, size and type of fasteners, accessories, and interface with adjacent work.
  - 2. Indicate sizes, layout, connections and attachment for framing supporting ornamental metal.
- C. Design Data: Submit design calculations for structural components and components resisting wind loads.
- D. Manufacturer's Certificate: Certify Products meet or exceed specific requirements.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: Submit for maintaining metal finishes. Include care and cleaning instructions, and list of recommended cleaning and polishing materials.

#### 1.5 QUALITY ASSURANCE

- A. Perform welding in accordance with:
  - 1. Steel: AWS D1.1.
  - 2. Aluminum: AWS D1.2.
- B. Finish joints in accordance with NOMMA Guideline 1.

#### 1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.
- B. Welders: AWS certified within previous 12 months.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect shop finished metal surfaces with wrapping or strippable coating before shipping. Do not use adhesive papers or sprayed coatings that bond when exposed to sunlight or weather.
- B. Accept ornamental metal on site in manufacturer's protective packaging. Inspect for damage.
- C. Store ornamental metal indoors, in temperature and humidity controlled environment. Store ornamental metal to prevent distortion of fabricated shape. Puncture protective wrappings at ends for ventilation.
- D. Protect metal finishes from surface contamination, staining, scratching, abrasion, and other physical damage when handling and during installation.

1.8 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.9 WARRANTY

1. Furnish five year manufacturer's warranty for galvanized galfan wire mesh panels and hot-dipped galvanized grating.

PART 2 PRODUCTS

2.1 GALVANIZED WIRE MESH PANELS

A. General:

1. Product Type: Square Wire Mesh.
2. Weight: 1.18 pounds / s.f.
3. Mesh Size: 2".
4. Percent Open Area: 82.

B. Manufacturers:

1. Basis-of-Design: McNichols Quality Wire Mesh, Square Welded, Galvanized Galfan Model 3420886062.
2. Architect's approved equivalent.

2.2 HOT-DIPPED GALVANIZED GRATING

A. General:

1. Product Type: Bar.
2. Weight: 16 pounds / s.f.
3. Percent Open Area: 81.

B. Manufacturers:

1. Basis-of-Design: McNichols Quality Press Locked Bar Grating, Galvanized Hot-Dipped Series GAA-200 Model 6420317034.
2. Architect's approved equivalent.

2.3 STRUCTURAL STEEL FRAME

- A. Profiles, sizes and dimensions as indicated in Drawings.

2.4 ALUMINUM FENCE AND GATE

Profiles, sizes and dimensions as indicated in Drawings.

2.5 COMPONENTS (As Needed)

A. Steel Materials:

1. Steel Sections: ASTM A36/A36M; ASTM A572/A572M; Grade 50.

2. Steel Plates: ASTM A36/A36M; ASTM A572/A572M; Grade 50.
3. Hollow Structural Sections: ASTM A500, Grade B; ASTM A501.
4. Pipes: ASTM A53/A53M.
5. Bolts: ASTM A307.
6. Nuts: ASTM A563 heavy hex type.
7. Washers: ASTM F436; Type 1.
8. Welding Materials: AWS D1.1; type required for materials being welded.

B. Aluminum Materials:

1. Aluminum Extrusions: ASTM B221.
2. Sheet and Plate: ASTM B209.
3. Tubing: ASTM B210, seamless.
4. Bars, Rod, and Wire: ASTM B211.
5. Bolts, Nuts, and Washers: Aluminum.
6. Welding Materials: AWS D1.2; type required for materials being welded.

2.6 ACCESSORIES

- A. Sealant: As specified in Section 07920.
- B. Backing Paint: Protective Backing Paint: FS TT-C-494, Bituminous.
- C. Grout: Non-shrink, minimum yield strength of 7,000psi at 28 days.

2.7 FABRICATION

- A. Fit and shop assemble components in largest practical sizes for delivery to site.
- B. Fabricate components with joints tightly fitted and secured. Use concealed fastenings where ever possible. Provide fittings to accommodate site assembly and installation.
- C. For welded joints, grind exposed joints flush and smooth with adjacent finish surface.
- D. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component. Use exposed fastenings only where concealed fastenings are not possible.
- E. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.8 SHOP FINISHING

- A. Steel Finishes:
  1. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.
  2. Do not paint surfaces in direct contact with concrete or where field welding is required.
  3. Shop and Touch-Up Primer: SSPC Paint 15, Type 1, red oxide

4. Galvanizing: ASTM A123/A123M; galvanize after fabrication.
  5. Galvanizing for Fasteners, Connectors, and Anchors:
    - a. Hot-Dipped Galvanizing: ASTM A153/A153M.
    - b. Mechanical Galvanizing: ASTM B695; Class 50 minimum.
  6. Chrome Plating: ASTM B177, nickel-chromium alloy.
- B. Aluminum Finishes:
1. Factory Finished: AA-M12C12R1x non-specular as fabricated mechanical finish, chemically cleaned, and prepared for applied coating; with organic coating.
    - a. Color: Black, as indicated in Drawings.

## PART 3 EXECUTION

### 3.1 EXAMINATION

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

### 3.2 PREPARATION

- A. Clean and strip primed steel items to bare metal where site welding is required.
- B. Supply items required to be cast into concrete or embedded in masonry with setting templates to appropriate sections.
- C. Apply protective backing paint to metals in contact with cementitious materials or dissimilar metals.

### 3.3 INSTALLATION

- A. Install components plumb and level, accurately fitted, free from distortion or defects.
- B. Provide for erection loads, and for sufficient temporary bracing to maintain indicated alignment until completion of erection and installation of permanent attachments.
- C. Anchor fabrications to structure with anchors.
  1. Concrete and Solid Masonry Substrate: Expansion anchors.
  2. Hollow Masonry: Toggle bolts.
  3. Metal: Threaded fasteners.
- D. Anchor fabrications with brackets as indicated on Drawings.
- E. Anchor fabrications to structure as indicated on Drawings.
- F. Field weld components indicated on Drawings. Grind welds smooth.
- G. Conceal bolts and screws whenever possible. Where not concealed, use flush countersunk fastenings.



- H. Obtain approval of Owner's Representative prior to site cutting or making adjustments not scheduled.
- I. Assemble fabrications with tight, hairline joints.
- J. Exercise care when installing components so as not to damage finish surfaces. Touch up as required to repair damaged finishes.
- K. After erection, prime welds, abrasions, and surfaces not galvanized, except surfaces to be in contact with concrete.

#### 3.4 ADJUSTING

- A. Adjust moveable components for smooth operation.

#### 3.5 CLEANING

- A. Remove protective material from shop finished surfaces.
- B. Remove excess sealant from ornamental metals.
- C. Wash down surfaces with solution of mild detergent in warm water, applied with soft, clean wiping cloths. Take care to remove dirt from corners. Wipe surfaces clean.

#### 3.6 PROTECTION OF FINISHED WORK

- A. Protect finished Work from damage.

END OF SECTION 05700

## SECTION 05730 - ORNAMENTAL FORMED METAL

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Closures and trim at intersection of gypsum board partitions and exterior aluminum storefront or curtain walls.

#### 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated, including finishes.
- B. Shop Drawings: Detail fabrication and installation of ornamental formed metal. Include plans, elevations, sections, and details of components and their connections. Show anchorage and accessory items.
- C. Samples: For each type of exposed finish required, prepare 6-inch- square samples of metal of same thickness and material indicated for the Work.

#### 1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain ornamental formed-metal items through one source from a single manufacturer.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver ornamental formed-metal products wrapped in protective coverings and strapped together in suitable packs or in heavy-duty cartons. Remove protective coverings before they stain or bond to finished surfaces.
- B. Store products on elevated platforms in a dry location.

## PART 2 - PRODUCTS

### 2.1 SHEET METAL

- A. General: Provide sheet metal without pitting, seam marks, roller marks, stains, discolorations, or other imperfections where exposed to view on finished units.
- B. Aluminum Sheet: Flat sheet complying with ASTM B 209, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than strength and durability properties of alloy 5005-H15.

### 2.2 MISCELLANEOUS MATERIALS

- A. Gaskets: As required to seal joints in ornamental formed metal and remain airtight.
  - 1. Closed cell polyurethane foam, adhesive on two sides, release paper protected.
- B. Fasteners: Use fasteners fabricated from same basic metal and alloy as fastened metal, unless otherwise indicated. Do not use metals that are corrosive or incompatible with materials joined.
  - 1. Provide concealed fasteners for interconnecting ornamental formed-metal items and for attaching them to other work, unless otherwise indicated.
  - 2. Provide Phillips flat-head machine screws for exposed fasteners, unless otherwise indicated.
- C. Sound-Deadening Materials:
  - 1. Insulation: Unfaced, mineral-fiber blanket insulation complying with ASTM C 665, Type I, and passing ASTM E 136 test.

### 2.3 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble ornamental formed-metal items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
- B. Coordinate dimensions and attachment methods of ornamental formed-metal items with those of adjoining construction to produce integrated assemblies with closely fitting joints and with edges and surfaces aligned, unless otherwise indicated.
- C. Form metal to profiles indicated, in maximum lengths to minimize joints. Produce flat, flush surfaces without cracking or grain separation at bends. Fold back exposed edges of unsupported sheet metal to form a 1/2-inch-wide hem on the concealed side, or ease edges to a radius of approximately 1/32 inch and support with concealed stiffeners.

## 2.4 CLOSURES AND TRIM

- A. Provide closures and trim at intersection of interior partitions and curtain wall framing.
- B. Form closures and trim from metal of type and thickness indicated below. Fabricate to fit tightly to adjoining construction.
  - 1. Aluminum Sheet: 0.040 inch.
    - a. Finish: High-performance organic coating.
- C. Conceal fasteners where possible; otherwise, locate where they will be as inconspicuous as possible. Size fasteners to support closures and trim, with fasteners spaced to prevent buckling or waviness in finished surfaces.
- D. Drill and tap holes needed for securing closures and trim to other surfaces.
- E. Incorporate gaskets where indicated or needed for concealed, continuous seal at abutting surfaces.

## 2.5 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

## 2.6 ALUMINUM FINISHES

- A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- B. High-Performance Organic Finish (2-Coat Fluoropolymer): AA-C12C40R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: conversion coating; Organic Coating: manufacturer's standard 2-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with AAMA 2605 and with coating and resin manufacturers' written instructions.
  - 1. Color and Gloss: As selected by Architect.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for conditions affecting performance of ornamental formed metal.
  - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Locate and place ornamental formed-metal items level and plumb and in alignment with adjacent construction.
- B. Form tight joints with exposed connections accurately fitted together.
- C. Install gaskets and insulation, as the Work progresses, to make interior ornamental formed-metal items soundproof or lightproof as applicable to the type of fabrication indicated.

### 3.3 PROTECTION

- A. Protect finishes of ornamental formed-metal items from damage during construction period. Remove temporary protective coverings at time of Substantial Completion.

END OF SECTION 05730

## SECTION 05811 - ARCHITECTURAL JOINT 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.

#### 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Architectural joint systems for building interiors.
  - 2. Architectural joint systems for building exteriors.

#### 1.3 DEFINITIONS

- A. Movement Capability: Value obtained from the difference between widest and narrowest widths of a joint opening typically expressed in numerical values (mm or inches) or a percentage (plus or minus) of nominal value of joint width.
- B. Nominal Joint Width: The width of the linear opening specified in practice and in which the joint system is installed.

#### 1.4 SUBMITTALS

- A. Shop Drawings: Provide the following for each joint system specified:
  - 1. Placement Drawings: Include line diagrams showing plans, elevations, sections, details, splices, blockout requirement, entire route of each joint system, and attachments to other work. Where joint systems change planes, provide isometric or clearly detailed drawing depicting how components interconnect.
- B. Samples:
  - 1. Full width by 6 inches long, for each system required.

#### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers trained and approved by manufacturer.
- B. Source Limitations: Obtain architectural joint systems through one source from a single manufacturer.

- C. Accessibility Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines (ADAAG)".
- D. Fire-Test-Response Characteristics: Where indicated, provide architectural joint system and fire-barrier assemblies identical to those of assemblies tested for fire resistance per UL 2079 or ASTM E 1966 by a testing and inspecting agency acceptable to authorities having jurisdiction.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Aluminum: ASTM B 221, Alloy 6063-T5 for extrusions; ASTM B 209, Alloy 6061-T6 for sheet and plate.
  - 1. Apply manufacturer's standard protective coating on aluminum surfaces to be placed in contact with cementitious materials.
  - 2. Class II, Clear Anodic Finish: AA-M12C22A31 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class II, clear coating 0.010 mm or thicker) complying with AAMA 611.
- B. Elastomeric Seals: Preformed elastomeric membranes or extrusions to be installed in metal frames.
- C. Fire Barriers: Any material or material combination, when fire tested after cycling, designated to resist the passage of flame and hot gases through a movement joint and to meet performance criteria for required rating period.
- D. Moisture Barrier: Flexible elastomeric material, PVC, minimum 30 mils thick.
- E. Accessories: Manufacturer's standard anchors, clips, fasteners, set screws, spacers, and other accessories compatible with material in contact, as indicated or required for complete installations.

### 2.2 ARCHITECTURAL JOINT SYSTEMS, GENERAL

- A. General: Provide architectural joint systems of design, basic profile, materials, and operation indicated. Provide units with capability to accommodate variations in adjacent surfaces.
  - 1. Furnish units in longest practicable lengths to minimize field splicing. Install with hairline mitered corners where joint changes direction or abuts other materials.
  - 2. Include factory-fabricated closure materials and transition pieces, tee-joints, corners, curbs, cross-connections, and other accessories as required to provide continuous joint systems.
- B. Design architectural joint systems for the following size and movement characteristics:
  - 1. Nominal Joint Width: As indicated on Drawings.
  - 2. Movement Capability: Plus or minus 50 percent.

3. Type of Movement: Seismic Wind sway.

## 2.3 ARCHITECTURAL JOINT SYSTEMS FOR BUILDING INTERIORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide the products specified in individual subparagraphs below as basis-of-design products or a comparable product by one of the following:
  1. Architectural Art Mfg., Inc.
  2. Balco, Inc.
  3. JointMaster/InPro Corporation.
  4. Watson Bowman Acme Corp.
- C. Floor-to-Floor Joint Systems:
  1. Basis-of-Design Product: "GFR-400;" Construction Specialties, Inc.
  2. Type: Cover plate.
    - a. Exposed Metal: Aluminum.
      - 1) Finish: Class II, clear anodic.
  3. Cover-Plate Design: Plain.
    - a. Recess Depth: As indicated on the Drawings.
  4. Attachment Method: Mechanical anchors.
  5. Load Capacity: Standard duty.
  6. Compression Seals: ASTM E 1612; preformed rectangular elastomeric extrusions having internal baffle system and designed to function under compression.
  7. Fire-Resistance Rating: Provide joint system and fire-barrier assembly with a rating not less than that of adjacent construction.
- D. Wall-to-Wall Joint Systems:
  1. Basis-of-Design Product: "GFW-400;" C/S Group, Construction Specialties, Inc.
  2. Type: Elastomeric seal.
    - a. Seal Material: PVC.
      - 1) Color: As selected by Architect from manufacturer's full range.
  3. Fire-Resistance Rating: Provide joint system and fire-barrier assembly with a rating not less than that of adjacent construction.
- E. Ceiling-to-Ceiling Joint Systems:



1. Basis-of-Design Product: "GFW-400" C/S Group, Construction Specialties, Inc.
2. Type: Elastomeric seal.
  - a. Seal Material: PVC.
    - 1) Color: As selected by Architect from manufacturer's full range.

## 2.4 ARCHITECTURAL JOINT SYSTEMS FOR BUILDING EXTERIORS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide the products specified in individual subparagraphs below as basis-of-design products or a comparable product by one of the following:
  1. Architectural Art Mfg., Inc.
  2. Balco, Inc.
  3. JointMaster/InPro Corporation.
  4. Watson Bowman Acme Corp.
  5. BASF Company; WABO Seismic Weather Seal.
- B. Architectural Joint Systems for Exterior Walls:
  1. Basis-of-Design Products:
    - a. Nominal 2-inch Joints: "WABO Seismic Weather Seal;" BASF Company.
    2. Type: Ribbed seal.
      - a. Seal Material: Silicone.
        - 1) Color: As selected by Architect from manufacturer's full range.
      - b. Secondary Seal: Manufacturer's standard extruded-elastomeric seal designed to prevent water and moisture infiltration.
- C. Architectural Joint Systems for Exterior Soffits:
  1. Basis-of-Design Products:
    - a. Nominal 2-inch Soffit-to-Wall Joints: "WABO Seismic Weather Seal;" BASF Company.
    2. Type: Ribbed seal.
      - a. Seal Material: Silicone.
        - 1) Color: As selected by Architect from manufacturer's full range.
      - b. Secondary Seal: Manufacturer's standard extruded-elastomeric seal designed to prevent water and moisture infiltration.

## 2.5 FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine surfaces and blockouts where architectural joint systems will be installed for installation tolerances and other conditions affecting performance of work.
  - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Prepare substrates according to architectural joint system manufacturer's written instructions.
- B. Repair concrete slabs and blockouts using manufacturer's recommended repair grout of compressive strength adequate for anticipated structural loadings.

### 3.3 INSTALLATION

- A. Comply with manufacturer's written instructions for storing, handling, and installing architectural joint assemblies and materials unless more stringent requirements are indicated.
- B. Metal Frames: Perform cutting, drilling, and fitting required to install joint systems.
  - 1. Install in true alignment and proper relationship to joints and adjoining finished surfaces measured from established lines and levels.
  - 2. Adjust for differences between actual structural gap and nominal design gap due to ambient temperature at time of installation. Notify Architect where discrepancies occur that will affect proper joint installation and performance.
  - 3. Cut and fit ends to accommodate thermal expansion and contraction of metal without buckling of frames.
  - 4. Locate in continuous contact with adjacent surfaces.
  - 5. Standard-Duty Systems: Shim to level where required. Support underside of frames continuously to prevent vertical deflection when in service.
  - 6. Locate anchors at interval recommended by manufacturer, but not less than 3 inches from each end and not more than 24 inches o.c.
- C. Seals in Metal Frames: Install elastomeric seals and membranes in frames to comply with manufacturer's written instructions. Install with minimum number of end joints.

1. Provide in continuous lengths for straight sections.
  2. Seal transitions according to manufacturer's written instructions. Vulcanize or heat-weld field-spliced joints as recommended by manufacturer.
  3. Installation: Mechanically lock seals into frames or adhere to frames with adhesive or pressure-sensitive tape as recommended by manufacturer.
- D. Fire-Resistance-Rated Assemblies: Coordinate installation of architectural joint assembly materials and associated work so complete assemblies comply with assembly performance requirements.
1. Fire Barriers: Install fire barriers, where indicated, to provide continuous, uninterrupted fire resistance throughout length of joint, including transitions and field splices.
- E. Water Barrier: Provide water barrier at exterior joints where indicated.

#### 3.4 PROTECTION

- A. Do not remove protective covering until finish work in adjacent areas is complete. When protective covering is removed, clean exposed metal surfaces to comply with manufacturer's written instructions.
- B. Protect the installation from damage by work of other Sections. Where necessary due to heavy construction traffic, remove and properly store cover plates or seals and install temporary protection over joints. Reinstall cover plates or seals prior to Substantial Completion of the Work.

END OF SECTION 05811

## SECTION 06105 - MISCELLANEOUS CARPENTRY

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Wood blocking and nailers.
  - 2. Wood furring.

#### 1.3 DEFINITIONS

- A. Dimension Lumber: Lumber of 2 inches nominal or greater but less than 5 inches nominal in least dimension.
- B. Lumber grading agencies, and the abbreviations used to reference them, include the following:
  - 1. NLGA: National Lumber Grades Authority.
  - 2. SPIB: The Southern Pine Inspection Bureau.
  - 3. WCLIB: West Coast Lumber Inspection Bureau.
  - 4. WWPA: Western Wood Products Association.

#### 1.4 SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
  - 1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
  - 2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
  - 3. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
  - 4. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

## 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Stack lumber and plywood flat with spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings.

## PART 2 - PRODUCTS

### 2.1 WOOD PRODUCTS, GENERAL

- A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
  - 1. Factory mark each piece of lumber with grade stamp of grading agency.
  - 2. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
  - 3. Provide dressed lumber, S4S, unless otherwise indicated.

### 2.2 WOOD-PRESERVATIVE-TREATED MATERIALS

- A. Preservative Treatment by Pressure Process: AWWA C2, except that lumber that is not in contact with the ground and is continuously protected from liquid water may be treated according to AWWA C31 with inorganic boron (SBX).
  - 1. Preservative Chemicals: Acceptable to Authorities Having Jurisdiction and containing no arsenic or chromium.
- B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or does not comply with requirements for untreated material.
- C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.
- D. Application: Treat items indicated on Drawings, including, but not limited to, the following:
  - 1. Wood blocking, nailers, and similar members in connection with roofing and flashing.

### 2.3 FIRE-RETARDANT-TREATED MATERIALS

- A. General: Comply with performance requirements in AWWA C20 (lumber).
  - 1. Use treatment that does not promote corrosion of metal fasteners.
  - 2. Use Interior Type A, unless otherwise indicated.
- B. Identify fire-retardant-treated wood with appropriate classification marking of testing and inspecting agency acceptable to Authorities Having Jurisdiction.

- C. For exposed items indicated to receive a stained or natural finish, use chemical formulations that do not bleed through, contain colorants, or otherwise adversely affect finishes.
- D. Application: Treat all miscellaneous carpentry, unless otherwise indicated.
  - 1. Concealed blocking, nailers and furring.

## 2.4 MISCELLANEOUS LUMBER

- A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
  - 1. Blocking.
  - 2. Nailers.
  - 3. Furring.
- B. For items of dimension lumber size, provide Construction or No. 2 grade lumber with 19 percent maximum moisture content and any of the following species:
  - 1. Mixed southern pine; SPIB.
  - 2. Spruce-pine-fir; NLGA.
  - 3. Hem-fir; WCLIB, or WWPA.
  - 4. Western woods; WCLIB or WWPA.
- C. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.
- D. For furring strips for installing hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

## 2.5 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture.
  - 1. Where carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.
- B. Nails, Brads, and Staples: ASTM F 1667.
- C. Power-Driven Fasteners: NES NER-272.
- D. Wood Screws: ASME B18.6.1.
- E. Screws for Fastening to Cold-Formed Metal Framing: ASTM C 954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.
- F. Lag Bolts: ASME B18.2.1.

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Set carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit carpentry to other construction; scribe and cope as needed for accurate fit. Locate furring, nailers, blocking, and similar supports to comply with requirements for attaching other construction.
- B. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.
- C. Sort and select lumber so that natural characteristics will not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- D. Comply with AWWA M4 for applying field treatment to cut surfaces of preservative-treated lumber.
  - 1. Use inorganic boron for items that are continuously protected from liquid water.
- E. Securely attach carpentry work to substrate by anchoring and fastening with appropriate fasteners.

### 3.2 WOOD BLOCKING, AND NAILER INSTALLATION

- A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.
- B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces, unless otherwise indicated.

END OF SECTION 06105

## SECTION 06402 - INTERIOR ARCHITECTURAL WOODWORK

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes the following:

1. Plastic-laminate cabinets.
2. Plastic-laminate countertops.
3. Solid-surfacing-material countertops.

- B. Related Sections include the following:

1. Division 6 Section "Miscellaneous Carpentry" for wood blocking required for installing woodwork and concealed within other construction before woodwork installation.
2. Division 10 Section "Impact-Resistant Wall Protection" for bumper guards attached to cabinets.

#### 1.3 SUBMITTALS

- A. Product Data: For panel products high-pressure decorative laminate adhesive for bonding plastic laminate solid-surfacing material cabinet hardware and accessories.

- B. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.

1. Show details full size.
2. Show locations and sizes of concealed metal backing plates specified in other Sections.
3. Show locations and sizes of cutouts and holes for plumbing fixtures faucets soap dispensers and other items installed in architectural woodwork.

- C. Samples:

1. Plastic laminates, 8 by 10 inches, for each type, color, pattern, and surface finish, with 1 sample applied to core material.
2. Solid-surfacing materials, 6 inches square.
3. Exposed cabinet hardware and accessories, one unit for each type.



#### 1.4 QUALITY ASSURANCE

- A. Quality Standard: Unless otherwise indicated, comply with AWI's "Architectural Woodwork Quality Standards" for grades of interior architectural woodwork indicated for construction, finishes, installation, and other requirements.
- B. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver woodwork until painting and similar operations that could damage woodwork have been completed in installation areas. If woodwork must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Project Conditions" Article.

#### 1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.
- B. Field Measurements: Where woodwork is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
  - 1. Locate concealed framing, blocking, and reinforcements that support woodwork by field measurements before being enclosed, and indicate measurements on Shop Drawings.
  - 2. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating woodwork without field measurements. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

#### 1.7 COORDINATION

- A. Coordinate sizes and locations of framing, metal backing plates and other related units of Work specified in other Sections to ensure that interior architectural woodwork can be supported and installed as indicated.

### PART 2 - PRODUCTS

#### 2.1 MATERIALS

- A. General: Provide materials that comply with requirements of AWI's quality standard for each type of woodwork and quality grade specified, unless otherwise indicated.

- B. Wood Products: Comply with the following:
  - 1. Hardboard: AHA A135.4.
  - 2. Medium-Density Fiberboard: ANSI A208.2, Grade MD, made with binder containing no urea formaldehyde.
  - 3. Particleboard: ANSI A208.1, Grade M-2 and M-2-Exterior Glue.
  - 4. Softwood Plywood: DOC PS 1, Medium Density Overlay.
  
- C. High-Pressure Decorative Plastic Laminate: NEMA LD 3, grades as indicated or, if not indicated, as required by woodwork quality standard.
  - 1. Manufacturers:
    - a. Basis-of-Design: Wilsonart; 4861-07, Gold Alchemy Matte Color, Class B.
    - b. Basis-of-Design: Wilsonart; 7939-38, Blond Echo Matte Color, Class B.
    - c. Basis-of-Design: Nevamar; WZ2004 T, Kendo Matte Color, Class B.
    - d. Interior Designer's approved equivalent.
  
- D. Solid-Surfacing Material: Homogeneous solid sheets of filled plastic resin complying with ISSFA-2.
  - 1. Manufacturers:
    - a. Basis-of-Design: Caesarstone; 4350, Taupe Polished Color, Class A.
    - b. Basis-of-Design: Corian; Serene Sage Matte Color, Class A.
    - c. Basis-of-Design: Corian; Fossil Matte Color, Class A.
    - d. Interior Designer's approved equivalent.
  
- E. Plastic Edge Banding: Solid PVC edge banding.
  - 1. Color: As selected by Architect from manufacturer's full line of standard solid or wood-grain colors
  - 2. Manufacturers:
    - a. "SpecLine," DOELLKEN-WOODTAPE, 350 West Armory Drive, South Holland, IL 60437, Tel: 425 349-2150; website [www.doellken-woodtape.com](http://www.doellken-woodtape.com).
    - b. Architect's approved equivalent.

## 2.2 CABINET HARDWARE AND ACCESSORIES

- A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets.
- B. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602, 135 degrees of opening, self-closing.
- C. Wire Pulls: Back mounted, solid metal, 4 inches long, 5/16 inch in diameter.
- D. Adjustable Shelf Standards and Supports: BHMA A156.9, B04071; with shelf rests, B04081.
- E. Shelf Rests: BHMA A156.9, B04013; metal.
- F. Drawer Slides: BHMA A156.9, B05091.

1. Standard Duty (Grade 1): Side mounted; full-extension type; with polymer rollers.
  2. Heavy Duty (Grade 1HD-100): Side mounted; full-extension type; zinc-plated steel ball-bearing slides.
  3. Box Drawer Slides: Grade 1HD-100; for drawers not more than 6 inches high and 24 inches wide.
  4. File Drawer Slides: Grade 1HD-200; for drawers more than 6 inches high or 24 inches wide.
  5. Pencil Drawer Slides: Grade 1; for drawers not more than 3 inches high and 24 inches wide.
  6. Keyboard Slides: Grade 1; for computer keyboard shelves.
- G. Door Locks: BHMA A156.11, E07121.
- H. Drawer Locks: BHMA A156.11, E07041.
- I. Grommets for Cable Passage through Countertops: 1-1/4-inch OD, black, molded-plastic grommets and matching plastic caps with slot for wire passage.
1. Manufacturers:
    - a. "OG series" by Doug Mockett & Company, Inc.
    - b. Architect's approved equivalent.
- J. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.
1. Satin Chromium Plated: BHMA 626 for brass or bronze base; BHMA 652 for steel base.
- K. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.

## 2.3 MISCELLANEOUS MATERIALS

- A. Adhesives, General: Do not use adhesives that contain urea formaldehyde.
- B. VOC Limits for Installation Adhesives and Glues: Use installation adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
1. Wood Glues: 30 g/L.
  2. Contact Adhesive: 250 g/L.
- C. Adhesive for Bonding Plastic Laminate: Unpigmented contact cement.
1. Adhesive for Bonding Edges: Hot-melt adhesive or adhesive specified above for faces.

## 2.4 FABRICATION, GENERAL

- A. Interior Woodwork Grade: Unless otherwise indicated, provide Custom-grade interior woodwork complying with referenced quality standard.

- B. Wood Moisture Content: Comply with requirements of referenced quality standard for wood moisture content in relation to ambient relative humidity during fabrication and in installation areas.
  - 1. Fabricate woodwork to dimensions, profiles, and details indicated.
- C. Complete fabrication, including assembly and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
- D. Shop-cut openings to maximum extent possible to receive hardware, appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.
  - 1. Seal edges of openings in countertops with a coat of varnish.

## 2.5 PLASTIC-LAMINATE CABINETS

- A. AWI Type of Cabinet Construction: Flush overlay.
- B. Laminate Cladding for Exposed Surfaces: High-pressure decorative laminate complying with the following requirements:
  - 1. Horizontal Surfaces Other Than Tops: Grade HGS.
  - 2. Postformed Surfaces: Grade HGP.
  - 3. Vertical Surfaces: Grade HGS.
  - 4. Edges: 3mm thick plastic edge band.
- C. Materials for Semiexposed Surfaces:
  - 1. Surfaces Other Than Drawer Bodies: Thermoset decorative panels.
    - a. Edges of Plastic-Laminate Shelves: 3 mm thick plastic edge banding.
  - 2. Drawer Sides and Backs: Solid-hardwood lumber.
  - 3. Drawer Bottoms: Thermoset decorative panels.
- D. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the requirements indicated in the Plastic Laminate Code Schedule provided by the Interior Designer.

## 2.6 PLASTIC-LAMINATE COUNTERTOPS

- A. High-Pressure Decorative Laminate Grade: HGS.
- B. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the requirements indicated in the Plastic Laminate Code Schedule provided by the Interior Designer.

- C. Edge Treatment: 1mm thick, plastic edge band.
- D. Core Material: Particleboard or medium-density fiberboard.
- E. Core Material at Sinks: Particleboard made with exterior glue, medium-density fiberboard made with exterior glue or exterior-grade plywood.
- F. Paper Backing: Provide paper backing on underside of countertop substrate.

## 2.7 SOLID-SURFACING-MATERIAL COUNTERTOPS

- A. Solid-Surfacing-Material Thickness: 1/2 inch.
- B. Colors, Patterns, and Finishes: Provide materials and products that result in colors of solid-surfacing material complying with the requirements indicated in the Solid Surface Code Schedule provided by the Interior Designer.
- C. Fabricate tops in one piece, unless otherwise indicated. Comply with solid-surfacing-material manufacturer's written recommendations for adhesives, sealers, fabrication, and finishing.
  - 1. Fabricate tops with shop-applied edges of materials and configuration indicated.
  - 2. Fabricate tops with loose backsplashes for field application.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Before installation, condition woodwork to average prevailing humidity conditions in installation areas.
- B. Before installing architectural woodwork, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.

### 3.2 INSTALLATION

- A. Grade: Install woodwork to comply with requirements for the same grade specified in Part 2 for fabrication of type of woodwork involved.
- B. Assemble woodwork and complete fabrication at Project site to comply with requirements for fabrication in Part 2, to extent that it was not completed in the shop.
- C. Install woodwork level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb (including tops) to a tolerance of 1/8 inch in 96 inches.
- D. Scribe and cut woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

- E. Anchor woodwork to wood blocking built in or directly attached framing. Secure with countersunk, concealed fasteners and blind nailing as required for complete installation. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork and matching final finish if transparent finish is indicated.
- F. Cabinets: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
  - 1. Install cabinets with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
  - 2. Fasten wall cabinets through back, near top and bottom, at ends and not more than 16 inches o.c. with No. 10 wafer-head sheet metal screws through metal backing or metal framing behind wall finish.
- G. Countertops: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.
  - 1. Align adjacent solid-surfacing-material countertops and form seams to comply with manufacturer's written recommendations using adhesive in color to match countertop. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
  - 2. Install countertops with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
  - 3. Secure backsplashes to walls with adhesive.
  - 4. Calk space between backsplash and wall with sealant specified in Division 7 Section "Joint Sealants."

### 3.3 ADJUSTING AND CLEANING

- A. Repair damaged and defective woodwork, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.
- B. Clean, lubricate, and adjust hardware.
- C. Clean woodwork on exposed and semiexposed surfaces

END OF SECTION 06402



## SECTION 07141 - COLD FLUID-APPLIED WATERPROOFING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Single-component polyurethane waterproofing.

#### 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include manufacturer's written instructions for evaluating, preparing, and treating substrate, technical data, and tested physical and performance properties of waterproofing.
- B. Warranty: Sample of special warranty.

#### 1.4 QUALITY ASSURANCE

- A. Installer Qualifications: A firm that is approved or licensed by waterproofing manufacturer for installation of waterproofing required for this Project.
- B. Preinstallation Conference: Conduct conference at Project site.
  - 1. Review waterproofing requirements including surface preparation, substrate condition and pretreatment, minimum curing period, forecasted weather conditions, special details and flashings, installation procedures, testing and inspection procedures, and protection and repairs.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver liquid materials to Project site in original containers with seals unbroken, labeled with manufacturer's name, product brand name and type, date of manufacture, shelf life, and directions for storing and mixing with other components.
- B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by waterproofing manufacturer.
- C. Remove and replace liquid materials that cannot be applied within their stated shelf life.



- D. Protect stored materials from direct sunlight.

## 1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Apply waterproofing within the range of ambient and substrate temperatures recommended by waterproofing manufacturer. Do not apply waterproofing to a damp or wet substrate or when relative humidity exceeds 85 percent.
  - 1. Do not apply waterproofing in rain, fog or mist, or when such weather conditions are imminent during application and curing period.
- B. Maintain adequate ventilation during application and curing of waterproofing materials.

## 1.7 WARRANTY

- A. Special Manufacturer's Warranty: Manufacturer's standard form in which waterproofing manufacturer and Installer agree to repair or replace waterproofing that does not comply with requirements or that fails to remain watertight within specified warranty period.
  - 1. Failure includes, but is not limited to, failure of waterproofing due to failure of substrate prepared and treated according to requirements or formation of new joints and cracks in substrate that exceed 1/16 inch in width.
  - 2. Warranty Period: Five years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 SINGLE-COMPONENT POLYURETHANE WATERPROOFING

- A. Single-Component, Modified Polyurethane Waterproofing: Comply with ASTM C 836 and with manufacturer's written physical requirements.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Carlisle Coatings & Waterproofing Inc.; CCW-525.
    - b. Karnak Corporation; One-Kote System.
    - c. Meadows, W.R., Inc.; Sealtight Meadow-Pruf Seamless
  - 2. Products: Subject to compliance with requirement, provide the following at green concrete surfaces.
    - a. Tremco Incorporated; Vulkem 250 GC.

### 2.2 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials recommended by manufacturer to be compatible with one another and with waterproofing, as demonstrated by waterproofing manufacturer, based on testing and field experience.

- B. Primer: Manufacturer's standard, factory-formulated polyurethane or epoxy primer.
- C. Joint Reinforcing Strip: Manufacturer's recommended fiberglass mesh or polyester fabric.
- D. Joint Sealant: Multicomponent polyurethane sealant, compatible with waterproofing, complying with ASTM C 920 Type M, Class 25; Grade NS for sloping and vertical applications or Grade P for deck applications; Use NT exposure; and as recommended by manufacturer for substrate and joint conditions.
  - 1. Backer Rod: Closed-cell polyethylene foam.

## 2.3 PROTECTION COURSE

- A. Protection Course: Fan folded, with a core of extruded-polystyrene board insulation faced one side(s) with plastic film, nominal thickness of 1/4 inch, with compressive strength not less than 8 psi per ASTM D 1621 and maximum water absorption by volume of 0.6 percent per ASTM C 272.

## 2.4 MOLDED-SHEET DRAINAGE PANELS

- A. Nonwoven-Geotextile-Faced, Molded-Sheet Drainage Panel: Manufactured composite subsurface drainage panels consisting of a nonwoven, needle-punched geotextile facing with an apparent opening size not exceeding No. 70 sieve laminated to one side with a polymeric film bonded to the other side of a studded, nonbiodegradable, molded-plastic-sheet drainage core, with a vertical flow rate of 9 to 15 gpm per ft..

# PART 3 - EXECUTION

## 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance.
  - 1. Verify that concrete has cured and aged for minimum time period recommended by waterproofing manufacturer.
  - 2. Verify that substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
  - 3. Proceed with installation only after unsatisfactory conditions have been corrected.

## 3.2 SURFACE PREPARATION

- A. Clean and prepare substrate according to manufacturer's written recommendations. Provide clean, dust-free, and dry substrate for waterproofing application.
- B. Mask off adjoining surfaces not receiving waterproofing to prevent spillage or overspray affecting other construction.

- C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, acid residues, and other penetrating contaminants or film-forming coatings from concrete.
- D. Remove fins, ridges, and other projections and fill honeycomb, aggregate pockets, and other voids.

### 3.3 PREPARATION AT TERMINATIONS AND PENETRATIONS

- A. Prepare vertical and horizontal surfaces at terminations and penetrations through waterproofing and at construction joints, drains, and sleeves according to ASTM C 1471 and manufacturer's written instructions.
- B. Prime substrate unless otherwise instructed by waterproofing manufacturer.
- C. Apply waterproofing in two separate applications, and embed a joint reinforcing strip in the first preparation coat when recommended by waterproofing manufacturer.
  - 1. Provide sealant cants around penetrations and at inside corners of deck-to-wall butt joints when recommended by waterproofing manufacturer.

### 3.4 JOINT AND CRACK TREATMENT

- A. Prepare, treat, rout, and fill joints and cracks in substrate according to ASTM C 1471 and waterproofing manufacturer's written instructions. Remove dust and dirt from joints and cracks, complying with ASTM D 4258, before coating surfaces.
  - 1. Comply with ASTM C 1193 for joint-sealant installation.
  - 2. Apply bond breaker between sealant and preparation strip.
  - 3. Prime substrate and apply a single thickness of preparation strip extending a minimum of 3 inches along each side of joint. Apply waterproofing in two separate applications and embed a joint reinforcing strip in the first preparation coat.

### 3.5 WATERPROOFING APPLICATION

- A. Apply waterproofing according to ASTM C 1471 and manufacturer's written instructions.
- B. Apply primer over prepared substrate.
- C. Unreinforced Waterproofing Applications: Mix materials and apply waterproofing by spray, roller, notched squeegee, trowel, or other application method suitable to slope of substrate.
  - 1. Apply one or more coats of waterproofing to obtain a seamless membrane free of entrapped gases, with an average dry film thickness of 60 mils and a minimum dry film thickness of 50 mils at any point.
  - 2. Apply waterproofing to prepared wall terminations and vertical surfaces.
  - 3. Verify wet film thickness of waterproofing every 100 sq. ft.
- D. Install protection course with butted joints over nominally cured membrane before starting subsequent construction operations.

1. Molded-sheet drainage panels may be used in place of a separate protection course to vertical applications when approved by waterproofing manufacturer.

### 3.6 MOLDED-SHEET DRAINAGE PANEL INSTALLATION

- A. Place and secure molded-sheet drainage panels, with geotextile facing away from wall or deck substrate, according to manufacturer's written instructions. Use adhesives that do not penetrate waterproofing. Lap edges and ends of geotextile fabric to maintain continuity. Protect installed molded-sheet drainage panels during subsequent construction.
  1. For vertical applications, install protection course before installing drainage panels.

### 3.7 CURING, PROTECTION, AND CLEANING

- A. Cure waterproofing according to manufacturer's written recommendations, taking care to prevent contamination and damage during application stages and curing.
- B. Protect waterproofing from damage and wear during remainder of construction period.

END OF SECTION 07141



## SECTION 07411 - METAL ROOF PANELS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Factory-formed and field-assembled, standing-seam metal roof panels.
- B. Related Sections include the following:
  - 1. Section 07920 - Joint Sealants.

#### 1.3 DEFINITIONS

- A. Metal Roof Panel Assembly: Metal roof panels, attachment system components, miscellaneous metal framing, underlayment, and accessories necessary for a complete weathertight roofing system.

#### 1.4 PERFORMANCE REQUIREMENTS

- A. General: Provide metal roof panel assemblies that comply with performance requirements specified as determined by testing manufacturers' standard assemblies similar to those indicated for this Project, by a qualified testing and inspecting agency.
- B. Air Infiltration: Air leakage through assembly of not more than 0.06 cfm/sq. ft. of roof area when tested according to ASTM E 283 at the following test-pressure difference:
  - 1. Test-Pressure Difference: Negative 1.57 lbf/sq. ft..
- C. Water Penetration: No water penetration when tested according to ASTM E 331 at the following test-pressure difference:
  - 1. Test-Pressure Difference: 20 percent of positive design wind pressure, but not less than 6.24 lbf/sq. ft. and not more than 12.0 lbf/sq. ft..
- D. FMG Listing: Provide metal roof panels and component materials that comply with requirements in FMG 4471 as part of a panel roofing system and that are listed in FMG's "Approval Guide" for Class 1 or noncombustible construction, as applicable. Identify materials with FMG markings.

1. Fire/Windstorm Classification: Class 1A- 140.
  2. Hail Resistance: SH.
- E. Structural Performance: Metal roof panels shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated according to the Uniform Building Code.
1. Wind Loads: Calculate wind loads according to Sections 1615 through 1622 and Section 1625 of the Uniform Building Code.
  2. Earthquake Loads: Provide capacity of withstanding the effects of earthquake motions determined according to Section 1610 and Sections 1626 through 1635 of the Uniform Building Code.
- F. Thermal Movements: Provide metal roof panel assemblies that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

## 1.5 SUBMITTALS

- A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of metal roof panel and accessory.
- B. Shop Drawings: Show fabrication and installation layouts of metal roof panels; details of edge conditions, joints, panel profiles, corners, anchorages, trim, flashings, closures, and accessories; and special details. Distinguish between factory- and field-assembled work.
1. Accessories: Include details of the following items, at a scale of not less than 1-1/2 inches per 12 inches:
    - a. Flashing and trim.
  2. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- C. Samples for Initial Selection: As directed by Architect.
- D. Samples for Verification:
1. Metal Roof Panels: 12 inches long by actual panel width. Include fasteners, clips, seam caps, and other metal roof panel accessories.
  2. Trim and Closures: 12 inches long. Include fasteners and other exposed accessories.
  3. Vapor Retarders: 6-inch- square Samples.
  4. Accessories: 12-inch- long Samples for each type of accessory.
- E. Warranties: Special warranties specified in this Section.

## 1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers trained and approved by manufacturer.
1. Installer's responsibilities include fabricating and installing metal roof panel assemblies and providing professional engineering services needed to assume engineering responsibility.
  2. Engineering Responsibility: Preparation of data for metal roof panels, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.
- B. Fire-Resistance Ratings: Where indicated in Drawings, provide metal roof panels identical to those of assemblies tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to Authorities Having Jurisdiction.
1. Combustion Characteristics: ASTM E 136.
  2. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another testing and inspecting agency.
  3. Metal roof panels shall be identified with appropriate markings of applicable testing and inspecting agency.
- C. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination." Review methods and procedures related to metal roof panel assemblies including, but not limited to, the following:
1. Meet with Owner, Architect, metal roof panel Installer, metal roof panel manufacturer's representative, deck Installer, and installers whose work interfaces with or affects metal roof panels including installers of roof accessories and roof-mounted equipment.
  2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
  3. Review methods and procedures related to metal roof panel installation, including manufacturer's written instructions.
  4. Examine deck substrate conditions for compliance with requirements, including flatness and attachment to structural members.
  5. Review structural loading limitations of deck during and after roofing.
  6. Review flashings, special roof details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect metal roof panels.
  7. Review governing regulations and requirements for insurance, certificates, and testing and inspecting if applicable.
  8. Review temporary protection requirements for metal roof panel assembly during and after installation.
  9. Review roof observation and repair procedures after metal roof panel installation.
  10. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver components, sheets, metal roof panels, and other manufactured items so as not to be damaged or deformed. Package metal roof panels for protection during transportation and handling.



- B. Unload, store, and erect metal roof panels in a manner to prevent bending, warping, twisting, and surface damage.
- C. Stack metal roof panels on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal roof panels to ensure dryness. Do not store metal roof panels in contact with other materials that might cause staining, denting, or other surface damage.
- D. Protect strippable protective covering on metal roof panels from exposure to sunlight and high humidity, except to extent necessary for period of metal roof panel installation.

## 1.8 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal roof panels to be performed according to manufacturers' written instructions and warranty requirements.

## 1.9 COORDINATION

- A. Coordinate installation of roof curbs, equipment supports, and roof penetrations.
- B. Coordinate metal panel roof assemblies with rain drainage work, flashing, trim, and construction of decks, parapets, walls, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

## 1.10 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal roof panel assemblies that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Structural failures, including rupturing, cracking, or puncturing.
    - b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
  - 2. Warranty Period: Two years from date of Substantial Completion.
- B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal roof panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
  - 1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:
    - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
    - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
    - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
  - 2. Finish Warranty Period: 20 years from date of Substantial Completion.

- C. Special Weathertightness Warranty for Standing-Seam Metal Roof Panels: Manufacturer's standard form in which manufacturer agrees to repair or replace standing-seam metal roof panel assemblies that fail to remain weathertight, including leaks, within specified warranty period.
  - 1. Warranty Period: 20 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

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

### 2.2 PANEL MATERIALS

- A. Aluminum Sheet: Coil-coated sheet, ASTM B 209, alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.
  - 1. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.
- B. Panel Sealants:
  - 1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.
  - 2. Joint Sealant: ASTM C 920; elastomeric silicone sealant; of type, grade, class, and use classifications required to seal joints in metal roof panels and remain weathertight; and as recommended in writing by metal roof panel manufacturer.

### 2.3 UNDERLAYMENT MATERIALS

- A. Self-Adhering, High-Temperature Sheet: 30 to 40 mils thick minimum, consisting of slip-resisting polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.
  - 1. Thermal Stability: Stable after testing at 240 deg F; ASTM D 1970.
  - 2. Products:
    - a. Carlisle Coatings & Waterproofing, Div. of Carlisle Companies Inc.; Dri-Start "HR."
    - b. Grace, W. R. & Co.; Vycor Ultra.
    - c. Henry Company; Perma-Seal PE.

- B. Slip Sheet: Building paper, minimum 5 lb/100 sq. ft., rosin sized.

## 2.4 MISCELLANEOUS MATERIALS

- A. Fasteners: Self-tapping screws, bolts, nuts, self-locking rivets and bolts, end-welded studs, and other suitable fasteners designed to withstand design loads.
  - 1. Fasteners for Roof Panels: Self-drilling or self-tapping, zinc-plated, hex-head carbon-steel screws, with a stainless-steel cap or zinc-aluminum-alloy head and EPDM or neoprene sealing washer.
  - 2. Fasteners for Flashing and Trim: Blind fasteners or self-drilling screws with hex washer head.
  - 3. Blind Fasteners: High-strength aluminum or stainless-steel rivets.

## 2.5 STANDING-SEAM METAL ROOF PANELS

- A. General: Provide factory-formed metal roof panels designed to be field assembled by lapping and interconnecting raised side edges of adjacent panels with joint type indicated and mechanically attaching panels to supports using concealed clips in side laps. Include clips, cleats, pressure plates, and accessories required for weathertight installation.
  - 1. Aluminum Panel Systems: Unless more stringent requirements are indicated, comply with ASTM E 1637.
- B. Vertical-Rib, Snap-Joint, Standing-Seam Metal Roof Panels: Formed with vertical ribs at panel edges and flat pan between ribs; designed for sequential installation by mechanically attaching panels to supports using concealed clips located under one side of panels and engaging opposite edge of adjacent panels, and snapping panels together.
  - 1. Manufacturers:
    - a. AEP-Span.
    - b. Innovative Metals Company, Inc.
    - c. Petersen Aluminum Corporation.
    - d. Architect approved equivalent.
  - 2. Material: Aluminum sheet, 0.032 inch thick.
    - a. Exterior Finish: Fluoropolymer.
  - 3. Batten: Same material, finish, and color as roof panels.
  - 4. Clips: Manufacturer's standard type.
    - a. Material: 0.0209-inch- thick, zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet.
  - 5. Uplift Rating: UL 90.

## 2.6 ACCESSORIES

- A. Roof Panel Accessories: Provide components required for a complete metal roof panel assembly including trim, copings, fasciae, corner units, ridge closures, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items.
1. Closures: Provide closures at eaves and ridges, fabricated of same metal as metal roof panels.
  2. Clips: Minimum 0.0625-inch- thick, stainless-steel panel clips designed to withstand negative-load requirements.
  3. Cleats: Mechanically seamed cleats formed from minimum 0.0250-inch- thick, stainless-steel or nylon-coated aluminum sheet.
  4. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
  5. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch- thick, flexible closure strips; cut or premolded to match metal roof panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
- B. Flashing and Trim: Formed from 0.032-inch- thick, aluminum sheet prepainted with coil coating. Provide flashing and trim as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers. Finish flashing and trim with same finish system as adjacent metal roof panels.

## 2.7 FABRICATION

- A. General: Fabricate and finish metal roof panels and accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
- B. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.
- C. Where indicated, fabricate metal roof panel joints with factory-installed captive gaskets or separator strips that provide a tight seal and prevent metal-to-metal contact, in a manner that will minimize noise from movements within panel assembly.
- D. Sheet Metal Accessories: Fabricate flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to the design, dimensions, metal, and other characteristics of item indicated.
1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
  2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
  3. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA standards.

4. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
5. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended by metal roof panel manufacturer.
  - a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal roof panel manufacturer for application but not less than thickness of metal being secured.

## 2.8 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal roof panel supports, and other conditions affecting performance of work.
  1. Examine solid roof sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal roof panel manufacturer.
  2. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Clean substrates of substances harmful to underlayment, including removing projections capable of interfering with underlayment attachment.
- B. Install flashings and other sheet metal to comply with requirements specified in Division 7 Section "Sheet Metal Flashing and Trim."

### 3.3 UNDERLAYMENT INSTALLATION

- A. Self-Adhering Sheet Underlayment: Install self-adhering sheet underlayment, wrinkle free, on roof sheathing under metal roof panels. Apply primer if required by manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation; use primer rather than nails for installing underlayment at low temperatures. Apply over entire roof, in shingle

fashion to shed water, with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches. Roll laps with roller. Cover underlayment within 14 days.

- B. Apply slip sheet over underlayment before installing metal roof panels.

### 3.4 METAL ROOF PANEL INSTALLATION, GENERAL

- A. General: Provide metal roof panels of full length from eave to ridge, unless otherwise indicated or restricted by shipping limitations. Anchor metal roof panels and other components of the Work securely in place, with provisions for thermal and structural movement.

1. Field cutting of metal roof panels by torch is not permitted.
2. Rigidly fasten eave end of metal roof panels and allow ridge end free movement due to thermal expansion and contraction. Pre-drill panels.
3. Provide metal closures at peaks rake edges rake walls and each side of ridge.
4. Flash and seal metal roof panels with weather closures at eaves, rakes, and at perimeter of all openings. Fasten with self-tapping screws.
5. Locate and space fastenings in uniform vertical and horizontal alignment.
6. Install ridge caps as metal roof panel work proceeds.
7. Lap metal flashing over metal roof panels to allow moisture to run over and off the material.

- B. Fasteners:

1. Aluminum Roof Panels: Use aluminum or stainless-steel fasteners for surfaces exposed to the exterior and aluminum or galvanized steel fasteners for surfaces exposed to the interior.

- C. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by metal roof panel manufacturer.

- D. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weatherproof performance of metal roof panel assemblies. Provide types of gaskets, fillers, and sealants indicated or, if not indicated, types recommended by metal roof panel manufacturer.

1. Seal metal roof panel end laps with double beads of tape or sealant, full width of panel. Seal side joints where recommended by metal roof panel manufacturer.
2. Prepare joints and apply sealants to comply with requirements in Division 7 Section "Joint Sealants."

### 3.5 FIELD-ASSEMBLED METAL ROOF PANEL INSTALLATION

- A. Standing-Seam Metal Roof Panels: Fasten metal roof panels to supports with concealed clips at each standing-seam joint at location, spacing, and with fasteners recommended by manufacturer.

1. Install clips to supports with self-tapping fasteners.
2. Install pressure plates at locations indicated in manufacturer's written installation instructions.
3. Snap Joint: Nest standing seams and fasten together by interlocking and completely engaging factory-applied sealant.

### 3.6 ACCESSORY INSTALLATION

- A. General: Install accessories with positive anchorage to building and weathertight mounting and provide for thermal expansion. Coordinate installation with flashings and other components.
  1. Install components required for a complete metal roof panel assembly including trim, ridge closures, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
- B. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
  1. Install exposed flashing and trim that is without excessive oil canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weather-resistant performance.
  2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped or bayonet-type expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

### 3.7 CLEANING AND PROTECTION

- A. Remove temporary protective coverings and strippable films, if any, as metal roof panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal roof panel installation, clean finished surfaces as recommended by metal roof panel manufacturer. Maintain in a clean condition during construction.
- B. Replace metal roof panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 07411

## SECTION 07552 - SBS-MODIFIED BITUMINOUS MEMBRANE ROOFING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes the following:
  - 1. SBS-modified bituminous membrane roofing installed over the following substrates:
    - a. Insulation
  - 2. Roof insulation.
- B. Related Sections include the following:
  - 1. Division 6 Section "Miscellaneous Carpentry" for wood nailers and blocking.
  - 2. Division 7 Section "Sheet Metal Flashing and Trim" for metal roof penetration flashings, flashings, and counterflashings.

#### 1.3 DEFINITIONS

- A. Roofing Terminology: Refer to ASTM D 1079 and glossary of NRCA's "The NRCA Roofing and Waterproofing Manual" for definition of terms related to roofing work in this Section.

#### 1.4 PERFORMANCE REQUIREMENTS

- A. General: Provide installed roofing membrane and base flashings that remain watertight; do not permit the passage of water; and resist specified uplift pressures, thermally induced movement, and exposure to weather without failure.
- B. Material Compatibility: Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by roofing manufacturer based on testing and field experience.
- C. Roofing System Design: Provide a roofing system that is identical to systems that have been successfully tested by a qualified testing and inspecting agency to resist uplift pressure calculated according to Sections 1615 through 1622 and Section 1625 of the Uniform Building Code.



## 1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For roofing system. Include plans, elevations, sections, details, and attachments to other Work.
  - 1. Base flashings and membrane terminations.
  - 2. Tapered insulation, including slopes.
  - 3. Insulation fastening patterns.
- C. Samples for Verification: For the following products:
  - 1. 12-by-12-inch square of base sheet base-ply sheet and flashing backer sheet.
  - 2. 12-by-12-inch square of mineral-granule-surfaced roofing membrane cap sheet metal-foil-surfaced roofing membrane cap sheet, of color specified.
  - 3. 12-by-12-inch square of roof insulation and cover board.
  - 4. 12-by-12-inch square of walkway pad or walkway cap sheet.
  - 5. Six base sheet fasteners of each type, length, and finish.
- D. Maintenance Data: For roofing system to include in maintenance manuals.
- E. Warranties: Special warranties specified in this Section.
- F. Inspection Report: Copy of roofing system manufacturer's inspection report of completed roofing installation.

## 1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's warranty.
- B. Source Limitations: Obtain components for roofing system from roofing system manufacturer.
- C. Fire-Test-Response Characteristics: Provide roofing materials with the fire-test-response characteristics indicated as determined by testing identical products per test method below by UL, FMG, or another testing and inspecting agency acceptable to Authorities Having Jurisdiction. Materials shall be identified with appropriate markings of applicable testing and inspecting agency.
  - 1. Exterior Fire-Test Exposure: Class A; ASTM E 108, for application and roof slopes indicated.
- D. Preinstallation Conference: Conduct conference at Project site. Review methods and procedures related to roofing system including, but not limited to, the following:
  - 1. Meet with Owner, Architect, roofing Installer, roofing system manufacturer's representative, deck Installer, and installers whose work interfaces with or affects roofing including installers of roof accessories and roof-mounted equipment.

2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
3. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
4. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
5. Review structural loading limitations of roof deck during and after roofing.
6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect roofing system.
7. Review temporary protection requirements for roofing system during and after installation.
8. Review roof observation and repair procedures after roofing installation.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, and directions for storage.
- B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.
  1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.
- C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.
- D. Handle and store roofing materials and place equipment in a manner to avoid permanent deflection of deck.

#### 1.8 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

#### 1.9 WARRANTY

- A. Special Warranty: Manufacturer's standard form, without monetary limitation, in which manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period. Failure includes roof leaks.
  1. Special warranty includes roofing membrane, base flashings, roof insulation, fasteners, cover boards, walkway products and other components of roofing system.
  2. Warranty Period: 20 years from date of Substantial Completion.

- B. Special Project Warranty: Submit roofing Installer's warranty, on warranty form at end of this Section, signed by Installer, covering Work of this Section, including all components of roofing system such as roofing membrane, base flashing, roof insulation, fasteners, cover boards, substrate boards, vapor retarders, and walkway products, for the following warranty period:
  - 1. Warranty Period: Two years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Basis-of-Design Roof Systems: The roofing systems are based on specification 2030IA by Siplast, Inc. Subject to compliance with requirements, provide the named roofing systems or equivalent roofing systems by one of the following:
  - 1. SBS-Modified Bituminous Membrane Roofing:
    - a. Johns Manville International, Inc.
    - b. Soprema Roofing and Waterproofing Inc.

### 2.2 SBS-MODIFIED ASPHALT-SHEET MATERIALS

- A. Roofing Membrane Sheet: ASTM D 6163, Grade S, Type I, glass-fiber-reinforced, SBS-modified asphalt sheet; smooth surfaced; suitable for application method specified.
  - 1. Basis-of-Design Product: Paradiene 20; Siplast, Inc.
- B. Roofing Membrane Cap Sheet: ASTM D 6163, Grade G, Type I, glass-fiber-reinforced, SBS-modified asphalt sheet; granular surfaced; suitable for application method specified, and as follows:
  - 1. Granule Color: White
  - 2. Basis-of-Design Product: Paradiene 30; Siplast, Inc.

### 2.3 BASE-SHEET MATERIALS

- A. Base Sheet: ASTM D 4601, Type II, SBS-modified asphalt-impregnated and asphalt-coated sheet, with glass-fiber-reinforcing mat, dusted with fine mineral surfacing on both sides.
  - 1. Weight: 20 lb/100 sq. ft., minimum.
  - 2. Basis-of-Design Product: Parabase; Siplast, Inc.

### 2.4 BASE FLASHING SHEET MATERIALS

- A. Backer Sheet: ASTM D 6163, Grade S, Type I, glass-fiber-reinforced, SBS-modified asphalt sheet; smooth surfaced; suitable for application method specified.

1. Basis-of-Design Product: Paradiene 20; Siplast, Inc.
- B. Flashing Sheet: ASTM D 6298, glass-fiber-reinforced, SBS-modified asphalt sheet; metal-foil surfaced; suitable for application method specified, and as follows:
  1. Foil Surfacing: Aluminum.
  2. Basis-of-Design Product: Veral; Siplast, Inc.

## 2.5 AUXILIARY ROOFING MEMBRANE MATERIALS

- A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with roofing membrane.
- B. Cold-Applied Adhesive: Roofing system manufacturer's standard asphalt-based, one or two-part, asbestos-free, cold-applied adhesive specially formulated for compatibility and use with roofing membrane.
  1. Basis-of-Design Product: PA 318; Siplast, Inc.
- C. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required by roofing system manufacturer for application.
- D. Fasteners: Factory-coated steel fasteners and metal or plastic plates meeting corrosion-resistance provisions in FMG 4470, designed for fastening roofing membrane components to substrate, tested by manufacturer for required pullout strength, and acceptable to roofing system manufacturer.
- E. Roofing Granules: Ceramic-coated roofing granules, No. 11 screen size with 100 percent passing No. 8 sieve and 98 percent of mass retained on No. 40 sieve, color to match roofing membrane.
  1. Basis-of-Design Product: Siplast No. 1 Roofing Granules; Siplast, Inc.
- F. Miscellaneous Accessories: Provide miscellaneous accessories recommended by roofing system manufacturer.

## 2.6 ROOF INSULATION

- A. General: Provide preformed roof insulation boards that comply with requirements and referenced standards, selected from manufacturer's standard sizes and of thicknesses indicated.
- B. Polyisocyanurate Board Insulation: ASTM C 1289, Type II, felt or glass-fiber mat facer on both major surfaces.
  1. Manufacturers:
    - a. Apache Products Company.
    - b. Atlas Roofing Corporation.
    - c. Johns Manville International, Inc.

- C. Tapered Insulation: Provide factory-tapered insulation boards fabricated to slope of 1/4 inch per 12 inches, unless otherwise indicated.
- D. Provide preformed insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated.

## 2.7 INSULATION ACCESSORIES

- A. General: Roof insulation accessories recommended by insulation manufacturer for intended use and compatible with membrane roofing.
- B. Cold-Applied Foam Adhesive: Adhesive formulated to adhere roof insulation to substrate and cover board to roofing insulation.
  - 1. Product: Insta-Stik, Dow Chemical Co.
- C. Tapered Edge Strips: ASTM C 728, perlite insulation board.
- D. Cover Board: ASTM C 728, perlite insulation board, 3/4 inch thick, with top surface seal-coated.

## 2.8 WALKWAYS

- A. Walkway Pads: Mineral-granule-surfaced, asphalt-impregnated polyester fabric, coated with polymer modified bitumen, manufactured as a traffic pad for foot traffic and acceptable to roofing system manufacturer, 217 mils thick, minimum.
  - 1. Granule Color: Manufacturer's standard.
  - 2. Basis-of-Design Product: Paratread; Siplast, Inc.
- B. Plastic Cement: ASTM 4586, Type II, asbestos free.
  - 1. Basis of Design Product: PA 1021 Plastic Cement, Siplast, Inc.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with the following requirements and other conditions affecting performance of roofing system:
  - 1. Verify that roof openings and penetrations are in place and set and braced and that roof drains are securely clamped in place.
  - 2. Verify that wood blocking and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.
  - 3. Verify that concrete substrate is visibly dry and free of moisture.
  - 4. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions. Remove sharp projections.
- B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.

### 3.3 INSULATION INSTALLATION

- A. Comply with roofing system manufacturer's written instructions for installing roof insulation.
- B. Insulation Cant Strips: Install and secure preformed 45-degree insulation cant strips at junctures of roofing membrane system with vertical surfaces or angle changes greater than 45 degrees.
- C. Install tapered insulation under area of roofing to conform to slopes indicated.
- D. Install insulation with long joints of insulation in a continuous straight line with end joints staggered between rows, abutting edges and ends between boards. Fill gaps exceeding 1/4 inch with insulation.
  - 1. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.
- E. Install one or more layers of insulation under area of roofing to achieve required thickness. Where overall insulation thickness is 2 inches or greater, install 2 or more layers with joints of each succeeding layer staggered from joints of previous layer a minimum of 6 inches in each direction.
- F. Trim surface of insulation where necessary at roof drains so completed surface is flush and does not restrict flow of water.
- G. Install tapered edge strips at perimeter edges of roof that do not terminate at vertical surfaces.
- H. Adhered Insulation: Install each layer of insulation and adhere to concrete substrates with cold-applied foam adhesive.
  - 1. Set each layer of insulation in cold-applied foam adhesive
  - 2. Adhere according to requirements in FMG's "Approval Guide" for specified Windstorm Resistance Classification.
  - 3. Adhere to resist uplift pressure at corners, perimeter and field of roof.
- I. Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Stagger joints from joints in insulation below a minimum of 6 inches in each direction. Loosely butt cover boards together and adhere to insulation with cold-applied foam adhesive.
  - 1. Adhere according to requirements in FMG's "Approval Guide" for specified Windstorm Resistance Classification.
  - 2. Adhere to resist uplift pressure at corners, perimeter, and field of roof.

### 3.4 ROOFING MEMBRANE INSTALLATION, GENERAL

- A. Install roofing membrane system according to roofing system manufacturer's written instructions and applicable recommendations of ARMA/NRCA's "Quality Control Guidelines for the Application of Polymer Modified Bitumen Roofing."
- B. Start installation of roofing membrane in presence of roofing system manufacturer's technical personnel.
- C. Coordinate installing roofing system so insulation and other components of the roofing membrane system not permanently exposed are not subjected to precipitation or left uncovered at the end of the workday or when rain is forecast.
  - 1. Provide tie-offs at end of each day's work to cover exposed roofing membrane sheets and insulation with a course of coated felt set in roofing cement or hot roofing asphalt with joints and edges sealed.
  - 2. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system.
  - 3. Remove and discard temporary seals before beginning work on adjoining roofing.

### 3.5 BASE-SHEET INSTALLATION

- A. At lightweight concrete roof insulation, install lapped base sheet course, extending sheet over and terminating beyond cants. Attach base sheet as follows:
  - 1. Mechanically fasten to substrate with manufacturer's recommended fasteners.

### 3.6 SBS-MODIFIED BITUMINOUS MEMBRANE INSTALLATION

- A. Install modified bituminous roofing membrane sheet and cap sheet according to roofing manufacturer's written instructions, starting at low point of roofing system. Extend roofing membrane sheets over and terminate beyond cants, installing as follows:
  - 1. Adhere to substrate in cold-applied adhesive.
  - 2. Unroll roofing membrane sheets and allow them to relax for minimum time period required by manufacturer.
- B. Laps: Accurately align roofing membrane sheets, without stretching, and maintain uniform side and end laps. Stagger end laps. Completely bond and seal laps, leaving no voids.
  - 1. Repair tears and voids in laps and lapped seams not completely sealed.
  - 2. Apply roofing granules to cover exuded bead at laps while bead is hot.
- C. Install roofing membrane sheets so side and end laps shed water.

### 3.7 FLASHING AND STRIPPING INSTALLATION

- A. Install base flashing over cant strips and other sloping and vertical surfaces, at roof edges, and at penetrations through roof, and secure to substrates according to roofing system manufacturer's written instructions and as follows:
  - 1. Backer Sheet Application: Mechanically fasten backer sheet to walls or parapets. Adhere backer sheet over roofing membrane at cants in cold-applied adhesive.
  - 2. Flashing Sheet Application: Torch apply flashing sheet to substrate.
- B. Extend base flashing up walls or parapets a minimum of 8 inches above roofing membrane and 4 inches onto field of roofing membrane.
- C. Mechanically fasten top of base flashing securely at terminations and perimeter of roofing.
- D. Install roofing membrane cap-sheet stripping where metal flanges and edgings are set on membrane roofing according to roofing system manufacturer's written instructions.
- E. Roof Drains: Set 30-by-30-inch metal flashing in bed of asphalt roofing cement on completed roofing membrane. Cover metal flashing with roofing membrane cap-sheet stripping and extend a minimum of 6 inches beyond edge of metal flashing onto field of roofing membrane. Clamp roofing membrane, metal flashing, and stripping into roof-drain clamping ring.
  - 1. Install stripping according to roofing system manufacturer's written instructions.

### 3.8 WALKWAY INSTALLATION

- A. Walkway Pads: Install walkway pads using units of manufacturer's standard size according to walkway pad manufacturer's written instructions.
  - 1. Set walkway pads in cold-applied adhesive or plastic cement.

### 3.9 PROTECTING AND CLEANING

- A. Protect roofing system from damage and wear during remainder of construction period. When remaining construction will not affect or endanger roofing, inspect roofing for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.
- B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.
- C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

### 3.10 ROOFING INSTALLER'S WARRANTY

- A. WHEREAS <Insert name> of <Insert address>, herein called the "Roofing Installer," has performed roofing and associated work ("work") on the following project:



1. Owner: <Insert name of Owner.>
  2. Address: <Insert address.>
  3. Building Name/Type: <Insert information.>
  4. Address: <Insert address.>
  5. Area of Work: <Insert information.>
  6. Acceptance Date: <Insert date.>
  7. Warranty Period: <Insert time.>
  8. Expiration Date: <Insert date.>
- B. AND WHEREAS Roofing Installer has contracted (either directly with Owner or indirectly as a subcontractor) to warrant said work against leaks and faulty or defective materials and workmanship for designated Warranty Period,
- C. NOW THEREFORE Roofing Installer hereby warrants, subject to terms and conditions herein set forth, that during Warranty Period he will, at his own cost and expense, make or cause to be made such repairs to or replacements of said work as are necessary to correct faulty and defective work and as are necessary to maintain said work in a watertight condition.
- D. This Warranty is made subject to the following terms and conditions:
1. Specifically excluded from this Warranty are damages to work and other parts of the building, and to building contents, caused by:
    - a. lightning;
    - b. peak gust wind speed exceeding <Insert wind speed> mph;
    - c. fire;
    - d. failure of roofing system substrate, including cracking, settlement, excessive deflection, deterioration, and decomposition;
    - e. faulty construction of parapet walls, equipment supports, and other edge conditions and penetrations of the work;
    - f. vapor condensation on bottom of roofing; and
    - g. activity on roofing by others, including construction contractors, maintenance personnel, other persons, and animals, whether authorized or unauthorized by Owner.
  2. When work has been damaged by any of foregoing causes, Warranty shall be null and void until such damage has been repaired by Roofing Installer and until cost and expense thereof have been paid by Owner or by another responsible party so designated.
  3. Roofing Installer is responsible for damage to work covered by this Warranty but is not liable for consequential damages to building or building contents resulting from leaks or faults or defects of work.
  4. During Warranty Period, if Owner allows alteration of work by anyone other than Roofing Installer, including cutting, patching, and maintenance in connection with penetrations, attachment of other work, and positioning of anything on roof, this Warranty shall become null and void on date of said alterations, but only to the extent said alterations affect work covered by this Warranty. If Owner engages Roofing Installer to perform said alterations, Warranty shall not become null and void unless Roofing Installer, before starting said work, shall have notified Owner in writing, showing reasonable cause for claim, that said alterations would likely damage or deteriorate work, thereby reasonably justifying a limitation or termination of this Warranty.

5. During Warranty Period, if original use of roof is changed and it becomes used for other use or service more severe than originally specified, this Warranty shall become null and void on date of said change, but only to the extent said change affects work covered by this Warranty.
6. Owner shall promptly notify Roofing Installer of observed, known, or suspected leaks, defects, or deterioration and shall afford reasonable opportunity for Roofing Installer to inspect work and to examine evidence of such leaks, defects, or deterioration.
7. This Warranty is recognized to be the only warranty of Roofing Installer on said work and shall not operate to restrict or cut off Owner from other remedies and resources lawfully available to Owner in cases of roofing failure. Specifically, this Warranty shall not operate to relieve Roofing Installer of responsibility for performance of original work according to requirements of the Contract Documents, regardless of whether Contract was a contract directly with Owner or a subcontract with Owner's General Contractor.

E. IN WITNESS THEREOF, this instrument has been duly executed this **<Insert day>** day of **<Insert month>**, **<Insert year>**.

1. Authorized Signature: **<Insert signature.>**
2. Name: **<Insert name.>**
3. Title: **<Insert title.>**

END OF SECTION 07552



## SECTION 07620 - SHEET METAL FLASHING AND TRIM

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes the following sheet metal flashing and trim:
  - 1. Manufactured reglets.
  - 2. Formed roof drainage system.
  - 3. Formed flashing and counterflashing.
  - 4. Formed equipment support flashing.
- B. Related Sections include the following:
  - 1. Division 6 Section "Miscellaneous Carpentry" for wood nailers, curbs, and blocking.
  - 2. Division 7 Section "SBS-Modified Bituminous Membrane Roofing" for installing sheet metal flashing and trim integral with roofing.
  - 3. Division 7 Section "Manufactured Roof Specialties" for manufactured roof specialties not part of sheet metal flashing and trim.
  - 4. Division 7 Section "Joint Sealants" for field-applied sheet metal flashing and trim sealants.

#### 1.3 PERFORMANCE REQUIREMENTS

- A. General: Install sheet metal flashing and trim to withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failing, rattling, leaking, and fastener disengagement.
- B. Thermal Movements: Provide sheet metal flashing and trim that allow for thermal movements resulting from changes in ambient and surface temperatures by preventing buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Provide clips that resist rotation and avoid shear stress as a result of sheet metal and trim thermal movements. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
- C. Water Infiltration: Provide sheet metal flashing and trim that do not allow water infiltration to building interior.

#### 1.4 SUBMITTALS

- A. Shop Drawings: Show layouts of sheet metal flashing and trim, including plans and elevations. Distinguish between shop- and field-assembled work. Include the following:
  - 1. Identify material, thickness, weight, and finish for each item and location in Project.
  - 2. Details for forming sheet metal flashing and trim, including profiles, shapes, seams, and dimensions.
  - 3. Details for fastening, joining, supporting, and anchoring sheet metal flashing and trim, including fasteners, clips, cleats, and attachments to adjoining work.
- B. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:
  - 1. Sheet Metal Flashing: 12 inches long. Include fasteners, cleats, clips, closures, and other attachments.

#### 1.5 QUALITY ASSURANCE

- A. Sheet Metal Flashing and Trim Standard: Comply with SMACNA's "Architectural Sheet Metal Manual." Conform to dimensions and profiles shown unless more stringent requirements are indicated.
- B. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."
  - 1. Meet with Owner, Architect, Installer, and installers whose work interfaces with or affects sheet metal flashing and trim including installers of roofing materials and roof-mounted equipment.
  - 2. Review methods and procedures related to sheet metal flashing and trim.
  - 3. Examine substrate conditions for compliance with requirements, including flatness and attachment to structural members.
  - 4. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver sheet metal flashing materials and fabrications undamaged. Protect sheet metal flashing and trim materials and fabrications during transportation and handling.
- B. Unload, store, and install sheet metal flashing materials and fabrications in a manner to prevent bending, warping, twisting, and surface damage.
- C. Stack materials on platforms or pallets, covered with suitable weathertight and ventilated covering. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage.

## 1.7 COORDINATION

- A. Coordinate installation of sheet metal flashing and trim with interfacing and adjoining construction to provide a leakproof, secure, and noncorrosive installation.

## PART 2 - PRODUCTS

### 2.1 SHEET METALS

- A. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304.
  - 1. Finish: No. 4 (fine reflective, polished directional satin).
- B. Aluminum Sheet: Coil-coated sheet, ASTM B 209, alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.
  - 1. Location: Use where Drawings indicate metal flashing and counterflashing is indicated as "prefinished."
  - 2. Surface: Smooth, flat finish.
  - 3. Exposed Finishes: Apply the following coating, as specified or indicated on Drawings.
    - a. High-Performance Organic Finish: AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: acid-chromate-fluoride-phosphate conversion coating; Organic Coating: as specified below). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
      - 1) Fluoropolymer Two-Coat System: Manufacturer's standard two-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight; complying with AAMA 2605.
  - 4. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.
  - 5. Color: As directed by Architect.
- C. Lead Sheet: ASTM B 749, Type L51121, copper-bearing lead sheet.

### 2.2 UNDERLAYMENT MATERIALS

- A. Self-Adhering, High-Temperature Sheet: 30 to 40 mils thick minimum, consisting of slip-resisting polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.
  - 1. Thermal Stability: Stable after testing at 240 deg F; ASTM D 1970.
  - 2. Products:

- a. Carlisle Coatings & Waterproofing, Div. of Carlisle Companies Inc.; Dri-Start "HR."
  - b. Grace, W. R. & Co.; Vycor Ultra.
  - c. Henry Company; Perma-Seal PE.
- B. Slip Sheet: Building paper, minimum 5 lb/100 sq. ft.

### 2.3 MISCELLANEOUS MATERIALS

- A. General: Provide materials and types of fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation.
- B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads.
- 1. Fasteners for Flashing and Trim: Blind fasteners or self-drilling screws, gasketed, with hex washer head.
  - 2. Blind Fasteners: High-strength stainless-steel rivets.
  - 3. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.
  - 4. Fasteners for Stainless-Steel Sheet: Series 300 stainless steel.
- C. Solder for Stainless Steel: ASTM B 32, Grade Sn60, with acid flux of type recommended by stainless-steel sheet manufacturer.
- D. Sealing Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealing tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape.
- E. Elastomeric Sealant: ASTM C 920, elastomeric silicone polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.
- F. Epoxy Seam Sealer: Two-part, noncorrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior nonmoving joints, including riveted joints.
- G. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

### 2.4 MANUFACTURED SHEET METAL FLASHING AND TRIM

- A. Reglets: Units of type, material, and profile indicated, formed to provide secure interlocking of separate reglet and counterflashing pieces, and compatible with flashing indicated with factory-mitered and -welded corners and junctions.
- 1. Manufacturer:
    - a. Fry Reglet Corporation.

2. Material: Stainless steel, 0.020 inch thick.
3. Surface-Mounted Type: Provide with slotted holes for fastening to substrate, with neoprene or other suitable weatherproofing washers, and with channel for sealant at top edge.
4. Counterflashing Wind-Restraint Clips: Provide clips to be installed before counterflashing to prevent wind uplift of counterflashing lower edge.

## 2.5 FABRICATION, GENERAL

- A. General: Custom fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated. Shop fabricate items where practicable. Obtain field measurements for accurate fit before shop fabrication.
- B. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
- C. Fabricate sheet metal flashing and trim without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.
  1. Seams for Stainless Steel: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
  2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints where necessary for strength.
- D. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA recommendations.
- E. Expansion Provisions: Where lapped or bayonet-type expansion provisions in the Work cannot be used, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with elastomeric sealant concealed within joints.
- F. Conceal fasteners and expansion provisions where possible on exposed-to-view sheet metal flashing and trim, unless otherwise indicated.
- G. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.
  1. Thickness: As recommended by SMACNA's "Architectural Sheet Metal Manual" and FMG Loss Prevention Data Sheet 1-49 for application but not less than thickness of metal being secured.

## 2.6 FORMED SHEET METAL FABRICATIONS

- A. Base Flashing: Fabricate from the following material:
  1. Stainless Steel: 0.0187 inch thick.
  2. Prefinished Aluminum: 0.032 inch thick.



- B. Counterflashing: Fabricate from the following material:
  - 1. Stainless Steel: 0.0187 inch thick.
  - 2. Prefinished Aluminum: 0.032 inch thick.
- C. Roof-Penetration Flashing: Fabricate from the following material:
  - 1. Stainless Steel: 0.0187 inch thick.
- D. Roof-Drain Flashing: Fabricate from the following material:
  - 1. Lead: 4.0 lb/sq. ft., hard tempered.

## 2.7 MISCELLANEOUS SHEET METAL FABRICATIONS

- A. Equipment Support Flashing: Fabricate from the following material:
  - 1. Stainless Steel: 0.0187 inch thick.

## 2.8 FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions and other conditions affecting performance of work.
  - 1. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
  - 2. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION, GENERAL

- A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
  - 1. Torch cutting of sheet metal flashing and trim is not permitted.
- B. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by fabricator or manufacturers of dissimilar metals.

1. Coat side of uncoated stainless-steel sheet metal flashing and trim with bituminous coating where flashing and trim will contact wood, ferrous metal, or cementitious construction.
  2. Underlayment: Where installing metal flashing directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip sheet or install a course of polyethylene underlayment.
- C. Install exposed sheet metal flashing and trim without excessive oil canning, buckling, and tool marks.
- D. Install sheet metal flashing and trim true to line and levels indicated. Provide uniform, neat seams with minimum exposure of solder, welds, and elastomeric sealant.
- E. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
1. Space cleats not more than 12 inches apart. Anchor each cleat with two fasteners. Bend tabs over fasteners.
- F. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped or bayonet-type expansion provisions cannot be used or would not be sufficiently watertight, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with elastomeric sealant concealed within joints.
- G. Fasteners: Use fasteners of sizes that will penetrate substrate not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws.
1. Stainless Steel: Use stainless-steel fasteners.
- H. Seal joints with elastomeric sealant as required for watertight construction.
1. Where sealant-filled joints are used, embed hooked flanges of joint members not less than 1 inch into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is moderate, set joint members for 50 percent movement either way. Adjust setting proportionately for installation at higher ambient temperatures.
  2. Prepare joints and apply sealants to comply with requirements in Division 7 Section "Joint Sealants."
- I. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pretin edges of sheets to be soldered to a width of 1-1/2 inches except where pretinned surface would show in finished Work.
1. Do not solder aluminum sheet.
  2. Stainless-Steel Soldering: Pretin edges of uncoated sheets to be soldered using solder recommended for stainless steel and phosphoric acid flux. Promptly wash off acid flux residue from metal after soldering.
  3. Do not use open-flame torches for soldering. Heat surfaces to receive solder and flow solder into joints. Fill joints completely. Completely remove flux and spatter from exposed surfaces.

### 3.3 ROOF FLASHING INSTALLATION

- A. General: Install sheet metal roof flashing and trim to comply with performance requirements and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, set units true to line, and level as indicated. Install work with laps, joints, and seams that will be permanently watertight.
- B. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending a minimum of 4 inches over base flashing. Install stainless-steel draw band and tighten.
- C. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Install flashing as follows:
  - 1. Turn lead flashing down inside piping, being careful not to block piping with flashing.
  - 2. Seal with elastomeric sealant and clamp flashing to pipes penetrating roof except for lead flashing on vent piping.

### 3.4 MISCELLANEOUS FLASHING INSTALLATION

- A. Equipment Support Flashing: Coordinate installation of equipment support flashing with installation of roofing and equipment. Weld or seal flashing with elastomeric sealant to equipment support member.

### 3.5 CLEANING AND PROTECTION

- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- B. Clean and neutralize flux materials. Clean off excess solder and sealants.
- C. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed. On completion of installation, clean finished surfaces, including removing unused fasteners, metal filings, pop rivet stems, and pieces of flashing. Maintain in a clean condition during construction.
- D. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 07620

## SECTION 07710 - MANUFACTURED ROOF SPECIALTIES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes the following manufactured roof specialties:
  - 1. Copings.
  - 2. Counterflashings and reglets.
- B. Related Sections include the following:
  - 1. Division 6 Section "Miscellaneous Carpentry" for wood nailers, curbs, and blocking.
  - 2. Division 7 Section "Sheet Metal Flashing and Trim" for metal flashing
  - 3. Division 7 Section "Joint Sealants" for field-applied sealants.

#### 1.3 PERFORMANCE REQUIREMENTS

- A. General: Manufacture and install manufactured roof specialties to resist thermally induced movement and exposure to weather without failing, rattling, leaking, and fastener disengagement.
- B. FMG Listing: Manufacture and install copings roof edge flashings that are listed in FMG's "Approval Guide" and approved for Windstorm Classification, Class 1- 140. Identify materials with FMG markings.
- C. Thermal Movements: Provide manufactured roof specialties that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Provide clips that resist rotation and avoid shear stress as a result of thermal movements. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
  - 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.
- D. Water Infiltration: Provide manufactured roof specialties that do not allow water infiltration to building interior.

## 1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: Show layouts of manufactured roof specialties, including plans and elevations. Identify factory- vs. field-assembled work. Include the following:
  - 1. Details for fastening, joining, supporting, and anchoring manufactured roof specialties including fasteners, clips, cleats, and attachments to adjoining work.
  - 2. Details for expansion and contraction.
- C. Samples for Initial Selection: For each type of manufactured roof specialty indicated with factory-applied color finishes.

## 1.5 COORDINATION

- A. Coordinate installation of manufactured roof specialties with interfacing and adjoining construction to provide a leakproof, secure, and noncorrosive installation.

## 1.6 WARRANTY

- A. Special Warranty on Painted Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace manufactured roof specialties that show evidence of deterioration of factory-applied finishes within specified warranty period.
  - 1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:
    - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
    - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
    - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
  - 2. Finish Warranty Period: 5 years from date of Substantial Completion.

## 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. Basis-of-Design Product: The designs for copings roof edge flashings roof edge drainage system and counterflashings and reglets are based on the products named. Subject to compliance with requirements, provide either the named products or comparable products by one of the other manufacturers specified.

## 2.2 EXPOSED METALS

- A. Aluminum Sheet: ASTM B 209, alloy and temper recommended by manufacturer for use and finish indicated, finished as follows:
  - 1. Surface: Smooth, flat finish.
- B. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- C. High-Performance Organic Finish: AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: acid-chromate-fluoride-phosphate conversion coating; Organic Coating: as specified below). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturer's written instructions.
  - 1. Fluoropolymer Two-Coat System: Manufacturer's standard two-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight; complying with AAMA 605.2.
    - a. Color and Gloss: Match Architect's sample.

## 2.3 CONCEALED METALS

- A. Aluminum Extrusions: ASTM B 221, alloy and temper recommended by manufacturer for type of use and structural performance indicated, mill finished.
- B. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G90 coating designation; structural quality.

## 2.4 MISCELLANEOUS MATERIALS

- A. General: Provide materials and types of fasteners, protective coatings, separators, sealants, and other miscellaneous items required by manufacturer for a complete installation.
- B. Fasteners: Manufacturer's recommended fasteners, suitable for application and designed to withstand design loads.
  - 1. Exposed Penetrating Fasteners: Gasketed screws with hex washer heads matching color of sheet metal.
- C. Sealing Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealing tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape.
- D. Elastomeric Sealant: ASTM C 920, elastomeric silicone polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

- E. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.
- F. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.
- G. Polyethylene Sheet: 6-mil- thick polyethylene sheet complying with ASTM D 4397.
- H. Felt: ASTM D 226, Type II (No. 30), asphalt-saturated organic felt, nonperforated.

## 2.5 COPINGS

- A. Copings: Manufactured coping system consisting of formed-metal coping cap in section lengths not exceeding 12 feet, concealed anchorage, concealed splice plates with same finish as coping caps, mitered corner units, and end cap units.
  - 1. Basis-of-Design Product: “Permasnap” parapet wall coping by W.P. Hickman Co. or a comparable product by one of the following:
    - a. Metal-Era, Inc.
    - b. MM Systems Corporation.
  - 2. Coping Caps: Snap-on, fabricated from the following exposed metal:
    - a. Aluminum: 0.050 inch thick.
  - 3. Corners: Continuously welded.
  - 4. Snap-on Coping Anchor Plates: Concealed, galvanized steel sheet, 12 inches wide, 0.028 inch thick, with integral cleats.
  - 5. Face Leg Cleats: Concealed, continuous galvanized steel sheet.

## 2.6 COUNTERFLASHINGS AND REGLETS

- A. Basis-of-Design Product: “Reglet and Flashing” by W.P. Hickman Co. or a comparable product by one of the following:
  - 1. Fry Reglet Corporation.
  - 2. Metal-Era, Inc.
  - 3. MM Systems Corporation.
- B. Counterflashings: Manufactured units in lengths not exceeding 12 feet designed to snap into reglets and compress against base flashings with joints lapped, from the following exposed metal in thickness indicated:
  - 1. Aluminum: 0.032 inch thick.
- C. Reglets: Manufactured units formed to provide secure interlocking of separate reglet and counterflashing pieces, and compatible with flashings indicated with factory-mitered and welded corners and junctions, from the following exposed metal in thickness indicated:

1. Aluminum: 0.050 inch thick, mill finish.
2. Type: Surface-mounted with slotted holes for fastening to substrate, with neoprene or other suitable weatherproofing washers, and with channel for sealant at top edge.

## 2.7 FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of work.
  1. Examine walls, roof edges, and parapets for suitable conditions for manufactured roof specialties.
  2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
  3. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. General: Install manufactured roof specialties according to manufacturer's written instructions. Anchor manufactured roof specialties securely in place and capable of resisting forces specified in performance requirements. Use fasteners, separators, sealants, and other miscellaneous items as required to complete manufactured roof specialty systems.
  1. Install manufactured roof specialties with provisions for thermal and structural movement.
  2. Torch cutting of manufactured roof specialties is not permitted.
- B. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.



1. Coat concealed side of uncoated aluminum manufactured roof specialties with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
  2. Underlayment: Where installing exposed-to-view components of manufactured roof specialties directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip sheet, or install a course of polyethylene underlayment.
  3. Bed flanges in thick coat of asphalt roofing cement where required by manufacturers of roof specialties for waterproof performance.
- C. Install manufactured roof specialties level, plumb, true to line and elevation, and without warping, jogs in alignment, excessive oil-canning, buckling, or tool marks.
- D. Install manufactured roof specialties to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before manufacture.
- E. Expansion Provisions: Provide for thermal expansion of exposed manufactured roof specialties. Space movement joints at a maximum of 12 feet with no unplanned joints within 18 inches of corners or intersections.
- F. Fasteners: Use fasteners of type and size recommended by manufacturer but of sizes that will penetrate substrate not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws.
- G. Seal joints with elastomeric sealant as required by manufacturer of roofing specialties.

### 3.3 COPING INSTALLATION

- A. Install cleats, anchor plates, and other anchoring and attachment accessories and devices with concealed fasteners.
- B. Anchor copings to resist uplift and outward forces according to performance requirements.
1. Interlock face and back leg drip edges into continuous cleats anchored to substrate at manufacturer's recommended spacing.

### 3.4 COUNTERFLASHING AND REGLET INSTALLATION

- A. Counterflashings: Coordinate installation of counterflashings with installation of base flashings. Insert counterflashings in reglets or receivers and fit tightly to base flashings. Extend counterflashings 4 inches over base flashings. Lap counterflashing joints a minimum of 4 inches and bed with elastomeric sealant.

### 3.5 CLEANING AND PROTECTION

- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering. Clean off excess sealants.

- B. Remove temporary protective coverings and strippable films as manufactured roof specialties are installed. On completion of installation, clean finished surfaces, including removing unused fasteners, metal filings, pop rivet stems, and pieces of flashing. Maintain in a clean condition during construction.
- C. Replace manufactured roof specialties that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION 07710



## SECTION 07811 - SPRAYED FIRE-RESISTIVE MATERIALS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Concealed SFRM.
- B. Related Sections include the following:
  - 1. Division 5 Section "Structural Steel" for surface conditions required for structural steel receiving SFRM.
  - 2. Division 7 Section "Through-Penetration Firestop Systems" for penetrations in fire-rated construction.
  - 3. Division 7 Section "Fire-Resistive Joint Systems" for fire-resistance-rated joint systems.

#### 1.3 DEFINITIONS

- A. SFRM: Sprayed fire-resistive material.
- B. Concealed: Fire-resistive materials applied to surfaces that are concealed from view behind other construction when the Work is completed.

#### 1.4 SUBMITTALS

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

#### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: A firm or individual certified, licensed, or otherwise qualified by SFRM manufacturer as experienced and with sufficient trained staff to install manufacturer's products according to specified requirements. A manufacturer's willingness to sell its SFRM to Contractor or to an installer engaged by Contractor does not in itself confer qualification on the buyer.
- B. Source Limitations: Obtain SFRM through one source from a single manufacturer.

- C. Fire-Test-Response Characteristics: Provide SFRM with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify bags containing SFRM with appropriate markings of applicable testing and inspecting agency.
  - 1. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" acceptable to Authorities Having Jurisdiction, for SFRM serving as direct-applied protection tested per ASTM E 119.
  - 2. Surface-Burning Characteristics: ASTM E 84.
- D. Provide products containing no detectable asbestos as determined according to the method specified in 40 CFR 763, Subpart E, Appendix E, Section 1, "Polarized Light Microscopy."
- E. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination." Review methods and procedures related to SFRM including, but not limited to, the following:
  - 1. Review products, exposure conditions, design ratings, restrained and unrestrained conditions, calculations, densities, thicknesses, bond strengths, and other performance requirements.
  - 2. Review and finalize construction schedule and verify sequencing and coordination requirements.
  - 3. Review weather predictions, ambient conditions, and proposed temporary protections for SFRM during and after installation.
  - 4. Review surface conditions and preparations.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to Project site in original, unopened packages with intact and legible manufacturers' labels identifying product and manufacturer, date of manufacture, shelf life if applicable, and fire-resistance ratings applicable to Project.
- B. Use materials with limited shelf life within period indicated. Remove from Project site and discard materials whose shelf life has expired.
- C. Store materials inside, under cover, and aboveground; keep dry until ready for use. Remove from Project site and discard wet or deteriorated materials.

#### 1.7 PROJECT CONDITIONS

- A. Ventilation: Ventilate building spaces during and after application of SFRM. Use natural means or, if they are inadequate, forced-air circulation until fire-resistive material dries thoroughly.

#### 1.8 COORDINATION

- A. Sequence and coordinate application of SFRM with other related work specified in other Sections to comply with the following requirements:

1. Provide temporary enclosure as required to confine spraying operations and protect the environment.
2. Provide temporary enclosures for applications to prevent deterioration of fire-resistive material due to exposure to weather and to unfavorable ambient conditions for humidity, temperature, and ventilation.
3. Avoid unnecessary exposure of fire-resistive material to abrasion and other damage likely to occur during construction operations subsequent to its application.
4. Do not begin applying fire-resistive material until clips, hangers, supports, sleeves, and other items penetrating fire protection are in place.
5. Defer installing ducts, piping, and other items that would interfere with applying fire-resistive material until application of fire protection is completed.
6. Do not install enclosing or concealing construction until after fire-resistive material has been applied, inspected, and tested and corrections have been made to defective applications.

## PART 2 - PRODUCTS

### 2.1 CONCEALED SFRM

- A. Products: Subject to compliance with requirements, provide one of the following:
1. Concealed Cementitious SFRM:
    - a. Grace, W. R. & Co. - Conn., Construction Products Div.; Monokote Type MK-6/HY.
  2. Concealed Sprayed-Fiber Fire-Resistive Material:
    - a. Isolatek International Corp.; Cafco Blaze-Shield II.
- B. Material Composition: Manufacturer's standard product, or either of the following:
1. Concealed Cementitious SFRM: Factory-mixed, dry formulation of gypsum or portland cement binders, additives, and lightweight mineral or synthetic aggregates mixed with water at Project site to form a slurry or mortar for conveyance and application.
  2. Concealed Sprayed-Fiber Fire-Resistive Material: Factory-mixed, dry formulation of inorganic binders, mineral fibers, fillers, and additives conveyed in a dry state by pneumatic equipment and mixed with water at spray nozzle to form a damp, as-applied product.
- C. Physical Properties: Minimum values, unless otherwise indicated, or higher values required to attain designated fire-resistance ratings, measured per standard test methods referenced with each property as follows:
1. Dry Density: 15 lb/cu. ft. for average and individual densities, or greater if required to attain fire-resistance ratings indicated, per ASTM E 605 or AWCI Technical Manual 12-A, Section 5.4.5, "Displacement Method."
  2. Thickness: Minimum average thickness required for fire-resistance design indicated according to the following criteria, but not less than 0.375 inch, per ASTM E 605:

- a. Where the referenced fire-resistance design lists a thickness of 1 inch or more, the minimum allowable individual thickness of SFRM is the design thickness minus 0.25 inch.
  - b. Where the referenced fire-resistance design lists a thickness of less than 1 inch but more than 0.375 inch, the minimum allowable individual thickness of SFRM is the greater of 0.375 inch or 75 percent of the design thickness.
  - c. No reduction in average thickness is permitted for those fire-resistance designs whose fire-resistance ratings were established at densities of less than 15 lb/cu. ft.
3. Bond Strength: 150 lbf/sq. ft. minimum per ASTM E 736 based on laboratory testing of 0.75-inch minimum thickness of SFRM.
  4. Compressive Strength: 5.21 lbf/sq. in. minimum per ASTM E 761. Minimum thickness of SFRM tested shall be 0.75 inch and minimum dry density shall be as specified but not less than 15 lb/cu. ft..
  5. Corrosion Resistance: No evidence of corrosion per ASTM E 937.
  6. Deflection: No cracking, spalling, or delamination per ASTM E 759.
  7. Effect of Impact on Bonding: No cracking, spalling, or delamination per ASTM E 760.
  8. Air Erosion: Maximum weight loss of 0.025 g/sq. ft. in 24 hours per ASTM E 859. For laboratory tests, minimum thickness of SFRM is 0.75 inch, maximum dry density is 15 lb/cu. ft., test specimens are not prepurged by mechanically induced air velocities, and tests are terminated after 24 hours.
  9. Fire-Test-Response Characteristics: Provide SFRM with the following surface-burning characteristics as determined by testing identical products per ASTM E 84 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
    - a. Flame-Spread Index: 10 or less.
    - b. Smoke-Developed Index: 0.
  10. Fungal Resistance: No observed growth on specimens per ASTM G 21.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for substrates and other conditions affecting performance of work. A substrate is in satisfactory condition if it complies with the following:
  1. Substrates comply with requirements in the Section where the substrate and related materials and construction are specified.
  2. Substrates are free of dirt, oil, grease, release agents, rolling compounds, mill scale, loose scale, incompatible primers, incompatible paints, incompatible encapsulants, or other foreign substances capable of impairing bond of fire-resistive materials with substrates under conditions of normal use or fire exposure.
  3. Objects penetrating fire-resistive material, including clips, hangers, support sleeves, and similar items, are securely attached to substrates.
  4. Substrates are not obstructed by ducts, piping, equipment, and other suspended construction that will interfere with applying fire-resistive material.

- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Cover other work subject to damage from fallout or overspray of fire-resistive materials during application.
- B. Clean substrates of substances that could impair bond of fire-resistive material, including dirt, oil, grease, release agents, rolling compounds, mill scale, loose scale, and incompatible primers, paints, and encapsulants.

### 3.3 APPLICATION, GENERAL

- A. Comply with fire-resistive material manufacturer's written instructions for mixing materials, application procedures, and types of equipment used to mix, convey, and spray on fire-resistive material, as applicable to particular conditions of installation and as required to achieve fire-resistance ratings indicated.
- B. Apply SFRM that is identical to products tested as specified in Part 1 "Quality Assurance" Article and substantiated by test reports, with respect to rate of application, accelerator use, sealers, topcoats, tamping, troweling, water overspray, or other materials and procedures affecting test results.
- C. Extend fire-resistive material in full thickness over entire area of each substrate to be protected. Unless otherwise recommended in writing by SFRM manufacturer, install body of fire-resistive covering in a single course.
- D. Sprays apply fire-resistive materials to maximum extent possible. Following the spraying operation in each area, complete the coverage by trowel application or other placement method recommended in writing by SFRM manufacturer.

### 3.4 APPLICATION, CONCEALED SFRM

- A. Apply concealed SFRM in thicknesses and densities not less than those required to achieve fire-resistance ratings designated for each condition, but apply in greater thicknesses and densities if specified in Part 2 "Concealed SFRM" Article.
- B. Cure concealed SFRM according to product manufacturer's written recommendations.

### 3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Contractor will engage a qualified testing agency to perform tests and inspections and prepare test reports.
  - 1. Testing and inspecting agency will interpret tests and state in each report whether tested work complies with or deviates from requirements.



- B. Tests and Inspections: Testing and inspecting of completed applications of SFRM shall take place in successive stages, in areas of extent and using methods as follows. Do not proceed with application of SFRM for the next area until test results for previously completed applications of SFRM show compliance with requirements. Tested values must equal or exceed values indicated and required for approved fire-resistance design.
  - 1. Thickness for Structural Frame Members: From a sample of 25 percent of structural members per floor, taking 9 measurements at a single cross section for structural frame beams or girders, 7 measurements of a single cross section for joists and trusses, and 12 measurements of a single cross section for columns per ASTM E 605.
  - 2. If testing finds applications of SFRM are not in compliance with requirements, testing and inspecting agency will perform additional random testing to determine extent of noncompliance.
- C. Remove and replace applications of SFRM that do not pass tests and inspections for cohesion and adhesion, for density, or for both and retest as specified above.
- D. Apply additional SFRM, per manufacturer's written instructions, where test results indicate that thickness does not comply with specified requirements, and retest as specified above.

### 3.6 CLEANING, PROTECTING, AND REPAIR

- A. Cleaning: Immediately after completing spraying operations in each containable area of Project, remove material overspray and fallout from surfaces of other construction and clean exposed surfaces to remove evidence of soiling.
- B. Protect SFRM, according to advice of product manufacturer and Installer, from damage resulting from construction operations or other causes so fire protection will be without damage or deterioration at time of Substantial Completion.
- C. Coordinate application of SFRM with other construction to minimize need to cut or remove fire protection. As installation of other construction proceeds, inspect SFRM and patch any damaged or removed areas.
- D. Repair or replace work that has not successfully protected steel.

END OF SECTION 07811

## SECTION 07841 - THROUGH-PENETRATION FIRESTOP 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.

#### 1.2 SUMMARY

- A. This Section includes through-penetration firestop systems for penetrations through fire-resistance-rated constructions, including both empty openings and openings containing penetrating items.
- B. Related Sections include the following:
  - 1. Division 7 Section "Fire-Resistive Joint Systems."

#### 1.3 PERFORMANCE REQUIREMENTS

- A. General: For penetrations through the following fire-resistance-rated constructions, including both empty openings and openings containing penetrating items, provide through-penetration firestop systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated.
  - 1. Fire-resistance-rated walls including fire walls, fire partitions, fire barriers, and smoke barriers.
  - 2. Fire-resistance-rated horizontal assemblies including floors, floor/ceiling assemblies, and ceiling membranes of roof/ceiling assemblies.
- B. Rated Systems: Provide through-penetration firestop systems with the following ratings determined per ASTM E 814 or UL 1479:
  - 1. F-Rated Systems: Provide through-penetration firestop systems with F-ratings indicated, but not less than that equaling or exceeding fire-resistance rating of constructions penetrated.
  - 2. T-Rated Systems: For the following conditions, provide through-penetration firestop systems with T-ratings indicated, as well as F-ratings, where systems protect penetrating items exposed to potential contact with adjacent materials in occupiable floor areas:
    - a. Penetrations located outside wall cavities.
    - b. Penetrations located outside fire-resistance-rated shaft enclosures.

3. L-Rated Systems: Where through-penetration firestop systems are indicated in smoke barriers, provide through-penetration firestop systems with L-ratings of not more than 3.0 cfm/sq. ft at both ambient temperatures and 400 deg F.
- C. For through-penetration firestop systems exposed to view, traffic, moisture, and physical damage, provide products that, after curing, do not deteriorate when exposed to these conditions both during and after construction.
1. For piping penetrations for plumbing and wet-pipe sprinkler systems, provide moisture-resistant through-penetration firestop systems.
  2. For floor penetrations with annular spaces exceeding 4 inches in width and exposed to possible loading and traffic, provide firestop systems capable of supporting floor loads involved, either by installing floor plates or by other means.
  3. For penetrations involving insulated piping, provide through-penetration firestop systems not requiring removal of insulation.
- D. For through-penetration firestop systems exposed to view, provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

#### 1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For each through-penetration firestop system, show each type of construction condition penetrated, relationships to adjoining construction, and type of penetrating item. Include firestop design designation of qualified testing and inspecting agency that evidences compliance with requirements for each condition indicated.
1. Submit documentation, including illustrations, from a qualified testing and inspecting agency that is applicable to each through-penetration firestop system configuration for construction and penetrating items.
  2. Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular through-penetration firestop condition, submit illustration, with modifications marked, approved by through-penetration firestop system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.
- C. Through-Penetration Firestop System Schedule: Indicate locations of each through-penetration firestop system, along with the following information:
1. Types of penetrating items.
  2. Types of constructions penetrated, including fire-resistance ratings and, where applicable, thicknesses of construction penetrated.
  3. Through-penetration firestop systems for each location identified by firestop design designation of qualified testing and inspecting agency.
- D. Qualification Data: For Installer.

## 1.5 QUALITY ASSURANCE

- A. **Installer Qualifications:** A firm experienced in installing through-penetration firestop systems similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified requirements. Manufacturer's willingness to sell its through-penetration firestop system products to Contractor or to Installer engaged by Contractor does not in itself confer qualification on buyer.
- B. **Installation Responsibility:** Assign installation of through-penetration firestop systems and fire-resistive joint systems in Project to a single qualified installer.
- C. **Source Limitations:** Obtain through-penetration firestop systems, for each kind of penetration and construction condition indicated, through one source from a single manufacturer.
- D. **Fire-Test-Response Characteristics:** Provide through-penetration firestop systems that comply with the following requirements and those specified in Part 1 "Performance Requirements" Article:
  - 1. Firestopping tests are performed by a qualified testing and inspecting agency. A qualified testing and inspecting agency is UL, or another agency performing testing and follow-up inspection services for firestop systems acceptable to authorities having jurisdiction.
  - 2. Through-penetration firestop systems are identical to those tested per testing standard referenced in "Part 1 Performance Requirements" Article. Provide rated systems complying with the following requirements:
    - a. Through-penetration firestop system products bear classification marking of qualified testing and inspecting agency.
    - b. Through-penetration firestop systems correspond to those indicated by reference to through-penetration firestop system designations listed by the following:
      - 1) UL in its "Fire Resistance Directory."
- E. **Preinstallation Conference:** Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver through-penetration firestop system products to Project site in original, unopened containers or packages with intact and legible manufacturers' labels identifying product and manufacturer, date of manufacture, lot number, shelf life if applicable, qualified testing and inspecting agency's classification marking applicable to Project, curing time, and mixing instructions for multicomponent materials.
- B. Store and handle materials for through-penetration firestop systems to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

## 1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install through-penetration firestop systems when ambient or substrate temperatures are outside limits permitted by through-penetration firestop system manufacturers or when substrates are wet due to rain, condensation, or other causes.
- B. Ventilate through-penetration firestop systems per manufacturer's written instructions by natural means or, where this is inadequate, forced-air circulation.

## 1.8 COORDINATION

- A. Coordinate construction of openings and penetrating items to ensure that through-penetration firestop systems are installed according to specified requirements.
- B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate through-penetration firestop systems.
- C. Notify Owner's inspecting agency at least seven days in advance of through-penetration firestop system installations; confirm dates and times on days preceding each series of installations.
- D. Do not cover up through-penetration firestop system installations that will become concealed behind other construction until each installation has been examined by building inspector, if required by authorities having jurisdiction.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide one of the through-penetration firestop systems indicated for each application that are produced by one of the following manufacturers:
  - 1. Hilti, Inc.
  - 2. RectorSeal Corporation (The).
  - 3. Specified Technologies Inc.
  - 4. 3M; Fire Protection Products Division.
  - 5. Tremco; Sealant/Weatherproofing Division.

### 2.2 FIRESTOPPING, GENERAL

- A. Compatibility: Provide through-penetration firestop systems that are compatible with one another; with the substrates forming openings; and with the items, if any, penetrating through-penetration firestop systems, under conditions of service and application, as demonstrated by through-penetration firestop system manufacturer based on testing and field experience.
- B. Accessories: Provide components for each through-penetration firestop system that are needed to install fill materials and to comply with Part 1 "Performance Requirements" Article. Use only components specified by through-penetration firestop system manufacturer and approved

by qualified testing and inspecting agency for firestop systems indicated. Accessories include, but are not limited to, the following items:

1. Permanent forming/damming/backing materials, including the following:
  - a. Slag-/rock-wool-fiber insulation.
  - b. Sealants used in combination with other forming/damming/backing materials to prevent leakage of fill materials in liquid state.
  - c. Fire-rated form board.
  - d. Fillers for sealants.
2. Temporary forming materials.
3. Substrate primers.
4. Collars.
5. Steel sleeves.

### 2.3 FILL MATERIALS

- A. General: Provide through-penetration firestop systems containing the types of fill materials specified in this section and according to Drawings. Fill materials are those referred to in directories of referenced testing and inspecting agencies as "fill," "void," or "cavity" materials.
- B. Cast-in-Place Firestop Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer metallic sleeve lined with an intumescent strip, a radial extended flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.
- C. Latex Sealants: Single-component latex formulations that after cure do not re-emulsify during exposure to moisture.
- D. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.
- E. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced elastomeric sheet bonded to galvanized steel sheet.
- F. Intumescent Putties: Nonhardening dielectric, water-resistant putties containing no solvents, inorganic fibers, or silicone compounds.
- G. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.
- H. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers, and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.
- I. Pillows/Bags: Reusable heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents, and fire-retardant additives.

- J. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.
- K. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below:
  - 1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces, and nonsag formulation for openings in vertical and other surfaces requiring a nonslumping, gunnable sealant, unless indicated firestop system limits use to nonsag grade for both opening conditions.
  - 2. Grade for Horizontal Surfaces: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces.
  - 3. Grade for Vertical Surfaces: Nonsag formulation for openings in vertical and other surfaces.

## 2.4 MIXING

- A. For those products requiring mixing before application, comply with through-penetration firestop system manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of work.
  - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Surface Cleaning: Clean out openings immediately before installing through-penetration firestop systems to comply with firestop system manufacturer's written instructions and with the following requirements:
  - 1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of through-penetration firestop systems.
  - 2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with through-penetration firestop systems. Remove loose particles remaining from cleaning operation.
  - 3. Remove laitance and form-release agents from concrete.

- B. Priming: Prime substrates where recommended in writing by through-penetration firestop system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.
- C. Masking Tape: Use masking tape to prevent through-penetration firestop systems from contacting adjoining surfaces that will remain exposed on completion of Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove smears from firestop system materials. Remove tape as soon as possible without disturbing firestop system's seal with substrates.

### 3.3 THROUGH-PENETRATION FIRESTOP SYSTEM INSTALLATION

- A. General: Install through-penetration firestop systems to comply with Part 1 "Performance Requirements" Article and with firestop system manufacturer's written installation instructions and published drawings for products and applications indicated.
- B. Install forming/damming/backing materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
  - 1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of firestop systems.
- C. Install fill materials for firestop systems by proven techniques to produce the following results:
  - 1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
  - 2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
  - 3. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

### 3.4 IDENTIFICATION

- A. Identify through-penetration firestop systems with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of edge of the firestop systems so that labels will be visible to anyone seeking to remove penetrating items or firestop systems. Use mechanical fasteners for metal labels. For plastic labels, use self-adhering type with adhesives capable of permanently bonding labels to surfaces on which labels are placed and, in combination with label material, will result in partial destruction of label if removal is attempted. Include the following information on labels:
  - 1. The words "Warning - Through-Penetration Firestop System - Do Not Disturb. Notify Building Management of Any Damage."
  - 2. Contractor's name, address, and phone number.
  - 3. Through-penetration firestop system designation of applicable testing and inspecting agency.
  - 4. Date of installation.



5. Through-penetration firestop system manufacturer's name.
6. Installer's name.

### 3.5 CLEANING AND PROTECTING

- A. Clean off excess fill materials adjacent to openings as Work progresses by methods and with cleaning materials that are approved in writing by through-penetration firestop system manufacturers and that do not damage materials in which openings occur.
- B. Provide final protection and maintain conditions during and after installation that ensure that through-penetration firestop systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated through-penetration firestop systems immediately and install new materials to produce systems complying with specified requirements.

END OF SECTION 07841

## SECTION 07842 - FIRE-RESISTIVE JOINT 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.

#### 1.2 SUMMARY

- A. This Section includes fire-resistive joint systems for the following:
  - 1. Head-of-wall joints.
- B. Related Sections include the following:
  - 1. Division 7 Section "Through-Penetration Firestop Systems."
  - 2. Division 7 Section "Joint Sealants" for non-fire-resistive joint sealants.

#### 1.3 PERFORMANCE REQUIREMENTS

- A. General: Provide fire-resistive joint systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of assembly in which fire-resistive joint systems are installed.
- B. Joint Systems in and between Fire-Resistance-Rated Constructions: Provide systems with assembly ratings equaling or exceeding the fire-resistance ratings of construction that they join, and with movement capabilities indicated as determined by UL 2079.

#### 1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For each fire-resistive joint system, show each kind of construction condition in which joints are installed; also show relationships to adjoining construction. Include fire-resistive joint system design designation of testing and inspecting agency acceptable to Authorities Having Jurisdiction that demonstrates compliance with requirements for each condition indicated.
  - 1. Submit documentation, including illustrations, from a qualified testing and inspecting agency that is applicable to each fire-resistive joint system configuration for construction and penetrating items.

## 1.5 QUALITY ASSURANCE

- A. Installation Responsibility: Assign installation of fire-resistive joint systems in Project to a single qualified installer.
- B. Source Limitations: Obtain fire-resistive joint systems, for each kind of joint and construction condition indicated, through one source from a single manufacturer.
- C. Fire-Test-Response Characteristics: Provide fire-resistive joint systems that comply with the following requirements and those specified in Part 1 "Performance Requirements" Article:
  - 1. Fire-resistance tests are performed by a qualified testing and inspecting agency. A qualified testing and inspecting agency is UL or another agency performing testing and follow-up inspection services for fire-resistive joint systems acceptable to authorities having jurisdiction.
  - 2. Fire-resistive joint systems are identical to those tested per methods indicated in Part 1 "Performance Requirements" Article and comply with the following:
    - a. Fire-resistive joint systems correspond to those indicated by referencing system designations of the qualified testing and inspecting agency.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver fire-resistive joint system products to Project site in original, unopened containers or packages with qualified testing and inspecting agency's classification marking applicable to Project and with intact and legible manufacturers' labels identifying product and manufacturer, date of manufacture, lot number, shelf life, curing time, and mixing instructions for multicomponent materials.
- B. Store and handle materials for fire-resistive joint systems to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

## 1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install fire-resistive joint systems when ambient or substrate temperatures are outside limits permitted by fire-resistive joint system manufacturers or when substrates are wet due to rain, condensation, or other causes.
- B. Ventilate fire-resistive joint systems per manufacturer's written instructions by natural means or, if this is inadequate, forced-air circulation.

## 1.8 COORDINATION

- A. Coordinate construction of joints to ensure that fire-resistive joint systems are installed according to specified requirements.
- B. Do not cover up fire-resistive joint system installations that will become concealed behind other construction until Owner's inspecting agency and building inspector of Authorities Having Jurisdiction have examined each installation.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide one of the fire-resistive joint systems indicated for each application in the Fire-Resistive Joint System Schedule at the end of Part 3.

### 2.2 FIRE-RESISTIVE JOINT SYSTEMS

- A. Compatibility: Provide fire-resistive joint systems that are compatible with joint substrates, under conditions of service and application, as demonstrated by fire-resistive joint system manufacturer based on testing and field experience.
- B. Accessories: Provide components of fire-resistive joint systems, including primers and forming materials, that are needed to install fill materials and to comply with Part 1 "Performance Requirements" Article. Use only components specified by fire-resistive joint system manufacturer and approved by the qualified testing and inspecting agency for systems indicated.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for joint configurations, substrates, and other conditions affecting performance of work.
  - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Surface Cleaning: Clean joints immediately before installing fire-resistive joint systems to comply with fire-resistive joint system manufacturer's written instructions and the following requirements:
  - 1. Remove from surfaces of joint substrates foreign materials that could interfere with adhesion of fill materials.
  - 2. Clean joint substrates to produce clean, sound surfaces capable of developing optimum bond with fill materials. Remove loose particles remaining from cleaning operation.
- B. Priming: Prime substrates where recommended in writing by fire-resistive joint system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

### 3.3 INSTALLATION

- A. General: Install fire-resistive joint systems to comply with Part 1 "Performance Requirements" Article and fire-resistive joint system manufacturer's written installation instructions for products and applications indicated.
- B. Install forming/packing/backing materials and other accessories of types required to support fill materials during their application and in position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
- C. Install fill materials for fire-resistive joint systems by proven techniques to produce the following results:
  - 1. Fill voids and cavities formed by openings and forming/packing/backing materials as required to achieve fire-resistance ratings indicated.
  - 2. Apply fill materials so they contact and adhere to substrates formed by joints.

### 3.4 CLEANING AND PROTECTING

- A. Clean off excess fill materials adjacent to joints as Work progresses by methods and with cleaning materials that are approved in writing by fire-resistive joint system manufacturers and that do not damage materials in which openings occur.
- B. Provide final protection and maintain conditions during and after installation that ensure fire-resistive joint systems are without damage or deterioration at time of Substantial Completion. If damage or deterioration occurs despite such protection, cut out and remove damaged or deteriorated fire-resistive joint systems immediately and install new materials to produce fire-resistive joint systems complying with specified requirements.

### 3.5 FIRE-RESISTIVE JOINT SYSTEM SCHEDULE

- A. Designation System for Joints in or between Fire-Resistance-Rated Constructions: Alphanumeric systems listed in UL's "Fire Resistance Directory" under Product Category XHBN.
- B. Head-of-Wall Fire-Resistive Joint Systems:
  - 1. UL-Classified Systems: HW-D-0023 and HW-D-0029.
  - 2. Assembly Rating: 1 and 2 hour.
  - 3. Nominal Joint Width: 1 inch.
  - 4. Movement Capabilities: Class II - 25 percent compression, 25 percent extension.
  - 5. L-Rating at Ambient: Less than 1 cfm/lin. ft.
  - 6. L-Rating at 400 deg F: Less than 1 cfm/lin. ft.

END OF SECTION 07842

## SECTION 07920 - JOINT SEALANTS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes joint sealants for the applications indicated in the Joint-Sealant Schedule at the end of Part 3.
- B. Related Sections include the following:
  - 1. Division 7 Section "Fire-Resistive Joint Systems" for sealing joints in fire-resistance-rated construction.
  - 2. Division 8 Section "Glazing" for glazing sealants.
  - 3. Division 9 Section "Gypsum Board Assemblies" for sealing perimeter joints of gypsum board partitions to reduce sound transmission.
  - 4. Division 9 Section "Acoustical Panel Ceilings" for sealing edge moldings at perimeters of acoustical ceilings.

#### 1.3 PERFORMANCE REQUIREMENTS

- A. Provide elastomeric joint sealants that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.

#### 1.4 SUBMITTALS

- A. Product Data: For each joint-sealant product indicated.
- B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

#### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized Installer who is approved or licensed for installation of elastomeric sealants required for this Project.
- B. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.

- C. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

## 1.6 PROJECT CONDITIONS

- A. Do not proceed with installation of joint sealants under the following conditions:
  - 1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer.
  - 2. When joint substrates are wet.
  - 3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
  - 4. Contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

## 1.7 WARRANTY

- A. Special Installer's Warranty: Installer's standard form in which Installer agrees to repair or replace elastomeric joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
  - 1. Warranty Period: Two years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide one of the products listed in other Part 2 articles.

### 2.2 MATERIALS, GENERAL

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer, based on testing and field experience.

### 2.3 ELASTOMERIC JOINT SEALANTS

- A. Elastomeric Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.
- B. Single-Component Neutral- and Basic-Curing Silicone Sealant:
  - 1. Available Products:

- a. Dow Corning Corporation; 790.
  - b. GE Silicones; SilPruf LM SCS2700.
  - c. Tremco; Spectrem 1 (Basic).
- 2. Type and Grade: S (single component) and NS (nonsag).
  - 3. Class: 100/50.
  - 4. Use Related to Exposure: NT (nontraffic).
  - 5. Uses Related to Joint Substrates: M, G, A, and, as applicable to joint substrates indicated, O.
    - a. Use O Joint Substrates: color anodic aluminum and galvanized steel.

C. Single-Component Mildew-Resistant Neutral-Curing Silicone Sealant:

- 1. Products:
  - a. Pecora Corporation; 898.
  - b. Tremco; Tremsil 600 White.
- 2. Type and Grade: S (single component) and NS (nonsag).
- 3. Class: 25.
- 4. Use Related to Exposure: NT (nontraffic).
- 5. Uses Related to Joint Substrates: M, G, A, and, as applicable to joint substrates indicated, O.

D. Single-Component Pourable Urethane Sealant:

- 1. Products:
  - a. Sika Corporation, Inc.; Sikaflex - 1CSL.
  - b. Sonneborn, Division of ChemRex Inc.; SL 1.
  - c. Tremco; Vulkem Nova 45 SSL.
- 2. Type and Grade: S (single component) and P (pourable).
- 3. Class: 25.
- 4. Uses Related to Exposure: T (traffic) and NT (nontraffic).
- 5. Uses Related to Joint Substrates: M, G, and A.

2.4 LATEX JOINT SEALANTS

A. Latex Sealant: Comply with ASTM C 834, Type P, Grade NF.

B. Available Products:

- 1. Pecora Corporation; AC-20+.
- 2. Sonneborn, Division of ChemRex Inc.; Sonolac.
- 3. Tremco; Tremflex 834.



## 2.5 JOINT-SEALANT BACKING

- A. General: Provide sealant backings of material and type that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin), and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance:

## 2.6 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
  - 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
  - 2. Clean porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:

- a. Portland cement plaster.
- 3. Clean nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
  - a. Metal.
- B. Joint Priming: Prime joint substrates, where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

### 3.3 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install sealant backings of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
  - 1. Do not leave gaps between ends of sealant backings.
  - 2. Do not stretch, twist, puncture, or tear sealant backings.
  - 3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
- D. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
  - 1. Place sealants so they directly contact and fully wet joint substrates.
  - 2. Completely fill recesses in each joint configuration.
  - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- E. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
  - 1. Remove excess sealant from surfaces adjacent to joints.

2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
3. Provide concave joint configuration per Figure 5A in ASTM C 1193, unless otherwise indicated.
4. Provide flush joint configuration where indicated per Figure 5B in ASTM C 1193.
5. Provide recessed joint configuration of recess depth and at locations indicated per Figure 5C in ASTM C 1193.
  - a. Use masking tape to protect surfaces adjacent to recessed tooled joints.

### 3.4 CLEANING

- A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

### 3.5 PROTECTION

- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

### 3.6 JOINT-SEALANT SCHEDULE

- A. Joint-Sealant Application: Exterior vertical and horizontal nontraffic construction joints in portland cement plaster.
  1. Joint Sealant: Single-component neutral- and basic-curing silicone sealant.
  2. Joint-Sealant Color: As selected by Architect from manufacturer's full range.
- B. Joint-Sealant Application: Exterior perimeter joints between Portland cement plaster and frames of doors, windows and louvers.
  1. Joint Sealant: Single-component neutral- and basic-curing silicone sealant.
  2. Joint-Sealant Color: As selected by Architect from manufacturer's full range.
- C. Joint-Sealant Application: Exterior control and expansion joints in soffits and other overhead surfaces.
  1. Joint Sealant: Single-component neutral- and basic-curing silicone sealant.
  2. Joint-Sealant Color: As selected by Architect from manufacturer's full range.
- D. Joint-Sealant Application: Exterior expansion and control joints in concrete slabs and surfaces.
  1. Joint Sealant: Single-component pourable urethane sealant.
  2. Joint Sealant Color: As selected by Architect from manufacturer's full range.

- E. Joint-Sealant Application: Interior perimeter joints of exterior openings.
  - 1. Joint Sealant: Latex sealant.
  - 2. Joint-Sealant Color: As selected by Architect from manufacturer's full range.
  
- F. Joint-Sealant Application: Interior joints between plumbing fixtures and adjoining walls, floors, and counters.
  - 1. Joint Sealant: Single-component mildew-resistant neutral-curing silicone sealant.
  - 2. Joint-Sealant Color: As selected by Architect from manufacturer's full range.
  
- G. Joint-Sealant Application: Perimeter joints between interior wall surfaces and frames of interior doors.
  - 1. Joint Sealant: Latex sealant.
  - 2. Joint-Sealant Color: As selected by Architect from manufacturer's full range.

END OF SECTION 07920



## SECTION 08110 - STEEL DOORS AND FRAMES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Standard hollow metal doors and frames.
- B. Related Sections
  - 1. Division 8 Section "Door Hardware".
  - 2. Division 9 Section "Painting".

#### 1.3 DEFINITIONS

- A. Minimum Thickness: Minimum thickness of base metal without coatings.
- B. Standard Hollow Metal Work: Hollow metal work fabricated according to ANSI/SDI A250.8.

#### 1.4 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Fiberglass column covers shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated according to the Uniform Building Code.
  - 1. Wind Loads: Calculate wind loads according to Sections 1615 through 1622 and Section 1625 of the Uniform Building Code.
  - 2. Earthquake Loads: Provide fiberglass column covers capable of withstanding the effects of earthquake motions determined according to Section 1610 and Sections 1626 through 1635 of the Uniform Building Code.
- B. Windborne-Debris-Impact-Resistance-Test Performance: Provide exterior steel doors and frames that pass large missile-impact tests and cyclic pressure tests according to Section 2315 of the Florida Building Code.

#### 1.5 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, core descriptions, fire-resistance rating, temperature-rise ratings, and finishes.

B. Shop Drawings: Include the following:

1. Elevations of each door design.
2. Details of doors, including vertical and horizontal edge details and metal thicknesses.
3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
4. Locations of reinforcement and preparations for hardware.
5. Details of each different wall opening condition.
6. Details of anchorage.

C. Other Action Submittals:

1. Schedule: Provide a schedule of hollow metal work prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with door hardware schedule.

1.6 QUALITY ASSURANCE

A. Source Limitations: Obtain hollow metal work from single source from single manufacturer.

B. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252.

1. Temperature-Rise Limit: At exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F above ambient after 30 minutes of standard fire-test exposure.

C. Regulatory Approval: Provide exterior steel doors and frames having a current NOA Number issued by Miami-Dade Building Code Compliance Office.

D. Preinstallation Conference: Conduct conference at Project site.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver hollow metal work palletized, wrapped, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.

1. Provide additional protection to prevent damage to finish of factory-finished units.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Store hollow metal work under cover at Project site. Place in stacks of five units maximum in a vertical position with heads up, spaced by blocking, on minimum 4-inch- high wood blocking. Do not store in a manner that traps excess humidity.

1. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

## 1.8 PROJECT CONDITIONS

- A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

## 1.9 COORDINATION

- A. Coordinate installation of anchorages for hollow metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Amweld Building Products, LLC.
  2. Ceco Door Products; an ASSA ABLOY Group Company.
  3. Curries Company; an Assa Abloy Group company.
  4. Steelcraft; an Ingersoll-Rand Company.

### 2.2 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum G60 or A60 metallic coating.
- D. Frame Anchors: ASTM A 591/A 591M, Commercial Steel (CS), 40Z coating designation; mill phosphatized.
  1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.
- E. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.
- F. Powder-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow metal frames of type indicated.



- G. Grout: ASTM C 476, except with a maximum slump of 4 inches, as measured according to ASTM C 143/C 143M.
- H. Glazing: Comply with requirements in Division 8 Section "Glazing."

## 2.3 STANDARD HOLLOW METAL DOORS

- A. General: Provide doors of design indicated, not less than thickness indicated; fabricated with smooth surfaces, without visible joints or seams on exposed faces unless otherwise indicated. Comply with ANSI/SDI A250.8.
  - 1. Design: Flush panel.
  - 2. Core Construction: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, polyisocyanurate, mineral-board, or vertical steel-stiffener core.
    - a. Fire Door Core: As required to provide fire-protection and temperature-rise ratings indicated.
  - 3. Vertical Edges for Single-Acting Doors: Beveled edge.
    - a. Beveled Edge: 1/8 inch in 2 inches.
  - 4. Vertical Edges for Double-Acting Doors: Round vertical edges with 2-1/8-inch radius.
  - 5. Top and Bottom Edges: Closed with flush or inverted 0.042-inch- thick, end closures or channels of same material as face sheets.
  - 6. Tolerances: Comply with SDI 117, "Manufacturing Tolerances for Standard Steel Doors and Frames."
- B. Exterior Doors: Face sheets fabricated from metallic-coated steel sheet. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:
  - 1. Level 3 and Physical Performance Level A (Extra Heavy Duty), Model 1 (Full Flush).
- C. Interior Doors: Face sheets fabricated from cold-rolled steel sheet. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:
  - 1. Level 3 and Physical Performance Level A (Extra Heavy Duty), Model 1 (Full Flush).
- D. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.
- E. Fabricate concealed stiffeners and hardware reinforcement from either cold- or hot-rolled steel sheet.

## 2.4 STANDARD HOLLOW METAL FRAMES

- A. General: Comply with ANSI/SDI A250.8 and with details indicated for type and profile.

- B. Exterior Frames: Fabricated from metallic-coated steel sheet.
  - 1. Fabricate frames with mitered or coped corners.
  - 2. Fabricate frames as face welded unless otherwise indicated.
  - 3. Frames for Level 3 Steel Doors: 0.053-inch- thick steel sheet.
- C. Interior Frames: Fabricated from cold-rolled steel sheet.
  - 1. Fabricate frames with mitered or coped corners.
  - 2. Fabricate frames as face welded unless otherwise indicated.
  - 3. Frames for Level 3 Steel Doors: 0.053-inch- thick steel sheet.
- D. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 with reinforcement plates from same material as frames.

## 2.5 FRAME ANCHORS

- A. Jamb Anchors:
  - 1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.042 inch thick, with corrugated or perforated straps not less than 2 inches wide by 10 inches long; or wire anchors not less than 0.177 inch thick.
  - 2. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch thick.
  - 3. Postinstalled Expansion Type for In-Place Concrete or Masonry: Minimum 3/8-inch-diameter bolts with expansion shields or inserts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.
- B. Floor Anchors: Formed from same material as frames, not less than 0.042 inch thick, and as follows:
  - 1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.

## 2.6 ACCESSORIES

- A. Transom Bars: Join to adjacent members by welding or rigid mechanical anchors.
- B. Grout Guards: Formed from same material as frames, not less than 0.016 inch thick.

## 2.7 FABRICATION

- A. Fabricate hollow metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.
- B. Tolerances: Fabricate hollow metal work to tolerances indicated in SDI 117.
- C. Hollow Metal Doors:

1. Exterior Doors: Provide weep-hole openings in bottom of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.
  2. Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch beyond edge of door on which astragal is mounted.
- D. Hollow Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
1. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.
  2. Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
  3. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
  4. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.
  5. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
  6. Jamb Anchors: Provide number and spacing of anchors as follows:
    - a. Masonry Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
      - 1) Three anchors per jamb from 60 to 90 inches high.
      - 2) Four anchors per jamb from 90 to 120 inches high.
    - b. Stud-Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
      - 1) Four anchors per jamb from 60 to 90 inches high.
      - 2) Five anchors per jamb from 90 to 96 inches high.
    - c. Postinstalled Expansion Type: Locate anchors not more than 6 inches from top and bottom of frame. Space anchors not more than 26 inches o.c.
  7. Door Silencers: Except on weather-stripped doors, drill stops to receive door silencers as follows. Keep holes clear during construction.
    - a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
    - b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.
- E. Fabricate concealed stiffeners, edge channels, and hardware reinforcement from either cold- or hot-rolled steel sheet.
- F. Hardware Preparation: Factory prepare hollow metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to the Door Hardware Schedule and templates furnished as specified in Division 8 Section "Door Hardware."

1. Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8.
2. Reinforce doors and frames to receive nontemplated, mortised and surface-mounted door hardware.
3. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.

## 2.8 STEEL FINISHES

- A. Prime Finish: Apply manufacturer's standard primer immediately after cleaning and pretreating.
  1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI/SDI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.
- C. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.
- B. Prior to installation, adjust and securely brace welded hollow metal frames for squareness, alignment, twist, and plumbness to the following tolerances:
  1. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
  2. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
  3. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
  4. Plumbness: Plus or minus 1/16 inch, measured at jambs on a perpendicular line from head to floor.

- C. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

### 3.3 INSTALLATION

- A. General: Install hollow metal work plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.

- B. Hollow Metal Frames: Install hollow metal frames of size and profile indicated. Comply with ANSI/SDI A250.11.

- 1. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.

- a. At fire-protection-rated openings, install frames according to NFPA 80.
- b. Install door silencers in frames before grouting.
- c. Remove temporary braces necessary for installation only after frames have been properly set and secured.
- d. Check plumbness, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.

- 2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.

- a. Floor anchors may be set with powder-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.

- 3. Metal-Stud Partitions: Solidly pack mineral-fiber insulation behind frames.

- 4. In-Place Concrete Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.

- 5. Installation Tolerances: Adjust hollow metal door frames for squareness, alignment, twist, and plumb to the following tolerances:

- a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
- b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
- c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
- d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.

- C. Hollow Metal Doors: Fit hollow metal doors accurately in frames, within clearances specified below. Shim as necessary.

- 1. Non-Fire-Rated Standard Steel Doors:

- a. Jambs and Head: 1/8 inch plus or minus 1/16 inch.
- b. Between Edges of Pairs of Doors: 1/8 inch plus or minus 1/16 inch.

- c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch.
  - d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch.
2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.

### 3.4 ADJUSTING AND CLEANING

- A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow metal work that is warped, bowed, or otherwise unacceptable.
- B. Remove grout and other bonding material from hollow metal work immediately after installation.
- C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.
- D. Metallic-Coated Surfaces: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

END OF SECTION 08110



## SECTION 08211 - FLUSH WOOD DOORS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:

1. Solid-core doors with wood-veneer faces.
2. Factory fitting flush wood doors to frames and factory machining for hardware.
3. Factory glazing of flush wood doors.

- B. Related Sections:

1. Division 8 Section "Glazing" for glass view panels in flush wood doors.

#### 1.3 SUBMITTALS

- A. Product Data: For each type of door indicated. Include details of core and edge construction and trim for openings. Include factory-finishing specifications.

- B. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; location and extent of hardware blocking; and other pertinent data.

1. Indicate dimensions and locations of mortises and holes for hardware.
2. Indicate dimensions and locations of cutouts.
3. Indicate requirements for veneer matching.
4. Indicate fire-protection ratings for fire-rated doors.

- C. Samples for Verification:

1. Factory finishes applied to actual door face materials, approximately 8 by 10 inches, for each material and finish.
2. Frames for light openings, 6 inches long, for each material, type, and finish required.

- D. Warranty: Sample of special warranty.

#### 1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain flush wood doors from single manufacturer.



- B. Quality Standard: In addition to requirements specified, comply with AWI's "Architectural Woodwork Quality Standards Illustrated."
- C. Fire-Rated Wood Doors: Doors complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to UBC Standard 7-2 or UL 10C.
  - 1. Temperature-Rise Limit: At exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F above ambient after 30 minutes of standard fire-test exposure.
- D. Preinstallation Conference: Conduct conference at Project site.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Comply with requirements of referenced standard and manufacturer's written instructions.
- B. Package doors individually in plastic bags.
- C. Mark each door on top and bottom rail with opening number used on Shop Drawings.

#### 1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

#### 1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Warping (bow, cup, or twist) more than 1/4 inch in a 42-by-84-inch section.
    - b. Telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch span.
  - 2. Warranty Period for Solid-Core Interior Doors: Life of installation.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Algoma Hardwoods, Inc.
2. Eggers Industries.
3. Marshfield Door Systems, Inc.

## 2.2 DOOR CONSTRUCTION, GENERAL

### A. Particleboard-Core Doors:

1. Particleboard: ANSI A208.1, Grade LD-2.
2. Provide doors with structural-composite-lumber cores instead of particleboard cores for doors indicated to receive exit devices.

### B. Structural-Composite-Lumber-Core Doors:

1. Structural Composite Lumber: WDMA I.S.10.
  - a. Screw Withdrawal, Face: 700 lbF.
  - b. Screw Withdrawal, Edge: 400 lbF.

### C. Fire-Protection-Rated Doors: Provide core specified or mineral core as needed to provide fire-protection rating indicated.

1. Edge Construction: Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed edges.
2. Pairs: Provide fire-retardant stiles that are listed and labeled for applications indicated without formed-steel edges and astragals. Provide stiles with concealed intumescent seals. Comply with specified requirements for exposed edges.

### D. Mineral-Core Doors:

1. Core: Noncombustible mineral product complying with requirements of referenced quality standard and testing and inspecting agency for fire-protection rating indicated.
2. Blocking: Provide composite blocking with improved screw-holding capability approved for use in doors of fire-protection ratings indicated as follows:
  - a. 5-inch top-rail blocking.
  - b. 5-inch bottom-rail blocking, in doors indicated to have protection plates.
  - c. 5-inch midrail blocking, in doors indicated to have armor plates.
  - d. 5-inch midrail blocking, in doors indicated to have exit devices.
3. Edge Construction: At hinge stiles, provide laminated-edge construction with improved screw-holding capability and split resistance. Comply with specified requirements for exposed edges.

## 2.3 VENEERED-FACED DOORS FOR OPAQUE FINISH

### A. Interior Solid-Core Doors:

1. Grade: Custom.

2. Species: Select white birch.
3. Cut: Plain sliced (flat sliced).
4. Match between Veneer Leaves: Book.
5. Assembly of Veneer Leaves on Door Faces: Running match.
6. Exposed Vertical Edges: Same species ad faces or compatible species.
7. Core: Either particleboard or structural composite lumber.
8. Construction: Five plies. Stiles and rails are bonded to core, then entire unit abrasive planed before veneering. Faces are bonded to core using a hot press.

## 2.4 LIGHT FRAMES

- A. Wood Beads for Light Openings in Wood Doors: Provide manufacturer's standard wood beads as follows unless otherwise indicated.
  1. Wood Species: Same species as door faces.
  2. Profile: Manufacturer's standard shape.
- B. Metal Frames for Light Openings in Fire-Rated Doors: Manufacturer's standard frame formed of 0.048-inch- thick, cold-rolled steel sheet; factory primed for paint finish; and approved for use in doors of fire-protection rating indicated.

## 2.5 FABRICATION

- A. Factory fit doors to suit frame-opening sizes indicated. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.
  1. Comply with requirements in NFPA 80 for fire-rated doors.
- B. Factory machine doors for hardware that is not surface applied. Locate hardware to comply with DHI-WDHS-3. Comply with final hardware schedules, door frame Shop Drawings, DHI A115-W series standards, and hardware templates.
  1. Coordinate with hardware mortises in metal frames to verify dimensions and alignment before factory machining.
- C. Openings: Cut and trim openings through doors in factory.
  1. Light Openings: Trim openings with moldings of material and profile indicated.
  2. Glazing: Factory install glazing in doors indicated to be factory finished. Comply with applicable requirements in Division 8 Section "Glazing."

## 2.6 FACTORY FINISHING

- A. General: Comply with referenced quality standard for factory finishing. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.
  1. Finish faces, all four edges, edges of cutouts, and mortises. Stains and fillers may be omitted on top and bottom edges, edges of cutouts, and mortises.

- B. Finish doors at factory.
- C. Opaque Finish:
  - 1. Grade: Custom.
  - 2. Finish: AWI conversion varnish or catalyzed polyurethane system.
  - 3. Color: Match Architect's sample.
  - 4. Sheen: Semigloss.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine doors and installed door frames before hanging doors.
  - 1. Verify that frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
  - 2. Reject doors with defects.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 INSTALLATION

- A. Hardware: For installation, see Division 8 Section "Door Hardware."
- B. Installation Instructions: Install doors to comply with manufacturer's written instructions and the referenced quality standard, and as indicated.
  - 1. Install fire-rated doors in corresponding fire-rated frames according to NFPA 80.
- C. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.
- D. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

#### 3.3 ADJUSTING

- A. Operation: Rehang or replace doors that do not swing or operate freely.
- B. Finished Doors: Replace doors that are damaged or that do not comply with requirements. Doors may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION 08211



## SECTION 08411 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Exterior and interior aluminum-framed storefronts.
- B. Related Sections include the following:
  - 1. Division 7 Section "Joint Sealants" for installation of joint sealants installed with aluminum-framed systems and for sealants to the extent not specified in this Section.
  - 2. Division 8 Section "Automatic Entrance Doors".
  - 3. Division 8 Section "Glazing" for glazing requirements to the extent not specified in this Section.

#### 1.3 PERFORMANCE REQUIREMENTS

- A. General: Provide aluminum-framed systems, including anchorage, capable of withstanding, without failure, the effects of the following:
  - 1. Structural loads.
  - 2. Thermal movements.
  - 3. Movements of supporting structure indicated on Drawings including, but not limited to, deflection from uniformly distributed and concentrated live loads.
  - 4. Dimensional tolerances of building frame and other adjacent construction.
  - 5. Failure includes the following:
    - a. Deflection exceeding specified limits.
    - b. Thermal stresses transferred to building structure.
    - c. Framing members transferring stresses, including those caused by thermal and structural movements, to glazing.
    - d. Glazing-to-glazing contact.
    - e. Noise or vibration created by wind and thermal and structural movements.
    - f. Loosening or weakening of fasteners, attachments, and other components.
    - g. Sealant failure.
- B. Structural Performance: Exterior aluminum-framed storefronts shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated according to the Uniform Building Code.

1. Wind Loads: Calculate wind loads according to Sections 1615 through 1622 and Section 1625 of the Uniform Building Code.
  2. Earthquake Loads: Provide fiberglass column covers capable of withstanding the effects of earthquake motions determined according to Section 1610 and Sections 1626 through 1635 of the Uniform Building Code.
- C. Windborne-Debris-Impact-Resistance-Test Performance: Provide aluminum-framed storefronts that pass the large-missile impact tests and cyclic pressure tests according to Section 2315 of the South Florida Building Code.
- D. Deflection of Framing Members:
1. Deflection Normal to Wall Plane: Limited to 1/175 of clear span for spans up to 13 feet 6 inches and to 1/240 of clear span plus 1/4 inch for spans greater than 13 feet 6 inches or an amount that restricts edge deflection of individual glazing lites to 3/4 inch, whichever is less.
  2. Deflection Parallel to Glazing Plane: Limited to 1/360 of clear span or 1/8 inch, whichever is smaller.
- E. Structural-Test Performance: Provide aluminum-framed storefronts tested according to ASTM E 330 as follows:
1. When tested at positive and negative wind-load design pressures, systems do not evidence deflection exceeding specified limits.
  2. When tested at 150 percent of positive and negative wind-load design pressures, systems, including anchorage, do not evidence material failures, structural distress, and permanent deformation of main framing members exceeding 0.2 percent of span.
  3. Test Durations: As required by design wind velocity but not less than 10 seconds.
- F. Thermal Movements: Provide aluminum-framed systems that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.
- G. Air Infiltration: Provide aluminum-framed systems with maximum air leakage through fixed glazing and framing areas of 0.06 cfm/sq. ft. of fixed wall area when tested according to ASTM E 283 at a minimum static-air-pressure difference of 6.24 lbf/sq. ft.
- H. Water Penetration Under Static Pressure: Provide aluminum-framed systems that do not evidence water penetration through fixed glazing and framing areas when tested according to ASTM E 331 at a minimum static-air-pressure difference of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft.

#### 1.4 SUBMITTALS

- A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of product indicated.

- B. Shop Drawings: For aluminum-framed systems. Include plans, elevations, sections, details, and attachments to other work.
  - 1. Include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
  - 2. Include details of provisions for system expansion and contraction and for draining moisture occurring within the system to the exterior.
- C. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.
- D. Warranties: Special warranties specified in this Section.

#### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Capable of assuming engineering responsibility and performing work of this Section and who is acceptable to manufacturer.
  - 1. Engineering Responsibility: Preparation of data for aluminum-framed systems including Shop Drawings based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project and submission of reports of tests performed on manufacturer's standard assemblies.
- B. Regulatory Approval: Provide exterior aluminum-framed storefronts having a current NOA number issued by Miami-Dade County, Building Code Compliance Office.

#### 1.6 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of structural supports for aluminum-framed systems by field measurements before fabrication and indicate measurements on Shop Drawings.
  - 1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating aluminum-framed systems without field measurements. Coordinate construction to ensure that actual dimensions correspond to established dimensions.

#### 1.7 WARRANTY

- A. Special Assembly Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of aluminum-framed systems that do not comply with requirements or that deteriorate as defined in this Section within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Structural failures including, but not limited to, excessive deflection.
    - b. Noise or vibration caused by thermal movements.
    - c. Deterioration of metals and other materials beyond normal weathering.
    - d. Adhesive or cohesive sealant failures.



- e. Water leakage through fixed glazing and framing areas.
  - f. Failure of operating components to function properly.
- 2. Warranty Period: Two years from date of Substantial Completion.
- B. Special Finish Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components on which finishes fail within specified warranty period. Warranty does not include normal weathering.
  - 1. Warranty Period: 5 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Basis-of-Design Product: The design for exterior aluminum-framed systems is based on "YHS 50" by YKK AP America. Subject to compliance with requirements, provide the named product or an equivalent product by one of the following:
  - 1. EFCO Corp.
  - 2. Kawneer Co., Inc.
- B. Basis-of-Design Product: The design for interior aluminum-framed storefronts is based on "YES 45 FS" by YKK AP America. Subject to compliance with requirements, provide the named product or an equivalent product by one of the following:
  - 1. EFCO Corp.
  - 2. Kawneer Co., Inc.

### 2.2 MATERIALS

- A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
  - 1. Sheet and Plate: ASTM B 209.
  - 2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221.
  - 3. Structural Profiles: ASTM B 308/B 308M.
  - 4. Welding Rods and Bare Electrodes: AWS A5.10/A5.10M.
- B. Steel Reinforcement: With manufacturer's standard corrosion-resistant primer complying with SSPC-PS Guide No. 12.00 applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM and prepare surfaces according to applicable SSPC standard.
  - 1. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
  - 2. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
  - 3. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.

## 2.3 FRAMING SYSTEMS

- A. Framing Members: Manufacturer's standard extruded-aluminum framing members of thickness required and reinforced as required to support imposed loads.
  - 1. Construction: High-performance plastic connectors separate framing members exposed to the exterior from members exposed to the interior.
- B. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.
- C. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
  - 1. Where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration, use self-locking devices.
  - 2. Reinforce members as required to receive fastener threads.
  - 3. Use exposed fasteners with countersunk Phillips screw heads, finished to match framing system.
- D. Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials. Form exposed flashing from sheet aluminum finished to match framing and of sufficient thickness to maintain a flat appearance without visible deflection.
- E. Framing System Gaskets and Sealants: Manufacturer's standard recommended by manufacturer for joint type.

## 2.4 GLAZING SYSTEMS

- A. Glazing: As specified in Division 8 Section "Glazing."
- B. Glazing Gaskets: Manufacturer's standard compression types, replaceable, molded or extruded, that maintain uniform pressure and watertight seal.
- C. Spacers and Setting Blocks: Manufacturer's standard elastomeric types.

## 2.5 ACCESSORY MATERIALS

- A. Joint Sealants: For installation at perimeter of aluminum-framed systems, as specified in Division 7 Section "Joint Sealants."
- B. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos, formulated for 30-mil thickness per coat.

## 2.6 FABRICATION

- A. Form aluminum shapes before finishing.

- B. Framing Members, General: Fabricate components that, when assembled, have the following characteristics:
  - 1. Profiles that are sharp, straight, and free of defects or deformations.
  - 2. Accurately fitted joints with ends coped or mitered.
  - 3. Means to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.
  - 4. Physical and thermal isolation of glazing from framing members.
  - 5. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
  - 6. Provisions for field replacement of glazing from interior.
  - 7. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
- C. Mechanically Glazed Framing Members: Fabricate for flush glazing (without projecting stops).
- D. Storefront Framing: Fabricate components for assembly using screw-spline system.

## 2.7 ALUMINUM FINISHES

- A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- C. Class I, Clear Anodic Finish: AA-M12C22A41 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.
  - 1. Location: Interior storefront framing.
- D. High-Performance Organic Finish (2-Coat Fluoropolymer): AA-C12C40R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: conversion coating; Organic Coating: manufacturer's standard 2-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with AAMA 2605 and with coating and resin manufacturers' written instructions.
  - 1. Color: As selected by Architect from manufacturer's full color line.
  - 2. Location: Exterior storefront framing.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

#### A. General:

1. Comply with manufacturer's written instructions.
2. Do not install damaged components.
3. Fit joints to produce hairline joints free of burrs and distortion.
4. Rigidly secure nonmovement joints.
5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration.
6. Seal joints watertight, unless otherwise indicated.

#### B. Metal Protection:

1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape or installing nonconductive spacers as recommended by manufacturer for this purpose.
2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

#### C. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.

#### D. Set continuous sill members and flashing in full sealant bed as specified in Division 7 Section "Joint Sealants" and to produce weathertight installation.

#### E. Install components plumb and true in alignment with established lines and grades, without warp or rack.

#### F. Install glazing as specified in Division 8 Section "Glazing."

#### G. Install perimeter joint sealants as specified in Division 7 Section "Joint Sealants" and to produce weathertight installation.

#### H. Erection Tolerances: Install aluminum-framed systems to comply with the following maximum tolerances:

1. Location and Plane: Limit variation from true location and plane to 1/8 inch in 12 feet; 1/4 inch over total length.
2. Alignment:
  - a. Where surfaces abut in line, limit offset from true alignment to 1/16 inch.
  - b. Where surfaces meet at corners, limit offset from true alignment to 1/32 inch.
3. Diagonal Measurements: Limit difference between diagonal measurement to 1/8 inch.

END OF SECTION 08411



## SECTION 08460 - AUTOMATIC ENTRANCE DOORS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:

- 1. Exterior power-operated automatic entrances.

- B. Related Sections:

- 1. Division 3 Section "Cast-in-Place Concrete" for forming recesses in concrete for recessed thresholds.
  - 2. Division 16 Sections for electrical connections including conduit and wiring for automatic entrance operators and access-control devices.

#### 1.3 DEFINITIONS

- A. AAADM: American Association of Automatic Door Manufacturers.
- B. Activation Device: Device that, when actuated, sends an electrical signal to the door operator to open the door.
- C. Safety Device: Device that, to avoid injury, prevents a door from opening or closing.
- D. For automatic door terminology, refer to BHMA A156.10 for definitions of terms.

#### 1.4 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design automatic entrances, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance: Exterior aluminum-framed storefronts shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated according to the Uniform Building Code.
  - 1. Wind Loads: Calculate wind loads according to Sections 1615 through 1622 and Section 1625 of the Uniform Building Code.

2. Earthquake Loads: Provide fiberglass column covers capable of withstanding the effects of earthquake motions determined according to Section 1610 and Sections 1626 through 1635 of the Uniform Building Code.
- C. Windborne-Debris-Impact-Resistance-Test Performance: Provide exterior automatic entrances that pass large missile-impact, small missile-impact and cyclic-pressure tests according to Section 2315 of the South Florida Building Code.
  - D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
    1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.
  - E. Operating Temperature Range: Provide automatic entrances that operate within minus 20 to plus 122 deg F.
  - F. Air Infiltration: Maximum air leakage through fixed glazing and framing areas of 1.25 cfm/sq. ft. of fixed entrance system area when tested according to ASTM E 283 at a minimum static-air-pressure difference of 6.24 lbF/sq. ft.
  - G. Opening-Force Requirements:
    1. Power-Operated Doors: Not more than 50 lbF required to manually set door in motion if power fails, and not more than 15 lbF required to open door to minimum required width.
    2. Breakaway Device for Power-Operated Doors: Not more than 50 lbF required for a breakaway door or panel to open.

## 1.5 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for automatic entrances. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: For automatic entrances. Include plans, elevations, sections, details, hardware mounting heights, and attachments to other work.
  1. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
  2. Wiring Diagrams: For power, signal, and control wiring.
  3. Activation and safety devices.
  4. Include hardware schedule and indicate hardware types, functions, quantities, and locations.
- C. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.

- D. Delegated-Design Submittal: For automatic entrances indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- E. Maintenance Data: For automatic entrances, safety devices, and control systems to include in maintenance manuals.

## 1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A manufacturer with company certificate issued by AAADM.
- B. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation and maintenance of units required for this Project and who employs a certified inspector.
  - 1. Maintenance Proximity: Not more than two hours' normal travel time from Installer's place of business to Project site.
- C. Certified Inspector Qualifications: Certified by AAADM.
- D. Source Limitations for Automatic Entrances: Obtain automatic entrances from single source from single manufacturer.
- E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- F. Power-Operated Door Standard: BHMA A156.10.
- G. Emergency-Exit Door Requirements: Comply with requirements of Authorities Having Jurisdiction for automatic entrances serving as a required means of egress.
- H. Regulatory Approval: Provide exterior automatic entrance doors that have a current NOA Number issued by Miami-Dade County, Building Code Compliance Office.
- I. Preinstallation Conference: Conduct conference at Project site.
  - 1. Review methods and procedures related to automatic entrances including, but not limited to, the following:
    - a. Structural load limitations.
    - b. Construction schedule. Verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
    - c. Coordination with electrical, glazing, and other trades.

## 1.7 PROJECT CONDITIONS

- A. Field Measurements: Verify actual dimensions of openings to receive automatic entrances by field measurements before fabrication.



## 1.8 COORDINATION

- A. Coordinate hardware with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish. Coordinate hardware for automatic entrances with hardware required for rest of Project.
- B. Electrical System Roughing-in: Coordinate layout and installation of automatic entrances with connections to power supplies and access-control system.

## 1.9 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of automatic entrances that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Structural failures including, but not limited to, excessive deflection.
    - b. Faulty operation of operators, controls, and hardware.
    - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.
  - 2. Warranty Period: Two years from date of Substantial Completion.
- B. Special Finish Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components that show evidence of deterioration of factory-applied finishes within specified warranty period.
  - 1. Deterioration includes, but is not limited to, the following:
    - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
    - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
    - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
  - 2. Warranty Period: 5 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
  - 1. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221.
  - 2. Sheet and Plate: ASTM B 209.
- B. Steel Reinforcement: With manufacturer's standard corrosion-resistant primer complying with SSPC-PS Guide No. 12.00 applied immediately after surface preparation and pretreatment.

Select surface preparation methods according to recommendations in SSPC-SP COM and prepare surfaces according to applicable SSPC standard.

1. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
  2. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
  3. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.
- C. Glazing: As specified in Division 8 Section "Glazing."
- D. Sealants and Joint Fillers: As specified in Division 7 Section "Joint Sealants."
- E. Nonmetallic, Shrinkage-Resistant Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout; complying with ASTM C 1107; of consistency suitable for application.
- F. Bituminous Paint: Cold-applied, asphalt-mastic paint complying with SSPC-Paint 12 requirements, except containing no asbestos; formulated for 30-mil thickness per coat.
- G. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

## 2.2 AUTOMATIC ENTRANCES

- A. General: Provide manufacturer's standard automatic entrances including doors, framing, headers, door operators, activation and safety devices, and accessories required for a complete installation.
- B. Automatic Entrance:
1. Basis-of-Design Product: Subject to compliance with requirements, provide YKK-YHS-50, Notice of Acceptance No. 06-1026.08 or comparable product approved equivalent by Architect.
  2. Configuration: Medium Stile with Panic Hardware, Hinges, Closer, Latching Hardware, Weather-stripping and ADA Threshold.

## 2.3 ENTRANCE COMPONENTS

- A. Framing Members: Manufacturer's standard extruded aluminum, minimum 0.125 inch thick and reinforced as required to support imposed loads.
1. Nominal Size: As indicated on Drawings.
  2. Extruded Glazing Stops and Applied Trim: Minimum 0.062-inch wall thickness.
- B. Stile and Rail Doors: Manufacturer's standard 1-3/4-inch- thick, glazed doors with minimum 0.125-inch- thick, extruded-aluminum tubular stile and rail members. Mechanically fasten corners with reinforcing brackets that are welded, or incorporate concealed tie-rods that span full length of top and bottom rails.
1. Glazing Stops and Gaskets: Square, snap-on, extruded-aluminum stops and manufacturer's standard preformed gaskets.

2. Stile Design: Medium stile, 3-1/2-inch nominal width.
  3. Rail Design: 5-inch nominal height.
  4. Muntin Bars: Horizontal tubular rail member for each door; match stile design and finish.
- C. Sidelite(s): Manufacturer's standard 1-3/4-inch- deep sidelite(s) with minimum 0.125-inch-thick, extruded-aluminum tubular stile and rail members matching door design and finish.
1. Glazing Stops and Gaskets: Same materials and design as for stile and rail door.
  2. Muntin Bars: Horizontal tubular rail members for each sidelite; match stile design.
- D. Headers: Fabricated from minimum 0.125-inch- thick, extruded aluminum and extending full width of automatic entrance units to conceal door operators and controls. Provide hinged or removable access panels for service and adjustment of door operators and controls. Secure panels to prevent unauthorized access.
1. Mounting: Concealed, with one side of header flush with framing.
  2. Capacity: Capable of supporting doors up to 175 lb per leaf over spans up to 14 feet without intermediate supports.
    - a. Provide sag rods for spans exceeding 14 feet.
- E. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.
- F. Signage: Affixed to both sides of each door as required by BHMA A156.10 for type of door and its operation.
1. Application Process: Door manufacturer's standard process.
  2. Provide sign materials with instructions for field application after glazing is installed.

## 2.4 DOOR OPERATORS AND ACTIVATION AND SAFETY DEVICES

- A. Door Operators: Provide door operators of size recommended by manufacturer for door size, weight, and movement; for condition of exposure; and for long-term, maintenance-free operation under normal traffic load for type of occupancy indicated.
1. Door Operator Performance: Provide door operators that will open and close doors and maintain them in fully closed position when subjected to Project's design wind loads.
  2. Electromechanical Operators: Concealed, self-contained, overhead unit powered by fractional-horsepower, permanent-magnet dc motor; with closing speed controlled mechanically by gear train and dynamically by braking action of electric motor; with solid-state microprocessor controller; UL 325; and with manual operation with power off.
- B. Motion Sensors: Self-contained, K-band-frequency, microwave-scanner units with metal or plastic housing; adjustable to provide detection field sizes and functions required by BHMA A156.10; with relay hold time of not less than 2 to 10 seconds.
1. Provide capability for switching between bidirectional and unidirectional detection.

2. For one-way-traffic entrances, sensor on egress side shall not be active when doors are fully closed.
- C. Photoelectric Beams: Pulsed infrared, sender-receiver assembly for recessed mounting. Beams shall not be active when doors are fully closed.
  - D. Presence Sensors: Self-contained, infrared-scanner units with metal or plastic housing; adjustable to provide detection field sizes and functions required by BHMA A156.10; with relay hold time of not less than 2 to 10 seconds. Sensors shall remain active at all times.
  - E. Electrical Interlocks: Unless units are equipped with self-protecting devices or circuits, provide electrical interlocks to prevent activation of operator when door is locked, latched, or bolted.

## 2.5 HARDWARE

- A. General: Provide units in sizes and types recommended by automatic entrance and hardware manufacturers for entrances and uses indicated. Finish exposed parts to match door finish.
- B. Breakaway Device for Power-Operated Doors: Provide breakaway device that allows door to swing out in direction of egress to full 90 degrees from any operating position. Maximum force to open door shall be 50 lbf according to BHMA A156.10. Interrupt powered operation of door operator while in breakaway mode.
- C. Emergency Egress: Provide panic exit devices on active leaves.
- D. Thresholds: BHMA A156.21, extruded-aluminum raised thresholds; with beveled edges with a slope of not more than 1:2 and a maximum height of 1/2 inch. Provide cutouts as required for door operating hardware.
- E. Weather Stripping: Manufacturer's standard replaceable components.
  1. Compression Type: Made of ASTM D 2000, molded neoprene, or ASTM D 2287, molded PVC.
  2. Weather Sweeps: Manufacturer's standard nylon brush sweep mounted to underside of door bottom.

## 2.6 FABRICATION

- A. General: Factory fabricate automatic entrance components to designs, sizes, and thicknesses indicated and to comply with indicated standards.
  1. Form aluminum shapes before finishing.
  2. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
  3. Use concealed fasteners to greatest extent possible. Where exposed fasteners are required, use countersunk Phillips flat-head machine screws, finished to match framing.
    - a. Where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration, use self-locking devices.

- b. Reinforce members as required to receive fastener threads.
- 4. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose.
- B. Framing: Provide automatic entrances as prefabricated assemblies. Complete fabrication, assembly, finishing, hardware application, and other work before shipment to Project site.
  - 1. Fabricate tubular and channel frame assemblies with manufacturer's standard welded or mechanical joints. Provide subframes and reinforcement as required for a complete system to support required loads.
  - 2. Perform fabrication operations in manner that prevents damage to exposed finish surfaces.
  - 3. Form profiles that are sharp, straight, and free of defects or deformations.
  - 4. Provide components with concealed fasteners and anchor and connection devices.
  - 5. Fabricate components with accurately fitted joints with ends coped or mitered to produce hairline joints free of burrs and distortion.
  - 6. Fabricate exterior components to drain water passing joints and condensation and moisture occurring or migrating within system to the exterior.
  - 7. Provide anchorage and alignment brackets for concealed support of assembly from building structure.
  - 8. Allow for thermal expansion of exterior units.
- C. Doors: Factory fabricated and assembled in profiles indicated. Reinforce as required to support imposed loads and for installing hardware.
- D. Door Operators: Factory fabricated and installed in headers, including adjusting and testing.
- E. Glazing: Fabricate framing with minimum glazing edge clearances for thickness and type of glazing indicated, according to GANA's "Glazing Manual."
- F. Hardware: Factory install hardware to greatest extent possible; remove only as required for final finishing operation and for delivery to and installation at Project site. Cut, drill, and tap for factory-installed hardware before applying finishes.
  - 1. Provide sliding-type weather stripping, mortised into door, at perimeter of doors and breakaway sidelites.
  - 2. Provide compression-type weather stripping at fixed stops of exterior doors. At locations without fixed stops, provide sliding-type weather stripping retained in adjustable strip mortised into door edge.
  - 3. Provide weather sweeps mounted to underside of door bottoms of exterior doors.
- G. Activation and Safety Devices:
  - 1. General: Factory install devices in doors and headers as required by BHMA A156.10 for type of door and direction of travel.
  - 2. Install photoelectric beams in vertical jambs of sidelites, with dimension above finished floor as follows:
    - a. Top Beam: 48 inches.

- b. Bottom Beam: 24 inches.

## 2.7 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

## 2.8 ALUMINUM FINISHES

- A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- C. High-Performance Organic Finish (2-Coat Fluoropolymer): AA-C12C40R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: conversion coating; Organic Coating: manufacturer's standard 2-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with AAMA 2605 and with coating and resin manufacturers' written instructions.
  - 1. Color: As selected by Architect from manufacturer's full color line.
  - 2. Location: Exterior storefront framing.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances, header support, and other conditions affecting performance of automatic entrances.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. General: Do not install damaged components. Fit frame joints to produce hairline joints free of burrs and distortion. Rigidly secure nonmovement joints. Seal joints watertight.

1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose.
  2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
- B. Entrances: Install automatic entrances plumb and true in alignment with established lines and grades without warp or rack of framing members and doors. Anchor securely in place.
1. Install surface-mounted hardware using concealed fasteners to greatest extent possible.
  2. Set headers, carrier assemblies, tracks, operating brackets, and guides level and true to location with anchorage for permanent support.
  3. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within system to exterior.
  4. Level recesses for recessed thresholds using nonshrink grout.
  5. Provide thresholds at exterior doors.
- C. Door Operators: Connect door operators to electrical power distribution system as specified in Division 16 Sections.
- D. Access-Control Devices: Connect access-control devices to access-control system as specified in Division 16 Sections.
- E. Activation Devices: Install and adjust devices to provide detection field and functions indicated.
- F. Glazing: Install glazing as specified in Division 8 Section "Glazing."
- G. Sealants: Comply with requirements specified in Division 7 Section "Joint Sealants" to provide weathertight installation.
1. Seal perimeter of framing members with sealant.
- H. Signage: Apply signage on both sides of each door and breakaway sidelight as required by referenced door standards.
- I. Wiring within Automatic Entrance Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's written limitations on bending radii. Provide and use lacing bars and distribution spools.

### 3.3 ADJUSTING

- A. Adjust door operators, controls, and hardware for smooth and safe operation and for weathertight closure; comply with requirements in BHMA A156.10.
- B. Lubricate operating hardware and other moving parts as recommended by manufacturer.
- C. Readjust door operators and controls after repeated operation of completed installation equivalent to 3 days' use by normal traffic (100 to 300 cycles). Lubricate hardware, operating equipment, and other moving parts.

### 3.4 CLEANING AND PROTECTION

- A. Clean glass and metal surfaces promptly after installation. Remove excess glazing and sealant compounds, dirt, and other substances. Repair damaged finish to match original finish.
  - 1. Comply with requirements in Division 8 Section "Glazing" for cleaning and maintaining glass.

### 3.5 DEMONSTRATION

- A. Engage a certified inspector to train Owner's maintenance personnel to adjust, operate, and maintain automatic entrances.

END OF SECTION 08460





## SECTION 08710 - DOOR HARDWARE

### PART 1 – GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:

1. Standard Builders Hardware
2. Electrified Hardware
3. Smoke Seals
4. Templates
5. Hardware Schedule
6. Keying System

- B. Related Sections:

1. Section 08110 “Steel Doors and Frames”
2. Section 08210 “Flush Wood Doors”
3. Division 16 Section “Electrical”

#### 1.3 REFERENCES:

- A. Reference and Standards: Where cited and except as modified by Project Specifications, applicable standards of the following Organizations apply:

1. American National Standards Institute (ANSI)
2. Builders Hardware Manufacturers Association (BHMA)
3. Door Hardware Institute (DHI)
4. National Fire Protection Association (NFPA)
5. Steel Door Institute (SDI)
6. Underwriters Laboratories (UL)
7. ICC/ANSI Accessibility Standard A117.1-2003
8. Uniform Building Code 1997

#### 1.4 SYSTEM DESCRIPTION:

- A. Performance Requirements:

1. Provide hardware for fire-rated openings in compliance with NFPA 80, 1999 edition or current edition.
2. Provide hardware tested and listed by Underwriters Laboratories or other approved testing agency.
3. Provide hardware for fire-rated openings conforming to UL10C positive pressure fire testing.

## 1.5 SUBMITTALS:

- A. Make submittals in accord with Division 0.
- B. Hardware Schedule: Submit six copies of a typed vertical style hardware schedule on 8-1/2 x 11 sheets. Schedule openings by door number and locations. Indicate door and frame material, dimensions, hand, degree of opening, label condition and special information. Hardware items shall include product description and number, finish, hand, size, keying, template and special requirements. The scheduling sequence and format shall be as recommended by DHI.
- C. Samples: Upon Architect / Engineer's request, submit samples showing function, finish, and design of proposed hardware items. Samples remain suppliers property and will be returned to him prior to project completion.
- D. Samples and Templates: Furnish to manufacturer of wood and metal doors and frames as required for proper hardware reinforcement and preparation of their work. If required, furnish physical hardware to the door and frame manufacturer for application.
- E. Catalog Cuts: Submit two sets of each type of hardware item used.
- F. Keying Schedule: Prepared by or under the supervision of Architectural Hardware Consultant detailing User's & final keying instructions for locks. Include schematic keying diagram and index each key set to unique door designations.
- G. Elevation Wiring Diagrams:
  - 1. Include with the hardware schedule submittal, elevation wiring diagrams of each different electrified hardware application.
  - 2. Schedules submitted without this requirement will be considered incomplete and will not be reviewed.
- H. Wiring Diagrams, Point-to-Point:
  - 1. Provide point to point wiring diagrams after hardware schedule submittal has been reviewed and returned and accepted as conforming to contract documents. Provide a complete description of the electrified hardware operation for each different electrified hardware application.
- I. Certifications: Arrange for hardware supplier to visit site and certify following:
  - 1. Hardware is installed and operating in a satisfactory manner.
  - 2. Hardware installed is as listed on the contract documents.
  - 3. Submit certifications in writing addressed to User in care of Architect.

J. Contract Close-Out Submittal:

1. Provide the following material in a 3-ring binder clearly tabbed and organized:
  - a. Final hardware schedule
  - b. Final key schedule
  - c. Wiring diagrams including detailed point-to-point wiring and power requirements
  - d. Catalog Cuts
  - e. Installation Instructions
  - f. Operating and adjustment instructions
  - g. Illustrated parts list for locks, exit devices, closers and auto operators
  - h. Warrantees

1.6 QUALITY ASSURANCE:

A. Qualifications:

1. Contractor is responsible for:
  - a. Proper application and fit of door and specialty hardware in locations as indicated on drawings or as specified.
  - b. Items not specifically mentioned, but necessary to complete work are to be furnished matching in quality and finish of specified items in similar locations.
  - c. Coordinate dimensions between hardware items.
  - d. Furnish and install only hardware items listed on approved door hardware submittal.
2. Contractor's selection of hardware supplier:
  - a. Select recognized builders hardware supplier who has been furnishing hardware in area of project for a period not less than five years.
  - b. Recognized supplier to have on staff an Architectural Hardware Consultant (AHC) certified by the Door and Hardware Institute. Provide a copy of the AHC certification with submittals.
  - c. Hardware supplier's AHC to be available at all reasonable times during course of work to meet personally with Owner, Architect or Contractor for hardware consultation.

B. Source Limitations: Obtain each type and variety of door hardware from a single manufacturer, unless otherwise indicated.

C. Electrified Hardware:

1. Unless noted otherwise in Division 16 provide electrified hardware items rated 24 VDC or less.
2. Coordinate electrical hardware requirements, with Division 16 work for electrical distribution, fire alarm, and security systems.

- D. Keying Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination." In addition to Owner Contractor, and Architect, conference participants shall also include Installer's Architectural Hardware Consultant. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including, but not limited to, the following:
1. Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
  2. Preliminary key system schematic diagram.
  3. Address for delivery of keys.

1.7 DELIVERY, STORAGE AND HANDLING:

- A. Delivery: Deliver items in manufacturer's original package. Each item individually packaged and carefully marked for intended opening and use. Each item complete with necessary screws, bolts, keys, instructions, and where necessary, installation templates.
- B. Storage: Protect materials on the job and during installation. Provide a secure, locked, dry storage area or room in the building. Store off the floor on temporary shelving.
- C. Handling: Handle items in a manner to prevent damage. Marred, defaced, damaged, and defective items will be rejected.

1.8 WARRANTY:

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.
1. Failures include, but are not limited to, the following:
    - a. Structural failures including excessive deflection, cracking, or breakage.
    - b. Faulty operation of operators and door hardware.
    - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.
  2. Warranty Period: One year from date of Substantial Completion, except as follows:
    - a. Hinges – Life of building.
    - b. Electromagnetic Locks: Five years from date of Substantial Completion.
    - c. Manual Closers: 10 years from date of Substantial Completion.

1.9 MAINTENANCE SERVICE

- A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

PART 2 – PRODUCTS

2.1 MANUFACTURERS:

- A. Catalog numbers of Manufacturers listed in Column 1 have been used to establish quality required. Manufacturers listed in Columns 2 & 3 are approved substitutes.
- B. It is the intent that approved door hardware be provided for every door on the project. Doors inadvertently omitted from the schedule shall be provided with hardware equal to doors of similar function.

<u>ITEM</u>	<u>1</u>	<u>2</u>	<u>3</u>
Hinges	Hager	Ives	McKinney
Continuous Hinges	Hager	Markar	
Locks, Anti-Ligature	Accurate	No Substitute	
Cylinders	Schlage	No Substitute	
Electric Strikes	Von Duprin	No Substitute	
Closers	LCN	No Substitute	
Push Bars, Kickplates	Hager	Hiawatha	Rockwood
Overhead Stops	GJ	Rixson	ABH
Stops, Flush Bolts	Ives	Hager	Rockwood
Smoke Seal	Pemko		

- C. Designations: Following abbreviations to identify list manufacturers.

ABH	Architectural Builders Hdwe., Elk Grove Village
Accurate	Accurate Lock & Hardware, Stamford, CT.
GJ	Glynn-Johnson Corp., Indianapolis, IN
Hager	C. Hager & Sons, St. Louis, MO
Hiawatha	Hiawatha Metalcraft, Bloomington, MN
Ives	Ives, Indianapolis, IN
LCN	LCN Closers, Princeton, IL
McKinney	McKinney, Scranton, PA
National	National Guard, Memphis, TN
Pemko	Pemko Mfg., Memphis, TN
Rixson	Rixson Corp., Charlotte, NC
Rockwood	Rockwood Mfg., Rockwood, PA
Schlage	Schlage Lock Co., Colorado Springs, CO

## 2.2 MATERIALS:

### A. SCREWS & FASTENERS:

- 1 Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to commercially recognized industry standards for application intended, except aluminum fasteners are not permitted. Provide Security Pin Torx flat-head screws with finished heads to match surface of door hardware, unless otherwise indicated.
  - a, Concealed Fasteners: For door hardware units that are exposed when door is closed, except for units already specified with concealed fasteners. Do not use through bolts for installation where bolt head or nut on opposite face is exposed unless it is the only means of securely attaching the door hardware. As approved by Owner/Architect.  
Where through bolts are used on hollow door and frame construction, provide sleeves for each through bolt.
  - b. Steel Machine or Wood Screws: For the following fire-rated applications:
    - 1) Mortise hinges to doors.
    - 2) Strike plates to frames.
    - 3) Closers to doors and frames.
  - c. Steel Through Bolts: For the following fire-rated applications unless door blocking is provided:
    - 1). Surface hinges to doors.
    - 2) Closers to doors and frames.
    - 3) Surface-mounted exit devices.
  - d. Spacers or Sex Bolts: For through bolting of hollow-metal doors.
  - e. Fasteners for Wood Doors: Comply with requirements in DHI WDHS.2, "Recommended Fasteners for Wood Doors."

### B. Hinges:

1. Interior door hinges: steel, plated .134 minimum thickness except as noted. Provide heavy weight .180 minimum thickness on doors wider than 3'0. Exterior door hinges: heavy weight .180 minimum thickness. Hinge size 4-1/2 x 4-1/2 unless otherwise noted in this schedule.
2. Provide quantities as follows unless otherwise noted in the schedule:
  - a. For doors up to 60 inches in height, provide 1 pair of hinges; for doors 60 inches to 90 inches in height, provide 1-1/2 pairs of hinges; for doors over 90 inches and up to 120 inches in height, provide 1 additional hinge for each 30 inches of height.
3. Provide "HT" security hospital tips.
4. Provide security pin torx fasteners

3. Manufacturers / Series:

<u>Hager</u>	<u>Ives</u>	<u>McKinney</u>
700	3PB1	T714
800	3PB1	T2314
AB850	3CB1HW	TA386
AB750	3CB1HW	TA786
AB700	3CB1	TA714

C. Continuous Hinges:

1. 14 gauge, type 304 stainless steel.
2. .25 diameter type 304 stainless steel pin, exterior barrel diameter .438.
3. 2 inch knuckles with split nylon bearings at each separation.
4. Provide UL listed at fire labeled openings.
5. Provide "HT" security hospital tips
6. Provide security pin torx fasteners
7. Manufacturer / Series:

<u>Markar</u>	<u>Hager</u>
FM300	790-900

D. Locks:

1. Heavy duty mortise type, ANSI A156.13, Series 1000, Grade 1
2. Manufacturer/Series

Schlage  
L9000-017A

E. Locks, keypad

1. Offline, keypad, heavy duty, mortise type, ANSI A156.13, Series 1000, Grade 1
2. .Battery powered using 4 standard "AA" batteries
3. Manually programmable up to 5000 users and 5000 audit trails.
4. Conventional key emergency override.
5. Manufacturer/Series

Schlage  
AD200-MS-70-KP-SPA

F. Locks, Anti-Ligature

1. Accurate Lock 9100 series, beveled latchbolt BL. Omit deadlatch
2. Locks scheduled as 9159 modified are always locked from both directions, double cylinder, fixed trim.
3. Trim: Crescent handles CH
4. Thumb Turns: ALT-ADA-P



G. Magnetic Locks:

1. Concealed mounting, 2700 lbs. holding force.
2. Supply with features and options:
  - a. MBS-Magnetic Bond Sensor
  - b. RTD-Relock Time Delay
  - c. ATS-Anti-tamper Switch
  - d. LED-Magnetic bond visual indicator
3. Manufacturer / Series:

Schlage  
GF3000

H. Power Transfers:

1. Provide device to transfer electrical power from the door frame to the door. Unit is completely concealed when the door is closed.
2. 10 wire, 24 ga. wire.
3. Manufacturer / Series:

Von Duprin  
EPT10

I. Power Supplies, EM Locks:

1. Single Door, 2 amp, 24VDC, regulated and filtered, NEMA enclosure. UL listed
2. Pairs of doors, 5 amp, 24VDC, regulated and filtered, NEMA enclosure UL listed.
3. Provide optional key lock cover
4. Fire/Emergency release input
5. Manufacturer/Series

Schlage  
505ULAC  
510ULAC

J. Electric Strikes:

1. Conform to requirements of ANSI A156.35, Grade 1
2. Voltage: 24VDC
3. Provide fail secure-FSE unless noted otherwise in the hardware sets.
4. Manufacturer/Series

	<u>Von Duprin</u>
Mortise Locks	6210
Bored Locks	6211

K. Door Position Switches:

1. DPDT magnetic reed switch. Housing ABS plastic, white
2. Manufacturer/Series

GE-Interlogix  
1076D

L. Closers:

1. Provide LCN door closers with features, functions and options shown in the hardware sets.
2. Materials and construction: High strength cast iron cylinder with full rack and pinion action. Spring power adjustable to 50%. Provide separate non-critical screw valves for regulation of latch speed, sweep speed, and back check. Hydraulic fluid type requiring no seasonal adjustment for temperatures ranging from 120 degrees F to -30 degrees F.
3. Provide brackets, drop plates, spacer blocks, and accessories required to insure proper installation.
4. Parallel arms: Extra duty forged steel main arm, forearm and shoe.
5. Provide door closers on fire labeled openings.

M. Kick Plates:

1. .050 stainless steel 10 inches high x 2 inches less than door width on singles and 1 inch less on pairs. Fasteners: full threaded, countersunk, undercut, security pin torx, stainless steel, sheet metal screws.

N. Stops, Flush Bolts, Dust Proof Strikes:

1. Manufacturers / Series:

<u>Ives</u>	<u>Hager</u>	<u>Rockwood</u>
WS402CVX	234W	400
WS402CCV	230W	403
358	283D	557
438	243F	442
458	282D	555
DP2	280X	570
FB32	295M	1848
FB42	295W	1948

O. Security Floor Stops

1. Manufacturer/Series

Hager  
269F

P. Smoke Seal:

1 Manufacturer/Series

Pemko  
S773

2. After installation razor cut in 12" lengths,

2.3 FINISHES:

	<u>US SYMBOL</u>	<u>ANSI SYMBOL</u>	<u>DESCRIPTION</u>
Continuous Hinges	US32D	630	Satin Stainless Steel
Hinges	US26D	626	Satin Chrome
Locks, Anti-Ligature	US32D	630	Satin Stainless Steel
Locks, Push/Pull	US32D	630	Satin Stainless Steel
Closers	AL	689	Alum. Powder Coat
O.H. Holders	US32D	630	Satin Stainless Steel
Stops, Flush Bolts	US26D	626	Satin Chrome
Push, Pull, Kickplates	US32D	630	Satin Stainless Steel

2.4 KEYS AND KEYING:

- A. Keying System: Factory registered, complying with guidelines in BHMA A156.28, Appendix A. Incorporate decisions made in keying conference.
- B. Cylinders: Key to existing system.
- C. Keys: Standard bow embossed on one side. Provide cut keys as follows:
  - 1. Master keys – 6 each, maximum
  - 2. Change keys – 6 each per change, maximum

PART 3 – EXECUTION

3.1 EXAMINATION:

- A. Verify doors and frames are ready to receive work and dimensions are as indicated on shop drawings or as instructed by manufacturers.
- B. Verify power supply is available to electrically operated devices.
- C. Beginning of installation means acceptance of existing conditions.

3.2 PREPARATION

- A. Steel Doors and Frames: Comply with DHI A115 Series.
  - 1. Surface-Applied Door Hardware: Drill and tap doors and frames according to ANSI A250.6.
- B. Wood Doors: Comply with DHI A115-W Series.

### 3.3 INSTALLATION:

#### A. General:

1. Install each hardware item in accordance with each manufacturer's instructions and recommendations.
2. Install no hardware until substrate finishes are complete.
3. Wherever cutting and fitting is required to install hardware onto or into surfaces, which are later to be painted or otherwise finished, install each item completely then remove and stored during application of finishes; Reinstall upon completion of finishing operations.
4. Set items level, plumb and true to line and location.
5. Adjust and reinforce attachment substrate as necessary for a secure installation.
6. Drill and countersink items not factory prepared for fasteners.
7. Space fasteners and anchors per manufacturer's instructions and in accordance with industry standards.
8. Do not install hardware on doors, which have been improperly prepared.
9. Attach wall mounted hardware to concealed wall blocking. Do not install wall mounted hardware where wall blocking has not been installed and arrange for blocking to be installed before proceeding.

#### B. Fire-Rated Openings:

1. In addition to previous requirements, conform to NFPA 80 covering installations of fire door assemblies.
2. Refer to instructions from door and frame manufacturer's regarding special hardware installation requirements, including function holes, undercutting and minimum clearances between hardware cutouts.

#### C. Installation Templates, Instruction Sheets and Schedules: Retain copies of templates, instruction sheets, schedules, installation details and similar data regarding hardware, maintenance and servicing. See Part 1 under Contract Closeout Submittals for assembly and distribution of data.

#### D. Mounting Heights: Heights given are centerline heights up from finish floor unless stated otherwise: Heights given "Number to Number" indicate one height within limits given. Where heights of items are not listed, install in accordance with recommendations of DHI.

- |    |                          |                                  |
|----|--------------------------|----------------------------------|
| 1. | Bottom Hinge             | 10 to 13 inches from floor       |
| 2. | Top Hinge                | 7-1/2 to 11-3/4 inches from head |
| 3. | Intermediate Hinge       | Equally spaced                   |
| 4. | Lock Lever               | 38 to 40-5/16 inches             |
| 5. | Hospital Push/Pull Latch | 45 inches                        |
| 6. | Deadlocks                | 46 to 48 inches                  |
| 7. | Push Bar                 | 46 to 48 inches                  |
| 8. | Push Plate               | 45 inches                        |
| 9. | Pull                     | 42 inches                        |

- E. Installation Requirements: In addition to mounting heights specified above, install hardware as follows:
1. Hinges:
    - a. Hang doors within following tolerances: 1/8" maximum between door and frame, and 1/8" maximum between meeting edges of pairs of doors.
    - b. Provide under door clearance at fire assemblies per NFPA 80.
    - c. Where shimming is necessary for proper door / frame installation, use only metal shims.
    - d. Install electric hinges or pivots as center hinge or second hinge from bottom where doors have 2 pairs of hinges..
  2. Locks: Install only curved lip strikes and dust box behind each strike.
  3. Closers:
    - a. Install closers to permit maximum degree of door swing allowed by job conditions. Follow manufacturer's instructions.
  4. Door Stops:
    - a. Install stops to permit maximum degree of door swing allowed by job conditions.
    - b. Locate floor stops so as not to create a tripping hazard, and to catch door at a point 6 inches in from latch edge, but in no case further than 1/3 door width measured from latch edge.
    - c. Wall stops intended for knobs and levers are to be located centered on spindle.
  5. Protection plates: (Armor and Kick Plates)
    - a. Armor and kick plates: Install on push side of single acting doors.
    - b. Unless otherwise indicated install 1/4 inch up from door bottom.
- F. Boxed Power Supplies: Locate power supplies as indicated or, if not indicated, above accessible ceilings. Verify location with Architect.
1. Configuration: Provide the least number of power supplies required to adequately serve doors with electrified door hardware.
- G. Doors with Electric Hardware:
1. Doors with Card Reader, Electric Strikes or Electric Locks:
    - a. Wire card reader or keypad to operate electric strike or lock.
    - b. Electric locks are fail secure and lock when power off unless noted differently in the hardware sets

### 3.3 FIELD QUALITY CONTROL:

#### A. Manufacturer's Field Service:

1. Closer: After air handling system has been balanced arrange for closer to be finally adjusted by person trained by closer manufacturer or closer manufacturer's representative.
  - a. Adjust closer to take 3 seconds minimum for door to swing from a 70 degree position to 3" from latching position.
  - b. Adjust closer not to exceed 5 lbs. opening force.  
Exception: Fire doors as required to close & latch.

### 3.4 ADJUSTING:

#### A. Adjusting & Cleaning:

1. Adjust and check each item of hardware and each door to insure proper operation and function of each unit.
2. Lubricate moving parts with graphite-type lubricant unless otherwise recommended by manufacturer.
3. Replace hardware, which cannot be lubricated and adjusted to operate freely and smoothly.
4. Final Adjustment:
  - a. Whenever hardware installation is made more than 1 month prior to acceptance of work, make final adjustment and check of hardware during week immediately prior to acceptance, unless otherwise directed by Architect.
  - b. Clean and re-lubricate operation items as necessary to restore proper functioning and finish of hardware and doors.
  - c. Make final adjustment of locksets and closers to compensate for operation of heating and ventilating systems under supervision of manufacturer's representative.

### 3.5 PROTECTION AND CLEANING:

#### A. Installed Hardware: Protect door hardware against damage.

#### B. Installed Doors:

1. Do not prop doors open using any item wedged between hinge jamb and door.
2. Use only rubber stops, cardboard or rope.
3. Do not use unprotected wood wedges under wood doors.
4. Do not use bare wire or other unprotected means of securing doors in open position, which may mar door or hardware.

#### C. Job Acceptance: Prior to acceptance of job, clean hardware surfaces on both interior and exterior doors of mortar, plaster, paint caulking and other contaminants. Replace hardware damaged after installation where finish cannot be restored after cleaning.

### 3.7 HARDWARE SCHEDULE:

A. Hardware set numbers have prefixes to identify the general function of the hardware.  
Prefix definitions:

1. EAC: Electrified with Card Access
2. BAC Battery powered Keypad Access
2. H: Mechanical Hardware

B. Abbreviations used in the Hardware Sets:

- Auto: Automatic  
CUSH: Positive Stop Closer Arm  
DA: Delayed Action  
EL: Electrified  
EM: Electro-Mechanical  
F: Fire Labeled  
H: Hold-Open  
L: Lever Trim  
O.H.: Overhead Holder

C. Provide and install hardware conforming to project specification in sets according to the following schedule

#### Hdwe Set EAC1

Doors C001A, C004A

Each to have:

- Hinges HTAB850 NRP
- 1 Lock 9159 modified
- 2 Cylinders
- 1 Electric Strike
- 1 Lock Guard LG1-32D
- 1 Door Position Switch
- 1 Closer 2211
- 1 Kick Plate
- 1 Threshold
- 1 Weatherstrip
- Card Readers & power supply by others
- Operation:
  1. Always locked on both sides
  2. Card Readers momentarily unlocks electric strike

### Hdwe Set EAC2

Doors C005

Each pair to have:

- Hinges HTAB850 NRP
- 2 Flush Bolts
- 1 Dustproof Strike
- 1 Lock 9159 modified
- 1 Electric Strike
- 1 Power Transfer EPT
- 2 Cylinders
- 1 Lock Guard LG1-32D
- 2 Door Position Switches
- 1 Closer 2211
- 2 Kick Plates
- 2 Wall Stops
- 1 Threshold
- 1 Weatherstrip
- Steel Astragal by H.M. Mfgr
- Card Readers & power supply by others
- Operation: 1. Same as EAC1

### Hdwe Set EAC3

Doors 101B

Each to have:

- 1 Continuous Hinge
- 1 Magnetic Lock
- 1 Power Supply
- 1 Closer 4211
- 1 Push/Pull Bar 153D-32D
- 1 Wall Stop
- Card Readers by others
- Operation: 1. Same as EAC1

### Hdwe Set EAC4

Doors 102

Each to have:

- Hinges HTAB750
- 1 Lock L9082
- 1 Electric Strike
- 1 Closer 4211
- 1 Kick Plate
- 1 Wall Stop
- Card Readers & power supply by others
- Operation: 1. Same as EAC1



Hdwe Set EAC5

Doors C003

Each to have:

- 1 Continuous Hinge
- 1 Lock 9159 modified
- 2 Cylinders
- 1 Electric Strike
- 1 Closer 2211
- 1 Kick Plate
- 1 Security Floor Stop
- Card Readers & power supply by others
- Operation: 1. Same as EAC1

Hdwe Set EAC6

Doors 132, 139, C004B

Each to have:

- 1 Continuous Hinge
- 1 Lock 9159 modified
- 2 Cylinders
- 1 Closer 2211
- 1 Kick Plate
- 1 Security Floor Stop
- 1 Smoke Seal
- Card Readers & power supply by others
- Operation: 1. Same as EAC1

Hdwe Set EAC7

Doors 110, C002A, C002B

Each pair to have:

- 2 Continuous Hinges
- 2 Push Plates
- 2 Magnetic Locks
- 1 Power Supply
- 2 Closers 2211
- 2 Kick Plates
- 2 Security Floor Stops
- Card Readers & power supply by others
- Operation: 1. Same as EAC1

Hdwe Set EAC8

Doors 118

Each pair to have:

- 2 Continuous Hinges
- 2 Exit Devices 9847EO-F-LBR
- 2 Power Transfers EPT
- 1 Power Supply EL
- 2 Magnetic Locks
- 1 Power Supply EM
- 2 Closers 2211
- 2 Kick Plates
- 2 Security Floor Stops
- 1 Smoke Seal perimeter & meeting stile
- Steel Astragal by H.M. Door Mfgr
- Card Readers by others
- Operation: 1. Same as EAC1

Hdwe Set EAC9

Doors 130

Each to have:

- Hinges AB750
- 1 Lock 9159
- 1 Cylinder
- 1 Electric Strike
- 1 Closer 4011 DA
- 1 Kick Plate
- 1 Floor Stop
- 1 Smoke Seal
- Card Reader & power supply by others
- Operation: 1. Card Reader momentarily unlocks electric strike
- 2. Opposite side: Exit at all times

Hdwe Set EAC10

Doors 140A

Each to have:

- 1 Continuous Hinge
- 1 Lock 9159
- 1 Cylinder
- 1 Closer 4111
- 1 Kick Plate
- 1 Security Floor Stop
- Card Reader & power supply by others
- Operation: 1. Same as EAC9

Hdwe Set EAC11

Doors 131

Each to have:

- Hinges AB750
- 1 Lock L9080
- 1 Electric Strike
- 1 Closer 4011 DA
- 1 Kick Plate
- 1 Wall Stop
- Card Reader & power supply by others
- Operation: 1. Same as EAC9

Hdwe Set EAC12

Doors 141

Each to have:

- 1 Continuous Hinge
- 1 Lock 9159
- 1 Cylinder
- 1 Electric Strike
- 1 Kick Plate
- 1 Security Floor Stop
- Card Reader & power supply by others
- Operation: 1. Same as EAC9

Hdwe Set BAC1

Doors 105, 106A, 106B, 107, 109, 119, 144

Each to have:

- Hinges HTAB750
- 1 Lock, keypad
- 1 Wall Stop

Hdwe Set BAC2

Doors 146, 147, 148, 149

Each to have:

- 1 Continuous Hinge
- 1 Lock, keypad
- 1 Security Floor Stop

### Hdwe Set BAC3

Doors 143, 145, 150

Each to have:

- Hinges AB750
- 1 Lock, keypad
- 1 Closer 4011 DA
- 1 Kick Plate
- 1 Floor Stop
- 1 Smoke Seal

### Hdwe Set BAC4

Doors 152

Each to have:

- Hinges AB750
- 1 Lock, keypad
- 1 Closer 4011
- 1 Kick Plate
- 1 Wall Stop

### Hdwe Set BAC5

Doors 140B

Each to have:

- 1 Continuous Hinge
- 1 Lock, keypad
- 1 Closer 4111
- 1 Security Floor Stop

### Hdwe Set E1

Doors 101A

Each to have:

- 1 Continuous Hinge
- 1 Exit Device CD3547A-NL-8190
- 2 Cylinders
- 1 Automatic Operator 4630
- 1 Bollard Post 8310-866
- 1 Bollard Post Actuator 8310-3853WB
- 1 Wall actuator 8310-856
- 1 Door Position Switch
- 1 Key Switch 652-04-L2 (activates/de-activates bollard post actuator)
- 1 Threshold
- Weatherstripping by Alum. Frame Mfgr.

### Hdwe Set E2

Doors 111

Each to have:

- Hinges AB850 NRP
- 1 Exit Device, delayed egress LX-CX98L-NL
- 1 Power Transfer EPT
- 1 Power Supply PS873-2
- 1 Door Position Switch
- 1 Closer 2211
- 1 Threshold
- 1 Weatherstrip

### Hdwe Set H1

Doors 112, 113, 114, 115, 116, 120, 121, 122, 123

Each to have:

- 1 Continuous Hinge
- 1 Lock 9124BL less thumbturn
- 1 Cylinder
- 1 Security Floor Stop
- Operation: 1. Normal operation, passage set
- 2. Key outside throws deadbolt to secure room when not in use.

### Hdwe Set H2

Doors 124

Each to have:

- 1 Continuous Hinge
- 1 Lock 9124BL less thumbturn
- 1 Cylinder
- 1 Closer 2211
- 1 Security Floor Stop
- 1 Smoke Seal
- Operation: 1 Same as H1

### Hdwe Set H3

Doors 108, 151

Each to have:

- Hinges AB700
- 1 Lock L9044
- 1 Closer 4111H
- 1 Kick Plate
- 1 Wall Stop

Hdwe Set H4

Doors 135, 137

Each to have:

- 1 Continuous Hinge
- 1 Latch 9125
- 1 Security Floor Stop

Hdwe Set H5

Doors 138

Each to have:

- Hinges AB700
- 1 Lock L9044
- 1 Closer 4011H
- 1 Kick Plate
- 1 Wall Stop

Hdwe Set H6

Doors 112T, 113T, 114T, 115T, 116T, 120T, 121T, 122T, 123T, 124T

All hardware by door manufacturer

End Section 08710



## SECTION 08800 - GLAZING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:
  - 1. Doors.
  - 2. Storefront framing.
  - 3. Glazed entrances.
  - 4. Interior borrowed lites.

#### 1.3 DEFINITIONS

- A. Manufacturers of Glass Products: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.
- B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.
- C. Deterioration of Laminated Glass: Defects developed from normal use that are attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.

#### 1.4 PERFORMANCE REQUIREMENTS

- A. General: Provide glazing systems capable of withstanding normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, and installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.
- B. Glass Design: Glass thickness designations indicated are minimums and are for detailing only. Confirm glass thicknesses by analyzing Project loads and in-service conditions. Provide glass lites in the thickness designations indicated for various size openings, but not less than



thicknesses and in strengths (annealed or heat treated) required to meet or exceed the following criteria:

1. Glass Thicknesses: Select minimum glass thicknesses to comply with ASTM E 1300, according to the following requirements:
  - a. Windborne-Debris-Impact-Resistance-Test Performance: Provide exterior glazing that passes large and small missile-impact tests and cyclic-pressure tests according to Section 2315 of the South Florida Building Code, edition 1994.
  - b. Wind Loads: Calculate wind according to Section 1615 through 1622 and Section 1625 of the Uniform Building Code.
  - c. Probability of Breakage for Vertical Glazing: 8 lites per 1000 for lites set vertically or not more than 15 degrees off vertical and under wind action.
    - 1) Load Duration: 3 seconds.
  - d. Maximum Lateral Deflection: For the following types of glass supported on all 4 edges, provide thickness required that limits center deflection at design wind pressure to 1/50 times the short side length or 1 inch, whichever is less.
    - 1) For laminated-glass lites.
  - e. Thickness of Tinted and Heat-Absorbing Glass: Provide the same thickness for each tint color indicated throughout Project.
- C. Thermal Movements: Provide glazing that allows for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures acting on glass framing members and glazing components. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
  1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.
- D. Thermal and Optical Performance Properties: Provide glass with performance properties specified based on manufacturer's published test data, as determined according to procedures indicated below:
  1. For laminated-glass lites, properties are based on products of construction indicated.

## 1.5 SUBMITTALS

- A. Product Data: For each glass product and glazing material indicated.
- B. Samples: For the following products, in the form of 12-inch- square Samples for glass.
  1. Tempered safety and decorative glass
  2. Impact resistant safety glass
  3. Wire glass
  4. Fire rated glazing
  5. For each color (except black) of exposed glazing sealant indicated.

- C. Glazing Schedule: Use same designations indicated on Drawings for glazed openings in preparing a schedule listing glass types and thicknesses for each size opening and location.
- D. Warranties: Special warranties specified in this Section.

#### 1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has completed glazing similar in material, design, and extent to that indicated for this Project; whose work has resulted in glass installations with a record of successful in-service performance.
- B. Source Limitations for Glass: Obtain the following through one source from a single manufacturer for each glass type: Coated float glass and laminated glass.
- C. Source Limitations for Glazing Accessories: Obtain glazing accessories through one source from a single manufacturer for each product and installation method indicated.
- D. Glazing for Fire-Rated Door Assemblies: Glazing for assemblies that comply with NFPA 80 and that are listed and labeled by a testing and inspecting agency acceptable to Authorities Having Jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 252.
- E. Safety Glazing Products: Comply with testing requirements in 16 CFR 1201 and, for wired glass, ANSI Z97.1.
  - 1. Where glazing units, including Kind FT glass and laminated glass, are specified in Part 2 articles for glazing lites more than 9 sq. ft. in exposed surface area of one side, provide glazing products that comply with Category II materials; for lites 9 sq. ft. or less in exposed surface area of one side, provide glazing products that comply with Category I or II materials, except for hazardous locations where Category II materials are required by 16 CFR 1201 and regulations of authorities having jurisdiction.
- F. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.
  - 1. GANA Publications: GANA Laminated Division's "Laminated Glass Design Guide" and GANA's "Glazing Manual."
- G. Regulatory Requirements: Provide glass that has been tested and approved for use in exterior aluminum-framed storefronts and glazed aluminum curtain walls having a current NOA number issued by Miami-Dade County, Building Code Compliance Office
- H. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing materials according to manufacturer's written instructions and as needed to prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

## 1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, condensation, or other causes.
  - 1. Do not install liquid glazing sealants when ambient and substrate temperature conditions are outside limits permitted by glazing sealant manufacturer.

## 1.9 WARRANTY

- A. Manufacturer's Special Warranty on Laminated Glass: Manufacturer's standard form, made out to Owner and signed by laminated-glass manufacturer agreeing to replace laminated-glass units that deteriorate as defined in "Definitions" Article, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.
  - 1. Warranty Period: Five years from date of Substantial Completion.

## 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 GLASS PRODUCTS

- A. Refer to "Door Schedule Opening Types" on Drawings.
- B. Wire Glass: ASTM C 1036, Type II (patterned and wired flat glass), Class 1 (clear), Quality-Q-6; and of form and mesh pattern specified.
- C. Laminated Glass: ASTM C 1172, and complying with other requirements specified and with the following:
  - 1. Interlayer: Polyvinyl butyral of thickness indicated with a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after laminating glass lites and installation.

- a. For polyvinyl butyral interlayers, laminate lites in autoclave with heat plus pressure.
2. Laminating Process: Fabricate laminated glass to produce glass free of foreign substances and air or glass pockets.

### 2.3 GLAZING GASKETS

- A. Dense Compression Gaskets: Molded or extruded gaskets of material indicated below, complying with standards referenced with name of elastomer indicated below, and of profile and hardness required to maintain watertight seal:
  1. EPDM, ASTM C 864.
  2. Silicone, ASTM C 1115.
  3. Thermoplastic polyolefin rubber, ASTM C 1115.
  4. Any material indicated above.

### 2.4 GLAZING SEALANTS

- A. General: Provide products of type indicated, complying with the following requirements:
  1. Compatibility: Select glazing sealants that are compatible with one another and with other materials they will contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
  2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
  3. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range.
- B. Elastomeric Glazing Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.
  1. Single-Component Neutral- and Basic-Curing Silicone Glazing Sealants:
    - a. Products:
      - 1) Dow Corning Corporation; 790.
      - 2) GE Silicones; SilPruf LM SCS2700.
      - 3) Tremco; Spectrem 1 (Basic).
    - b. Type and Grade: S (single component) and NS (nonsag).
    - c. Class: 100/50.
    - d. Use Related to Exposure: NT (nontraffic).
    - e. Uses Related to Glazing Substrates: M, G, A, and, as applicable to glazing substrates indicated, O.

- 1) Use O Glazing Substrates: Coated glass and color anodic aluminum.

## 2.5 GLAZING TAPES

- A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based elastomeric tape with a solids content of 100 percent; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; packaged on rolls with a release paper backing; and complying with ASTM C 1281 and AAMA 800 for products indicated below:
  1. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
  2. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

## 2.6 MISCELLANEOUS GLAZING MATERIALS

- A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.
- B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
- D. Spacers: Elastomeric blocks or continuous extrusions with a Shore, Type A durometer hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
- E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).
- F. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

## 2.7 FABRICATION OF GLAZING UNITS

- A. Fabricate glazing units in sizes required to glaze openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.

## 2.8 MONOLITHIC FLOAT-GLASS UNITS

- A. Uncoated Clear Float-Glass Units: Class 1 (clear) Kind FT (fully tempered) float glass.
  1. Thickness: 6.0 mm.

## 2.9 MONOLITHIC WIRED-GLASS UNITS

- A. Polished Wired-Glass Units: Form 1 (wired glass, polished both sides), Quality-Q6, Mesh 2 (M2) (Square), 6.0 mm thick.
  - 1. Manufacturers:
    - a. Asahi/AMA Glass Corp.; affiliated with AFG Industries, Inc.
    - b. Central Glass Co., Ltd.; distributed by Northwestern Industries Inc.
    - c. Pilkington Sales (North America) Ltd.

## 2.10 LAMINATED-GLASS UNITS

- A. Laminated-Glass Units:
  - 1. Kind LHS, consisting of two lites of annealed float glass.
  - 2. Outer Lite: Class 2 (tinted) float glass, heat strengthened.
    - a. Basis-of-Design: high performance tinted glass by Pilkington Building Products North America.
    - b. Thickness: 6.0 mm.
  - 3. Plastic Interlayer:
    - a. Product: As tested and approved to receive NOA number.
    - b. Thickness: 0.070 inch minimum.
    - c. Interlayer Color: Clear.
  - 4. Inner Lite: Class 1 (clear) float glass, heat strengthened.
    - a. Thickness: 6.0 mm.
  - 5. Visible Light Transmittance: 55 percent minimum.
  - 6. Summer Daytime U-Factor: 0.93 maximum.
  - 7. Solar Heat Gain Coefficient: 0.52 maximum.
  - 8. Shading Coefficient: 0.61 maximum.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine framing glazing, with Installer present, for compliance with the following:
  - 1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
  - 2. Presence and functioning of weep system.
  - 3. Minimum required face or edge clearances.
  - 4. Effective sealing between joints of glass-framing members.

- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

### 3.3 GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Glazing channel dimensions, as indicated on Drawings, provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances. Adjust as required by Project conditions during installation.
- C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.
- D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction sealant-substrate testing.
- E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- G. Provide spacers for glass lites where length plus width is larger than 50 inches as follows:
  - 1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
  - 2. Provide 1/8-inch minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.
- H. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.
- I. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

### 3.4 TAPE GLAZING

- A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.
- B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.
- C. Cover vertical framing joints by applying tapes to heads and sills first and then to jambs. Cover horizontal framing joints by applying tapes to jambs and then to heads and sills.
- D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
- E. Do not remove release paper from tape until just before each glazing unit is installed.
- F. Apply heel bead of elastomeric sealant.
- G. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.
- H. Apply cap bead of elastomeric sealant over exposed edge of tape.

### 3.5 GASKET GLAZING (DRY)

- A. Fabricate compression gaskets in lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
- B. Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- C. Install gaskets so they protrude past face of glazing stops.

### 3.6 SEALANT GLAZING (WET)

- A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.
- B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.
- C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.



### 3.7 CLEANING AND PROTECTION

- A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels, and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations, including weld splatter. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended by glass manufacturer.
- C. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.
- D. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

END OF SECTION 08800

## SECTION 09220 - PORTLAND CEMENT PLASTER

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Exterior Portland cement plasterwork on metal lath, and monolithic concrete.
- B. Related Sections include the following:
  - 1. Division 5 Section "Cold-Formed Metal Framing" for non-structural steel studs that support lath and Portland cement plaster.
  - 2. Division 7 Section "Joint Sealants" for sealants installed with exterior Portland cement plaster.

#### 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples 12 inches long of each type of accessory and trim.

#### 1.4 QUALITY ASSURANCE

- A. Preinstallation Conference: Conduct conference at Project site.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes.

#### 1.6 PROJECT CONDITIONS

- A. Comply with ASTM C 926 requirements.
- B. Exterior Plasterwork:

1. Apply and cure plaster to prevent plaster drying out during curing period. Use procedures required by climatic conditions, including moist curing, providing coverings, and providing barriers to deflect sunlight and wind.

## 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 NONSTRUCTURAL STEEL FRAMING MEMBERS, GENERAL

- A. Manufacturers:
  1. Clark Steel Framing Systems.
  2. Dietrich Industries, Inc.
  3. Marino/Ware; Division of Ware Industries, Inc.
- B. Cold-Rolled Channels: Base metal thickness of 0.0538 inch with ASTM A 653/A 653M, G60, hot-dip galvanized zinc coating.
- C. Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, not less than 0.0475-inch diameter, unless otherwise indicated.

### 2.3 STEEL FRAMING FOR CEILINGS

- A. Suspended Furring:
  1. Cross Furring: Cold-rolled channels, 3/4 inch deep.
- B. Tie Wire:
  1. For tying main runners directly to beams or joists (where wire hangers are used between beams or joists), use double loop of 0.1205-inch- diameter wire.

### 2.4 METAL LATH

- A. Expanded-Metal Lath: ASTM C 847 with ASTM A 653/A 653M, G60, hot-dip galvanized zinc coating.
  1. Manufacturers:
    - a. Alabama Metal Industries Corporation (AMICO).

- b. Dietrich Metal Framing, a Worthington Industries Company
  - c. MarinoWARE.
2. 3/8-Inch Rib Lath:
- a. Weight: 3.4 lb/sq. yd.

## 2.5 ACCESSORIES

- A. General: Comply with ASTM C 1063 and coordinate depth of trim and accessories with thicknesses and number of plaster coats required.
- B. Metal Accessories:
  - 1. Manufacturers:
    - a. Alabama Metal Industries Corporation (AMICO).
    - b. Dietrich Metal Framing, a Worthington Industries company.
    - c. Fry Reglet Corporation
    - d. MarinoWARE.
    - e. Niles Building Products Co.
  - 2. Foundation Weep Screed: Fabricated from zinc.
  - 3. Cornerite: Fabricated from metal lath with ASTM A 653/A 653M, G60, hot-dip galvanized zinc coating.
  - 4. Cornerbeads: Small nose cornerbeads fabricated from zinc or plastic; use unless otherwise indicated.
  - 5. Casing Beads: Fabricated from zinc; square-edged style; with expanded flanges.
  - 6. Control Joints: Fabricated from zinc; one-piece-type, folded pair of unperforated screeds in M-shaped configuration; with perforated flanges and removable protective tape on plaster face of control joint.
  - 7. Soffit Vents and reveals: Prefabricated, of material and type indicated below:
    - a. Aluminum: Alloy 6063-T5, clear anodized finish.
    - b. Profile: As indicated, coordinated with thickness of Portland cement plaster.

## 2.6 MISCELLANEOUS MATERIALS

- A. Water for Mixing: Potable and free of substances capable of affecting plaster set or of damaging plaster, lath, or accessories.
- B. Bonding Compound: ASTM C 932.
- C. Steel Drill Screws: For metal-to-metal fastening, ASTM C 1002 or ASTM C 954, as required by thickness of metal being fastened; with pan head that is suitable for application; in lengths required to achieve penetration through joined materials of not fewer than three exposed threads.
- D. Fasteners for Attaching Metal Lath to Substrates: Complying with ASTM C 1063.

## 2.7 PLASTER MATERIALS

- A. Portland Cement: ASTM C 150, Type I.
  - 1. Color for Finish Coats: Gray.
- B. Masonry Cement: ASTM C 91, Type N.
  - 1. Color for Finish Coats: Gray.
- C. Lime: ASTM C 206, Type S; or ASTM C 207, Type S.
- D. Sand Aggregate: ASTM C 897.

## 2.8 PLASTER MIXES

- A. General: Comply with ASTM C 926 for applications indicated.
- B. Base-Coat Mixes for Use over Metal Lath: Scratch and brown coats for three-coat plasterwork as follows:
  - 1. Portland Cement Mixes:
    - a. Scratch Coat: For cementitious material, mix 1 part Portland cement and 0 to 3/4 parts lime. Use 2-1/2 to 4 parts aggregate per part of cementitious material (sum of separate volumes of each component material).
    - b. Brown Coat: For cementitious material, mix 1 part Portland cement and 0 to 3/4 parts lime. Use 3 to 5 parts aggregate per part of cementitious material (sum of separate volumes of each component material).
- C. Base-Coat Mixes: Single base coats for two-coat plasterwork as follows:
  - 1. Portland Cement Mix: For cementitious material, mix 1 part portland cement and 3/4 to 1-1/2 parts lime. Use 2-1/2 to 4 parts aggregate per part of cementitious material.
- D. Job-Mixed Finish-Coat Mixes:
  - 1. Portland Cement Mix: For cementitious materials, mix 1 part portland cement and 3/4 to 1-1/2 parts lime. Use 1-1/2 to 3 parts aggregate per part of cementitious material (sum of separate volumes of each component material).

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Protect adjacent work from soiling, spattering, moisture deterioration, and other harmful effects caused by plastering.
- B. Prepare solid substrates for plaster that are smooth or that do not have the suction capability required to bond with plaster according to ASTM C 926.

### 3.3 INSTALLING NONSTRUCTURAL STEEL FRAMING, GENERAL

- A. General: Comply with requirements in ASTM C 1063 for applications indicated.
  1. Comply with ASTM C 754 for installation of items not addressed in ASTM C 1063.
- B. Install supplementary framing, blocking, and bracing at terminations in plaster assemblies to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.
- C. Isolate steel framing from building structure to prevent transfer of loading imposed by structural movement.
  1. Isolate ceiling assemblies where they abut or are penetrated by building structure.
- D. Soffits: Unless otherwise detailed on Drawings, install furred or suspended soffits to comply with requirements for ceiling installation; install framed soffits to comply with requirements for partition installation.

### 3.4 INSTALLING STEEL FRAMING FOR CEILINGS

- A. Suspend ceiling hangers from building structure as follows:
  1. Install hangers plumb and free of contact with insulation or other objects within ceiling plenum that are not part of supporting structural or ceiling suspension system. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
  2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with the location of hangers required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices. Size supplemental suspension members and hangers to limit deflection to 1/360 of span while supporting ceiling loads.
  3. Wire Hangers: Secure by looping and tying, either directly to structure or directly to fasteners that are secure and appropriate for substrate, in a manner that will not cause them to deteriorate or otherwise fail.
  4. Do not attach hangers to steel roof deck. Attach hangers to structural members.
  5. Do not connect steel framing to or suspend it from ducts, pipes, or conduit.

- B. Installation Tolerances: Install steel framing components for ceilings so members are level to within 1/4 inch in 10 feet measured lengthwise on each member and transversely between parallel members.
- C. Install steel framing components for ceilings in sizes and spacings indicated but not less than that required by the referenced steel framing and installation standards.
  - 1. Hanger Spacing: 48 inches o.c.
  - 2. Main Runner (Carrying Channel) Spacing: For suspended ceilings, 48 inches o.c.
  - 3. Cross-Furring Spacing: For suspended ceilings, 16 inches o.c.

### 3.5 INSTALLING METAL LATH

- A. Expanded-Metal Lath: Install according to ASTM C 1063.
  - 1. Flat-Ceiling and Horizontal Framing: Install rib lath.

### 3.6 INSTALLING ACCESSORIES

- A. Install according to ASTM C 1063 and at locations indicated on Drawings.
- B. Reinforcement for External Corners:
  - 1. Install lath-type external-corner reinforcement at exterior locations.
  - 2. Install cornerbead at interior locations.
- C. Control Joints: Install control joints at locations indicated on Drawings.
  - 1. As required to delineate plasterwork into areas (panels) of the following maximum sizes:
    - a. Vertical Surfaces: 144 sq. ft.
    - b. Horizontal and other Nonvertical Surfaces: 100 sq. ft.
  - 2. At distances between control joints of not greater than 18 feet o.c.
  - 3. As required to delineate plasterwork into areas (panels) with length-to-width ratios of not greater than 2-1/2:1.
  - 4. Where control joints occur in surface of construction directly behind plaster.
  - 5. Where plasterwork areas change dimensions, to delineate rectangular-shaped areas (panels) and to relieve the stress that occurs at the corner formed by the dimension change.

### 3.7 PLASTER APPLICATION

- A. General: Comply with ASTM C 926.
  - 1. Do not deviate more than plus or minus 1/4 inch in 10 feet from a true plane in finished plaster surfaces, as measured by a 10-foot straightedge placed on surface.
  - 2. Finish plaster flush with metal frames and other built-in metal items or accessories that act as a plaster ground, unless otherwise indicated. Where casing bead does not terminate

plaster at metal frame, cut base coat free from metal frame before plaster sets and groove finish coat at junctures with metal.

3. Provide plaster surfaces that are ready to receive field-applied finishes indicated.

B. Bonding Compound: Apply on concrete plaster bases.

C. Walls; Base-Coat Mixes for Use over Metal Lath: Scratch and brown coats for three-coat plasterwork; 3/4-inch thickness.

1. Portland cement mixes.

D. Ceilings; Base-Coat Mixes for Use over Metal Lath: Scratch and brown coats for three-coat plasterwork; 3/4-inch thickness.

1. Portland cement mixes.

E. Walls; Base-Coat Mix: Scratch coat for two-coat plasterwork, 3/8 inch thick on concrete and concrete masonry units.

1. Portland cement mixes.

F. Plaster Finish Coats: Apply to provide sand float finish to match Architect's sample.

### 3.8 CUTTING AND PATCHING

A. Cut, patch, replace, and repair plaster as necessary to accommodate other work and to restore cracks, dents, and imperfections. Repair or replace work to eliminate blisters, buckles, crazing and check cracking, dry outs, efflorescence, sweat outs, and similar defects and where bond to substrate has failed.

### 3.9 CLEANING AND PROTECTION

A. Remove temporary protection and enclosure of other work. Promptly remove plaster from doorframes, windows, and other surfaces not indicated to be plastered. Repair floors, walls, and other surfaces stained, marred, or otherwise damaged during plastering.

END OF SECTION 09220





## SECTION 09260 - GYPSUM BOARD ASSEMBLIES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Interior gypsum wallboard.
  - 2. Tile backing panels.
  - 3. Non-load-bearing steel framing.
  - 4. Framing and connections for earthquake loads.
- B. Related Sections include the following:
  - 1. Division 5 Section "Cold-Formed Metal Framing" for exterior steel stud framing.

#### 1.3 PERFORMANCE REQUIREMENTS

- A. Earthquake Loads: Provide gypsum board assemblies capable of withstanding the effects of earthquake motions determined according to Section 1610 and Sections 1626 through 1635 of the Uniform Building Code.

#### 1.4 DEFINITIONS

- A. Gypsum Board Terminology: Refer to ASTM C 11 for definitions of terms for gypsum board assemblies not defined in this Section or in other referenced standards.

#### 1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show locations, fabrication, and installation of control and expansion joints including plans, elevations, sections, details of components, and attachments to other units of Work.
- C. Samples: For the following products:
  - 1. Trim Accessories: Full-size sample in 12-inch- long length for each trim accessory indicated.

## 1.6 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: For gypsum board assemblies with fire-resistance ratings, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing and inspecting agency acceptable to Authorities Having Jurisdiction.
  - 1. Fire-Resistance-Rated Assemblies: Indicated by design designations from UL's "Fire Resistance Directory."

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original packages, containers, or bundles bearing brand name and identification of manufacturer or supplier.
- B. Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes. Stack gypsum panels flat to prevent sagging.

## 1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.
- B. Do not install interior products until installation areas are enclosed and conditioned.
- C. Do not install panels that are wet, those that are moisture damaged, and those that are mold damaged.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Steel Framing and Furring:
    - a. Dietrich Metal Framing, a Worthington Industries company.
    - b. MarinoWARE.
    - c. United States Gypsum Co.
  - 2. Gypsum Board and Related Products:
    - a. G-P Gypsum Corp.
    - b. National Gypsum Company.
    - c. United States Gypsum Co.

- B. Where a specific manufacturer's product is listed in the fire-resistance-rated assemblies shown on the Drawings, use only the products shown in the assembly.

## 2.2 STEEL SUSPENDED CEILING AND SOFFIT FRAMING

- A. Components, General: Comply with ASTM C 754 for conditions indicated.
- B. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.0625-inch- diameter wire, or double strand of 0.0475-inch- diameter wire.
- C. Hanger Attachments: As indicated on the Drawings.
- D. Hangers: As follows:
  - 1. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.162-inch diameter.
  - 2. Rod Hangers: ASTM A 510, mild carbon steel.
    - a. Diameter: As indicated.
    - b. Protective Coating: ASTM A 153/A 153M, hot-dip galvanized.
  - 3. Flat Hangers: Commercial-steel sheet, ASTM A 653/A 653M, G40, hot-dip galvanized.
    - a. Size: As indicated.
  - 4. Angle Hangers: ASTM A 653/A 653M, G40, hot-dip galvanized commercial-steel sheet.
    - a. Minimum Base Metal Thickness: As indicated.
    - b. Size: As indicated.
- E. Carrying Channels: Cold-rolled, commercial-steel sheet with a base metal thickness of 0.0538 inch, a minimum 1/2-inch- wide flange, with ASTM A 653/A 653M, G40, hot-dip galvanized zinc coating.
  - 1. Depth: As indicated.
- F. Furring Channels (Furring Members): Commercial-steel sheet with ASTM A 653/A 653M, G40, hot-dip galvanized zinc coating.
  - 1. Cold Rolled Channels: 0.0538-inch bare steel thickness, with minimum 1/2-inch- wide flange, 3/4 inch deep.
  - 2. Steel Studs: ASTM C 645.
    - a. Minimum Base Metal Thickness: 0.0312 inch.
    - b. Depth: As indicated.
  - 3. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch deep.
    - a. Minimum Base Metal Thickness: 0.0312 inch.

## 2.3 STEEL PARTITION AND SOFFIT FRAMING

- A. Components, General: As follows:
  - 1. Comply with ASTM C 754 for conditions indicated.
  - 2. Steel Sheet Components: Complying with ASTM C 645 requirements for metal and with ASTM A 653/A 653M, G40, hot-dip galvanized zinc coating.
- B. Steel Studs and Runners: ASTM C 645.
  - 1. Minimum Base Metal Thickness: 0.0312 inch.
  - 2. Depth: As indicated.
- C. Deep-Leg Deflection Track: ASTM C 645 top runner with 3-inch- deep flanges.
- D. Flat Strap and Runner Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
  - 1. Minimum Base Metal Thickness: As indicated.
- E. Cold-Rolled Channel Bridging: 0.0538-inch bare steel thickness, with minimum 1/2-inch- wide flange.
  - 1. Depth: As indicated.
  - 2. Clip Angle: 1-1/2 by 1-1/2 inch, 0.068-inch- thick, galvanized steel.
- F. Hat-Shaped, Rigid Furring Channels: ASTM C 645.
  - 1. Minimum Base Metal Thickness: 0.0312 inch.
  - 2. Depth: 7/8 inch.
- G. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

## 2.4 INTERIOR GYPSUM WALLBOARD

- A. Panel Size: Provide in maximum lengths and widths available that will minimize joints in each area and correspond with support system indicated.
- B. Gypsum Wallboard: ASTM C 36.
  - 1. Regular Type:
    - a. Thickness: As indicated.
    - b. Long Edges: Tapered.
    - c. Location: As indicated.
  - 2. Type X:
    - a. Thickness: As indicated.
    - b. Long Edges: Tapered.

- c. Location: As indicated and where required for fire-resistance-rated assembly.
  - 3. Water-Resistant Type X.
    - a. Thickness: As indicated.
    - b. Long Edges: Tapered.
- C. Proprietary, Special Fire-Resistive Type: ASTM C 36, having improved fire resistance over standard Type X.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. G-P Gypsum Corp.; Firestop Type C.
    - b. National Gypsum Company; Gold Bond Fire-Shield G.
    - c. United States Gypsum Co.; SHEETROCK Brand Gypsum Panels, FIRECODE C Core.
  - 2. Thickness: As indicated.
  - 3. Long Edges: Tapered.
  - 4. Location: As indicated.

## 2.5 TILE BACKING PANELS

- A. Panel Size: Provide in maximum lengths and widths available that will minimize joints in each area and correspond with support system indicated.
- B. Glass-Mat, Water-Resistant Backing Board:
  - 1. Complying with ASTM C 1178/C 1178M.
    - a. Product: Subject to compliance with requirements, provide "DensShield Tile Guard" by G-P Gypsum.
  - 2. Core: 5/8 inch, Type X.

## 2.6 TRIM ACCESSORIES

- A. Interior Trim: ASTM C 1047.
  - 1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized steel sheet.
  - 2. Shapes:
    - a. Cornerbead: Use at outside corners.
    - b. LC-Bead: J-shaped; exposed long flange receives joint compound; use at exposed panel edges.
    - c. L-Bead: L-shaped; exposed long leg receives joint compound; use where indicated.
    - d. Expansion (Control) Joint: Use where indicated.

## 2.7 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C 475.
- B. Joint Tape:
  - 1. Interior Gypsum Wallboard: Paper.
  - 2. Tile Backing Panels: As recommended by panel manufacturer.
- C. Joint Compound for Interior Gypsum Wallboard: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.
  - 1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
  - 2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.
    - a. Use setting-type compound for installing paper-faced metal trim accessories.
  - 3. Fill Coat: For second coat, use setting-type, sandable topping compound.
  - 4. Finish Coat: For third coat, use setting-type, sandable topping compound.
- D. Joint Compound for Tile Backing Panels:
  - 1. Glass-Mat, Water-Resistant Backing Panel: As recommended by backing panel manufacturer.

## 2.8 ACOUSTICAL SEALANT

- A. Products: Subject to compliance with requirements, provide one of the following:
  - 1. Acoustical Sealant for Exposed and Concealed Joints:
    - a. Pecora Corp.; AC-20 FTR Acoustical and Insulation Sealant.
    - b. United States Gypsum Co.; SHEETROCK Acoustical Sealant.
- B. Acoustical Sealant for Exposed and Concealed Joints: Nonsag, paintable, nonstaining, latex sealant, with a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24), complying with ASTM C 834 that effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.

## 2.9 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.
- B. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.

1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch thick.
- C. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
  1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Suspended Ceilings: Coordinate installation of ceiling suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive ceiling hangers at spacing required to support ceilings and that hangers will develop their full strength.

### 3.3 INSTALLING STEEL FRAMING, GENERAL

- A. Installation Standards: ASTM C 754, and ASTM C 840 requirements that apply to framing installation.
- B. Install supplementary framing and backing plates in gypsum board assemblies to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, cabinets, furnishings, or similar construction. Comply with details indicated and with gypsum board manufacturer's written recommendations or, if none available, with United States Gypsum's "Gypsum Construction Handbook."
- C. Isolate steel framing from building structure at locations indicated to prevent transfer of loading imposed by structural movement.
  1. Isolate ceiling assemblies where they abut or are penetrated by building structure.
  2. Isolate partition framing and wall furring where it abuts structure, except at floor. Install slip-type joints at head of assemblies that avoid axial loading of assembly and laterally support assembly.
    - a. Use deep-leg deflection track.



- D. Do not bridge building control and expansion joints with steel framing or furring members. Frame both sides of joints independently.

### 3.4 INSTALLING STEEL SUSPENDED CEILING AND SOFFIT FRAMING

- A. Suspend ceiling hangers from building structure as follows:
  - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or ceiling suspension system. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
  - 2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with the location of hangers required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.
  - 3. Secure wire hangers by looping and wire-tying, either directly to structures or to inserts, eyescrews, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause them to deteriorate or otherwise fail.
  - 4. Secure rod, flat and angle hangers to structure, including intermediate framing members, by attaching to inserts, eyescrews, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
  - 5. Do not connect or suspend steel framing from ducts, pipes, or conduit.
- B. Installation Tolerances: Install steel framing components for suspended ceilings so members for panel attachment are level to within 1/8 inch in 12 feet measured lengthwise on each member and transversely between parallel members.
- C. Sway-brace suspended steel framing with hangers used for support.
- D. Wire-tie furring channels to supports, as required to comply with requirements for assemblies indicated.
- E. Install suspended steel framing components in sizes and spacings indicated, but not less than that required by the referenced steel framing and installation standards.
  - 1. Hangers: 48 inches o.c.
  - 2. Carrying Channels (Main Runners): 48 inches o.c.
  - 3. Furring Channels (Furring Members): 16 inches o.c.

### 3.5 INSTALLING STEEL PARTITION AND SOFFIT FRAMING

- A. Install tracks (runners) at floors, ceilings, and structural walls and columns where gypsum board assemblies abut other construction.
- B. Installation Tolerance: Install each steel framing and furring member so fastening surfaces vary not more than 1/8 inch from the plane formed by the faces of adjacent framing.

- C. Extend partition framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing over frames for doors and openings and frame around ducts penetrating partitions above ceiling to provide support for gypsum board.
  - 1. Cut studs 1/2 inch short of full height to provide perimeter relief.
  - 2. For fire-resistance-rated partitions that extend to the underside of floor/roof slabs and decks or other continuous solid-structure surfaces to obtain ratings, install framing around structural and other members extending below floor/roof slabs and decks, as needed to support gypsum board closures and to make partitions continuous from floor to underside of solid structure.
- D. Install steel studs and furring at the following spacings:
  - 1. Single-Layer Construction: 16 inches o.c., unless otherwise indicated.
  - 2. Multilayer Construction: 16 inches o.c., unless otherwise indicated.
- E. Install steel studs so flanges point in the same direction and leading edge or end of each panel can be attached to open (unsupported) edges of stud flanges first.
- F. Frame door openings to comply with GA-600 and with gypsum board manufacturer's applicable written recommendations, unless otherwise indicated. Connect vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.
  - 1. Provide welded connections where indicated
  - 2. Install two studs at each jamb, unless otherwise indicated.
  - 3. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch clearance from jamb stud to allow for installation of control joint.
  - 4. Extend jamb studs through suspended ceilings and attach to underside of floor or roof structure above.
- G. Frame openings other than door openings the same as required for door openings, unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.

### 3.6 APPLYING AND FINISHING PANELS, GENERAL

- A. Gypsum Board Application and Finishing Standards: ASTM C 840 and GA-216.
- B. Install sound attenuation blankets before installing gypsum panels, unless blankets are readily installed after panels have been installed on one side.
- C. Install ceiling board panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in the central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- D. Install gypsum panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.

- E. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
- F. Attach gypsum panels to steel studs so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
- G. Attach gypsum panels to framing provided at openings and cutouts.
- H. Form control and expansion joints with space between edges of adjoining gypsum panels.
- I. Cover both faces of steel stud partition framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
  - 1. Fit gypsum panels around ducts, pipes, and conduits.
- J. Space fasteners in gypsum panels according to referenced gypsum board application and finishing standard and manufacturer's written recommendations.
  - 1. Space screws a maximum of 12 inches o.c. for vertical applications.
- K. Space fasteners in panels that are tile substrates a maximum of 8 inches o.c.

### 3.7 PANEL APPLICATION METHODS

- A. Single-Layer Application:
  - 1. On ceilings, apply gypsum panels before wall/partition board application to the greatest extent possible and at right angles to framing, unless otherwise indicated.
  - 2. On partitions/walls, apply gypsum panels vertically (parallel to framing), unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
    - a. Stagger abutting end joints not less than one framing member in alternate courses of board.
- B. Multilayer Application on Partitions/Walls: Apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
- C. Single-Layer Fastening Methods: Apply gypsum panels to supports with steel drill screws.
- D. Multilayer Fastening Methods: Fasten base layers and face layers separately to supports with screws.
- E. Tile Backing Panels:
  - 1. Cementitious Backer Units: ANSI A108.11, at locations indicated to receive tile.

### 3.8 INSTALLING TRIM ACCESSORIES

- A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
- B. Control Joints: Install control joints at locations indicated on Drawings.

### 3.9 FINISHING GYPSUM BOARD ASSEMBLIES

- A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
- B. Prefill open joints, rounded or beveled edges, and damaged surface areas.
- C. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.
- D. Gypsum Board Finish Levels: Finish panels to levels indicated below, according to ASTM C 840, for locations indicated:
  - 1. Level 2: Embed tape and apply separate first coat of joint compound to tape, fasteners, and trim flanges where panels are substrate for tile and where indicated.
  - 2. Level 4: Embed tape and apply separate first, fill, and finish coats of joint compound to tape, fasteners, and trim flanges at panel surfaces that will be exposed to view, unless otherwise indicated.
- E. Cementitious Backer Units: Finish according to manufacturer's written instructions.

END OF SECTION 09260



## SECTION 09310 - CERAMIC TILE

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes the following (as indicated in Drawings):
  - 1. Porcelain and porcelain mosaic tile for both floor and wall applications.
  - 2. Ceramic and ceramic mosaic tile for both floor and wall applications.
  - 3. Glass floor and wall tile.
  - 4. Stone floor and wall tile.
  - 5. Thresholds.
  - 6. Waterproof membrane for thin-set tile installations.
- B. Related Sections include the following:
  - 1. Division 3 Section "Cast-in-Place Concrete" for monolithic slab finishes specified for tile substrates.
  - 2. Division 5 Section "Metal Fabrications" for metal thresholds.
  - 3. Division 9 Section "Gypsum Board Assemblies" for gypsum board substrates for tile.

#### 1.3 DEFINITIONS

- A. Facial Dimension: Nominal tile size as defined in ANSI A137.1.

#### 1.4 PERFORMANCE REQUIREMENTS

- A. Static Coefficient of Friction: For tile installed on walkway surfaces, provide products with the following values as determined by testing identical products per ASTM C 1028:
  - 1. Level Surfaces: Minimum 0.6.

#### 1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Verification:
  - 1. Full-size units of each type and composition of tile and for each color and finish required.

2. Assembled samples with grouted joints for each type and composition of tile and for each color and finish required, at least 12 inches square and mounted on rigid panel. Use grout of type and in color or colors approved for completed work.
  3. Full-size units of each type of trim for each color and finish required.
- C. Master Grade Certificates: For each shipment, type, and composition of tile, signed by tile manufacturer and Installer.

## 1.6 QUALITY ASSURANCE

- A. Source Limitations for Tile: Obtain all tile of same type and color or finish from one source or producer.
1. Obtain tile from same production run and of consistent quality in appearance and physical properties for each contiguous area.
- B. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from a single manufacturer and each aggregate from one source or producer.
- C. Source Limitations for Other Products: Obtain Waterproofing products specified in this Section through one source from a single manufacturer for each product.
- D. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

## 1.7 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. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

## 1.8 PROJECT CONDITIONS

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.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products selected by Interior Designer
- B. Refer to “Ceramic and Glass Tile Code Schedule” and “Stone Code Schedule” in Drawings.

## 2.2 PRODUCTS, GENERAL

- A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1, "Specifications for Ceramic Tile," for types, compositions, and other characteristics indicated.
  - 1. Provide tile complying with Standard grade requirements, unless otherwise indicated.
  - 2. For facial dimensions of tile, comply with requirements relating to tile sizes specified in Part 1 "Definitions" Article.
- B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI standards referenced in "Setting and Grouting Materials" Article.
- C. Colors, Textures, and Patterns: As selected by Interior Designer.
- D. Factory Blending: For tile exhibiting color variations within ranges selected during Sample submittals, blend tile in factory and package so tile units taken from one package show same range in colors as those taken from other packages and match approved Samples.
- E. Mounting: For factory-mounted tile, provide back- or edge-mounted tile assemblies as standard with manufacturer, unless otherwise indicated.

## 2.3 TILE PRODUCTS

- A. Refer to “Ceramic and Glass Tile Code Schedule” and “Stone Code Schedule” in Drawings.
- B. Glazed Wall Tile Trim Units: Matching characteristics of adjoining flat tile and coordinated with sizes and coursing of adjoining flat tile where applicable. Provide shapes as follows, selected from manufacturer's standard shapes, as needed:
  - 1. Base for Portland Cement Mortar Installations: Coved, module size 4-1/4 by 4-1/4 inches.
  - 2. Base for Thin-Set Mortar Installations: Coved, module size 4-1/4 by 4-1/4 inches.
  - 3. Wainscot Cap for Thin-Set Mortar Installations: Surface bullnose, module size 4-1/4 by 4-1/4 inches.  
External Corners for Thin-Set Mortar Installations: Surface bullnose.

## 2.4 THRESHOLDS

- A. General: Fabricate to sizes and profiles indicated in Drawings or required to provide transition between adjacent floor finishes.
- B. Basis-of-Design:
  - 1. Ceramic Tile Transition: Shluter Systems, Schiene-E, Stainless Steel, Class 1.



2. Carpet Tile Transition: Shluter Systems, R-AE30 Schiene, Satin Anodized Aluminum, Class 1.

C. Refer to Section 05500: Metal Fabrications.

## 2.5 WATERPROOFING FOR THIN-SET TILE INSTALLATIONS

A. General: Manufacturer's standard product that complies with ANSI A118.10.

B. Fabric-Reinforced, Fluid-Applied Product: System consisting of liquid-latex rubber and fabric reinforcement.

1. Products:

- a. LATICRETE International Inc.; Laticrete 9235 Waterproof Membrane.
- b. MAPEI Corporation; PRP M19.
- c. Summitville Tiles, Inc.; S-9000.
- d. Architect's approved equivalent.

## 2.6 SETTING AND GROUTING MATERIALS

A. Manufacturers:

1. Bonsal, W. R., Company.
2. LATICRETE International Inc.
3. MAPEI Corporation.
4. Southern Grouts & Mortars, Inc.

B. Portland Cement Mortar (Thickset) Installation Materials: ANSI A108.1A and as specified below:

1. Cleavage Membrane: Asphalt felt, ASTM D 226, Type I (No. 15); or polyethylene sheeting, ASTM D 4397, 4.0 mils thick.
2. Reinforcing Wire Fabric: Galvanized, welded wire fabric, 2 by 2 inches by 0.062-inch diameter; comply with ASTM A 185 and ASTM A 82 except for minimum wire size.
3. Latex Additive: Manufacturer's standard styrene-butadiene-rubber water emulsion, serving as replacement for part or all of gaging water, of type specifically recommended by latex-additive manufacturer for use with field-mixed portland cement and aggregate mortar bed.

C. Dry-Set Portland Cement Mortar (Thin Set): ANSI A118.1.

1. For wall applications, provide nonsagging mortar that complies with Paragraph C-4.6.1 in addition to the other requirements in ANSI A118.1.

D. Latex-Portland Cement Mortar (Thin Set): ANSI A118.4, consisting of the following:

1. Prepackaged dry-mortar mix combined with styrene-butadiene-rubber liquid-latex additive.

- a. For wall applications, provide nonsagging mortar that complies with Paragraph F-4.6.1 in addition to the other requirements in ANSI A118.4.
- E. Standard Unsanded Cement Grout: ANSI A118.6, color as indicated.
- F. Polymer-Modified Tile Grout: ANSI A118.7, color as indicated.
  - 1. Polymer Type: Styrene-Butadiene rubber in liquid-latex form for addition to prepackaged dry grout mix.
    - a. Unsanded grout mixture for joints 1/8 inch and narrower.
    - b. Sanded grout mixture for joints 1/8 inch and wider.

## 2.7 MISCELLANEOUS MATERIALS

- A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.
- 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.

## 2.8 MIXING MORTARS AND GROUT

- A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.
- B. Add materials, water, and additives in accurate proportions.
- C. 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.

Refer to "Ceramic and Glass Tile Code Schedule" and "Stone Code Schedule" in Drawings for installations where grout is required to be an epoxy mix.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of installed tile.
  - 1. Verify that substrates for setting tile are firm; dry; clean; free of oil, waxy films, and curing compounds; and within flatness tolerances required by referenced ANSI A108 Series of tile installation standards for installations indicated.

- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Remove coatings, including curing compounds and other substances that contain soap, wax, oil, or silicone, that are incompatible with tile-setting materials.
- B. Provide concrete substrates for tile floors installed with thin-set mortar that comply with flatness tolerances specified in referenced ANSI A108 Series of tile installation standards.
  - 1. Fill cracks, holes, and depressions with trowelable leveling and patching compound according to tile-setting material manufacturer's written instructions. Use product specifically recommended by tile-setting material manufacturer.
  - 2. Remove protrusions, bumps, and ridges by sanding or grinding.
- C. Blending: For tile exhibiting color variations within ranges selected during Sample submittals, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

### 3.3 INSTALLATION, GENERAL

- A. ANSI Tile Installation Standards: Comply with parts of ANSI A108 Series "Specifications for Installation of Ceramic Tile" that apply to types of setting and grouting materials and to methods indicated in ceramic tile installation schedules.
- B. TCA Installation Guidelines: TCA's "Handbook for Ceramic Tile Installation." Comply with TCA installation methods indicated in ceramic tile installation schedules.
- C. 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.
- D. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.
- E. 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. 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.
- F. Lay out tile wainscots to next full tile beyond dimensions indicated.
- G. Grout tile to comply with requirements of the following tile installation standards:

1. For ceramic tile grouts (sand-portland cement; dry-set, commercial portland cement; and latex-portland cement grouts), comply with ANSI A108.10.

### 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.
- B. Do not install tile over waterproofing until waterproofing has cured and been tested to determine that it is watertight.

### 3.5 FLOOR TILE INSTALLATION

- A. General: Install tile to comply with requirements in the Floor Tile Installation Schedule, including those referencing TCA installation methods and ANSI A108 Series of tile installation standards.
  1. For installations indicated below, follow procedures in ANSI A108 Series tile installation standards for providing 95 percent mortar coverage.
    - a. Tile floors in wet areas.
- B. Joint Widths: Install tile on floors with the following joint widths:
  1. Ceramic and Porcelain Mosaic Tile: 1/16 inch.

### 3.6 WALL TILE INSTALLATION

- A. Install types of tile designated for wall installations to comply with requirements in the Wall Tile Installation Schedule, including those referencing TCA installation methods and ANSI setting-bed standards.
- B. Joint Widths: Install tile on walls with the following joint widths:
  1. Glazed Wall Tile: 1/16 inch.

### 3.7 CLEANING AND PROTECTING

- A. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.
  1. Remove latex-portland cement 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. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.
- C. Before final inspection, remove protective coverings and rinse neutral cleaner from tile surfaces.

### 3.8 FLOOR TILE INSTALLATION SCHEDULE

- A. Tile Installation: Interior floor installation on concrete; thin-set mortar; TCA F113 and ANSI A108.5.
  - 1. Tile Type: As indicated in Drawings.
  - 2. Thin-Set Mortar: Dry-set or latex- portland cement mortar.
  - 3. Grout: Standard unsanded cement or polymer-modified unsanded grout.
- B. Tile Installation: Interior floor installation on waterproof membrane over concrete; cement mortar bed (thickset); TCA F121 and ANSI A108.1B.
  - 1. Tile Type: As indicated in Drawings.
  - 2. Thin-Set Mortar: Dry-set or latex- portland cement mortar.
  - 3. Grout: Standard unsanded cement or polymer-modified unsanded grout.
- C. Tile Installation: Interior floor installation on waterproof membrane over concrete; thin-set mortar; TCA F122 and ANSI A108.5.
  - 1. Tile Type: As indicated in Drawings.
  - 2. Thin-Set Mortar: Dry-set or latex-portland cement mortar.
  - 3. Grout: Standard unsanded cement or polymer-modified unsanded grout.

### 3.9 WALL TILE INSTALLATION SCHEDULE

- A. Tile Installation: Interior wall installation over gypsum board; thin-set mortar; TCA W243 and ANSI A108.5.
  - 1. Tile Type: Glazed wall tile.
  - 2. Thin-Set Mortar: Dry-set or latex- portland cement mortar.
  - 3. Grout: Standard unsanded cement or polymer-modified unsanded grout.

END OF SECTION 09310

## SECTION 09511 - ACOUSTICAL PANEL CEILINGS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Acoustical panels and exposed suspension systems for ceilings.
  - 2. Perimeter trim channels.
  - 3. Bracing and connections for earthquake loads.

#### 1.3 PERFORMANCE REQUIREMENTS

- A. Earthquake Loads: Comply with applicable requirements of Section 1610 and Section 1626 through Section 1635 of the Uniform Building Code.

#### 1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For each component indicated and for each exposed finish required.
  - 1. Acoustical Panel: Set of 12-inch- square samples of each type, color, pattern, and texture.
  - 2. Exposed Suspension System Members, Moldings, and Trim: Set of 12-inch- long samples of each type, finish, and color.

#### 1.5 QUALITY ASSURANCE

- A. Source Limitations:
  - 1. Acoustical Ceiling Panel: Obtain each type through one source from a single manufacturer.
  - 2. Suspension System: Obtain each type through one source from a single manufacturer.
- B. Fire-Test-Response Characteristics: Provide acoustical panel ceilings that comply with the following requirements:

1. Surface-Burning Characteristics: Provide acoustical panels with the following surface-burning characteristics complying with ASTM E 1264 for Class A materials as determined by testing identical products per ASTM E 84:
  - a. Smoke-Developed Index: 450 or less.
- C. Seismic Standard: Provide acoustical panel ceilings designed and installed to withstand the effects of earthquake motions according to the following:
  1. UBC Standard 25-2, "Metal Suspension Systems for Acoustical Tile and for Lay-in Panel Ceilings."
- D. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver acoustical panels, suspension system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.
- B. Before installing acoustical panels, permit them to reach room temperature and stabilized moisture content.
- C. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.

#### 1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

#### 1.8 COORDINATION

- A. Coordinate layout and installation of acoustical panels and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. United States Gypsum, Co.; Clima Plus.
2. Interior Designer approved equivalent.

## 2.2 ACOUSTICAL PANELS

- A. Acoustical Panel Size and Color: 24" x 24" White.

Basis-of-Design Product: 86200 Square Edge, United States Gypsum, Co.; Clima Plus.

## 2.3 METAL SUSPENSION SYSTEMS, GENERAL

- A. Metal Suspension System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635.
- B. Finishes and Colors, General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Provide manufacturer's standard factory-applied finish for type of system indicated.
- C. Attachment Devices: Size for five times the design load indicated in ASTM C 635, Table 1, "Direct Hung," unless otherwise indicated.
- D. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:
  1. Zinc-Coated Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
  2. Size: Select wire diameter so its stress at three times hanger design load (ASTM C 635, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.135-inch- diameter wire.
- E. Hanger Rods and Flat Hangers: Mild steel, zinc coated or protected with rust-inhibitive paint.
- F. Angle Hangers: Angles with legs not less than 7/8 inch wide; formed with 0.04-inch- thick, galvanized steel sheet complying with ASTM A 653/A 653M, G90 coating designation; with bolted connections and 5/16-inch- diameter bolts.
- G. Seismic Struts: Manufacturer's standard compression struts designed to accommodate seismic forces.
- H. Seismic Clips: Manufacturer's standard seismic clips designed and spaced to secure acoustical panels in-place.

## 2.4 METAL SUSPENSION SYSTEM FOR ACOUSTICAL PANEL CEILING

- A. Wide-Face, Capped, Double-Web, Exposed Tee, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet, prepainted, electrolytically zinc coated, or hot-dip galvanized according to ASTM A 653/A 653M, not less than G30 coating designation, with prefinished 15/16-inch wide metal caps on flanges.



1. Structural Classification: Heavy-duty system.
2. End Condition of Cross Runners: Override (stepped) type.
3. Face Design: Flat, flush.
4. Cap Material: Steel Aluminum Steel or aluminum cold-rolled sheet.
5. Cap Finish: Painted white.

## 2.5 METAL EDGE MOLDINGS AND TRIM

- A. Roll-Formed Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that fit acoustical panel edge details and suspension systems indicated; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension system runners.
  1. For lay-in panels with reveal edge details, provide stepped edge molding that forms reveal of same depth and width as that formed between edge of panel and flange at exposed suspension member.

## 2.6 ACOUSTICAL SEALANT

- A. Products:
  1. Acoustical Sealant for Exposed and Concealed Joints:
    - a. Pecora Corp; AC-20 FTR Acoustical and Insulation Sealant.
    - b. United States Gypsum Co.; SHEETROCK Acoustical Sealant.
- B. Acoustical Sealant for Exposed and Concealed Joints: Manufacturer's standard nonsag, paintable, nonstaining latex sealant, with a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24), complying with ASTM C 834 and effective in reducing airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans.

### 3.3 INSTALLATION, GENERAL

- A. General: Install acoustical panel ceilings to comply with UBC Standard 25-2 and seismic requirements indicated, per manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."
- B. Suspend ceiling hangers from building's structural members and as follows:
  - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
  - 2. Splay hangers where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
  - 3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
  - 4. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
  - 5. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both structure to which hangers are attached and type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
  - 6. Attach hangers to structural members.
  - 7. Space hangers not more than 48 inches o.c. along each member supported directly from hangers, unless otherwise indicated; provide hangers not more than 8 inches from ends of each member.
- C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.
- D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.
  - 1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.

2. Screw attach moldings to substrate at intervals not more than 16 inches o.c. and not more than 3 inches from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet. Miter corners accurately and connect securely.
  3. Do not use exposed fasteners, including pop rivets, on moldings and trim.
- E. Install perimeter trim channels according to manufacturer's written instructions.
- F. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- G. Install acoustical panels with undamaged edges and fit accurately into suspension system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.
1. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension system runners and moldings.
  2. For reveal-edged panels on suspension system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
  3. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.
  4. Install hold-down clips in areas indicated, in areas required by authorities having jurisdiction, and for fire-resistance ratings; space as recommended by panel manufacturer's written instructions, unless otherwise indicated.

### 3.4 CLEANING

- A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 09511

## SECTION 09624 – MODULAR ATHLETIC FLOORING

### PART 1 - GENERAL

#### 1.1 DESCRIPTION

##### A. Scope

1. The complete installation of modular sports surfacing system including the interlocking suspended high-impact polypropylene copolymer tile of proprietary formulation and striping.

#### 1.2 REFERENCES

##### A. ASTM (American Society for Testing and Materials)

ASTM C1028

ASTM D256

ASTM D638

ASTM D648

ASTM D696

ASTM D785

ASTM D1929

ASTM E1745

ASTM G-21

#### 1.3 SUBMITTALS

- A. One sample of specified system, if requested by Architect.
- B. Manufacturer's Installation Instructions and Maintenance Guide.

#### 1.4 QUALITY ASSURANCE

- A. Material Supplier: Shall be Sport Court, Inc.
  1. No Substitutions Allowed.
- B. Manufacturer: Must be ISO 9001:2008 Certified to assure proper quality control.

- C. Installer: The complete installation of the modular sports surfacing system, as described in these specifications, shall be carried out by an experienced Flooring Contractor and the work shall be performed in accordance with current installation instructions of Sport Court.
  - 1. Installer shall be liable for all matters related to installation for a period of one year after the floor has been substantially installed and completed.
  - 2. Successful bidder must submit a minimum of 5 completed modular projects of similar magnitude and complexity within the last 2 years.

#### 1.5 DELIVERY, STORAGE AND HANDLING

- A. Materials must be delivered in Sport Court's original, unopened and undamaged packaging with identification labels intact.
- B. Store material protected from exposure to harmful weather conditions, on a clean, dry, flat surface protected from possible damage.

#### 1.6 SITE CONDITIONS

- A. In order to prevent damage and not void the warranty, installation of modular materials shall not commence until all other finishes and trades have completed their work in the modular floor areas.
- B. Subsurface shall be clean, dry, free from dirt, dust, oil, grease, or other foreign materials.
- C. Sports surfacing installation shall not begin until levelness of the concrete subsurface has been met. The installation area shall be closed to all traffic and activity for a period to be set by the Flooring Contractor.
- D. After modular sports surfaces are installed and the game lines painted, the area is to be closed to allow curing time for the system, typically 3-5 days. No other trades or personnel are allowed on the floor until it has been accepted by the Owner's Representative.

#### 1.7 WARRANTY

- A. Sport Court warrants that the materials it has supplied will be free from manufacturing defects for a period of 10 years. The foregoing warranty is in lieu of and excludes all other warranties not expressly set forth herein, whether expressed or implied in operation of law or otherwise, including, but not limited to, any implied warranties of merchantability or fitness. This warranty is expressly limited to the flooring materials (goods) supplied by Sport Court. This warranty does not cover floor damage caused (wholly or in part) by fire, winds, floods, moisture, other unfavorable atmospheric conditions or chemical action, nor does it apply to damage caused by ordinary wear, misuse, abuse, negligent or intentional misconduct, aging, faulty building construction, concrete slab separation, faulty or unsuitable subsurface or site preparation, settlement of the building walls or faulty or unprofessional installation of Sport Court flooring systems.
- B. Sport Court shall not be liable for incidental or consequential losses, damages, or expenses directly or indirectly arising from the sale, handling or use of the materials (goods) or from any

other cause relating thereto, and their liability hereunder in any case is expressly limited to the replacement of materials (goods) not complying with this agreement or, at their election, to the repayment of, or crediting buyer with, an amount equal to the purchase price of such materials (goods), whether such claims are for breach of warranty or negligence. Any claim shall be deemed waived by buyer unless submitted to Sport Court in writing within 30 days from the date buyer discovered, or should have discovered, any claimed breach.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Sport Court PowerGame Suspended Flooring – Imperial, grid top design shall be, high impact polypropylene, copolymer suspended modules with 907 support leg structure as supplied by Sport Court. The tile shall have a patented positive locking system.
- B. Size: 12” x 12” x 5/8”
- C. Weight: 0.70 lbs.
- D. Sanitary Information
  - 1. Resistance to the following:
    - a. Surface fungi growth prior to and following leaching
    - b. Bacteria and mildew
- E. Game Line Paint
  - 1. Primer – proprietary tile primer as supplied by Sport Court.  
Paint – aliphatic polyurethane as supplied by Sport Court. Select from standard colors, as indicated by Architect.

## PART 3 - EXECUTION

### 3.1 INSPECTION

- A. Inspect concrete slab for contamination, dryness and levelness. Report any discrepancies to the General Contractor.
- B. Concrete slab shall be broom cleaned, mopped and dust free by the General Contractor.
- C. Flooring Contractor shall document all working conditions prior to starting installation. Report any discrepancies to the General Contractor.

### 3.2 INSTALLATION

- A. Floor will be installed to pre-approved layout.
- B. Proper expansion must be at all vertical obstructions, as indicated on Drawings.

- C. Floor surface shall be clean and dust free.
- D. Game Lines
  - 1. Use only high-quality masking tape approved by Sport Court.
  - 2. Lines shall be primed and painted using Sport Court proprietary primer and recommended aliphatic polyurethane paint.
  - 3. Provide game lines as indicated on Drawings.
- E. Remove all excess and waste materials from the area of work. Dispose of empty containers in accordance with federal and local statutes.

END OF SECTION 09624

## SECTION 09652 - RESILIENT SHEET FLOORING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes:
  - 1. Rubber sheet floor coverings.
- B. Related Sections include the following:
  - 1. Division 9 Section "Resilient Wall Base and Accessories" for resilient wall base, reducer strips, and other accessories installed with resilient sheet floor coverings.

#### 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Initial Selection: For each type of floor covering indicated.
- C. Samples for Verification: In manufacturer's standard size, but not less than 6-by-9-inch sections of each different color and pattern of floor covering required.
  - 1. For heat-welding bead, manufacturer's standard-size Samples, but not less than 9 inches long, of each color required.
- D. Seam Samples: For seamless-installation technique indicated and for each floor covering product, color, and pattern required; with seam running lengthwise and in center of 6-by-9-inch Sample applied to a rigid backing and prepared by Installer for this Project.
- E. Maintenance Data: For floor coverings to include in maintenance manuals.

#### 1.4 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs workers for this Project that are competent in heat-welding techniques required by manufacturer for floor covering installation.
- B. Fire-Test-Response Characteristics: Provide products identical to those tested for fire-exposure behavior per test method indicated by a testing and inspecting agency acceptable to Authorities Having Jurisdiction.



- C. Mockups: Build mockups for rubber sheet flooring to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
  - 1. Build mockups for floor coverings including accessories.
    - a. Size: Minimum 100 sq. ft. for each type, color and pattern in locations directed by Architect.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- Store floor coverings and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F. Store rolls upright.

#### 1.6 PROJECT CONDITIONS

- A. Maintain temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 85 deg F, in spaces to receive floor tile during the following time periods:
  - 1. 48 hours before installation.
  - 2. During installation.
  - 3. 48 hours after installation.
- B. Close spaces to traffic during floor covering installation.
- C. Close spaces to traffic for 48 hours after floor covering installation.
- D. Install floor coverings after other finishing operations, including painting, have been completed.

### PART 2 - PRODUCTS

#### 2.1 RUBBER SHEET FLOOR COVERING

- A. Products: Subject to compliance with requirements, provide the following:
  - 1. Nora Rubber Flooring: Noraplan Environcare.
- B. Unbacked Rubber Sheet Floor Covering: ASTM F 1859.
  - 1. Type: Type I (homogeneous rubber sheet).
  - 2. Thickness: 2 mm and 3 mm, as indicated on Drawings.
- C. Hardness: Manufacturer's standard hardness, measured using Shore, Type A durometer per ASTM D 2240.
- D. Wearing Surface: Smooth.

- E. Sheet Width: As standard with manufacturer.
- F. Seaming Method: Heat welded.
- G. Colors and Patterns: As indicated on Drawings.

## 2.2 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, Portland cement based or blended hydraulic cement based formulation provided or approved by floor covering manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by manufacturer to suit resilient sheet floor covering and substrate conditions indicated.
- C. Heat-Welding Bead: Solid-strand product of floor covering manufacturer.
  - 1. Color: Match floor covering.
- D. Integral-Flash-Cove-Base Accessories:
  - 1. Cove Strip: 1-1/4-inch radius provided or approved by floor covering manufacturer.
    - a. Basis-of-Design by Johnsonite Inc.
  - 2. Cove Cap Strip: Rounded top unit.
    - a. Basis-of-Design by Johnsonite, Inc.

## 2.3 FABRICATION

- A. Cutting of Rubber Sheet Flooring:
  - 1. Engage a firm experienced in cutting rubber flooring with a computer controlled high-pressure water jet. A qualified firm is:
    - a. Waterjet Works!  
11305 Indian Trail  
Dallas, TX 75229  
Tel: 800 856-0972  
[www.waterjetworks.com](http://www.waterjetworks.com)

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances, moisture content, and other conditions affecting performance.

1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of floor coverings.
2. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Prepare substrates according to manufacturer's written recommendations to ensure adhesion of floor coverings.
- B. Concrete Substrates: Prepare according to ASTM F 710.
  1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
  2. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
  3. Moisture Testing:
    - a. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
    - b. Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
- C. Remove substrate coatings and other substances that are incompatible with floor covering adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
- D. Use trowelable leveling and patching compound to fill cracks, holes, and depressions in substrates.
- E. Move floor coverings and installation materials into spaces where they will be installed at least 48 hours in advance of installation.
  1. Do not install floor coverings until they are same temperature as space where they are to be installed.
- F. Sweep and vacuum clean substrates to be covered by floor coverings immediately before installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, and dust. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.3 INSTALLATION

- A. Unroll resilient sheet floor coverings and allow them to stabilize before cutting and fitting.
- B. Lay out resilient sheet floor coverings as follows:
  1. Maintain uniformity of floor covering direction.
  2. Minimize number of seams; place seams in inconspicuous and low-traffic areas, at least 6 inches away from parallel joints in floor covering substrates.
  3. Match edges of floor coverings for color shading at seams.

- 4. Avoid cross seams.
- C. Scribe and cut floor coverings to butt neatly and tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings.
- D. Extend floor coverings into toe spaces, door reveals, closets, and similar openings.
- E. Adhere floor coverings to substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.
- F. Heat-Welded Seams: Comply with ASTM F 1516. Rout joints and use welding bead to permanently fuse sections into a seamless floor covering. Prepare, weld, and finish seams to produce surfaces flush with adjoining floor covering surfaces.
- G. Integral Flash Cove Base: Cove floor coverings 6 inches up vertical surfaces, unless otherwise indicated. Support floor coverings at horizontal and vertical junction by cove strip. Butt at top against cap strip.

### 3.4 CLEANING AND PROTECTION

- A. Perform the following operations immediately after completing floor covering installation:
  - 1. Remove adhesive and other blemishes from floor covering surfaces.
  - 2. Sweep and vacuum floor coverings thoroughly.
  - 3. Damp-mop floor coverings to remove marks and soil.
    - a. Do not wash floor coverings until after time period recommended by manufacturer.
- B. Protect floor coverings from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period. Use protection methods recommended in writing by manufacturer.

END OF SECTION 09652



## SECTION 09653 - RESILIENT WALL BASE AND ACCESSORIES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Wall base.
  - 2. Molding accessories.
- B. Related Sections include the following:
  - 1. Division 9 Section "Resilient Sheet Flooring."
  - 2. Division 9 Section "Carpet."

#### 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Verification: For each type of product indicated, in manufacturer's standard-size Samples but not less than 12 inches long, of each resilient product color, texture, and pattern required.

#### 1.4 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: Provide resilient accessories with a critical radiant flux classification of Class I, not less than 0.45 W/sq. cm, as determined by testing identical products per ASTM E 648 by a testing and inspecting agency acceptable to Authorities Having Jurisdiction.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F.

#### 1.6 PROJECT CONDITIONS

- A. Maintain temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive floor tile during the following time periods:
  - 1. 48 hours before installation.
  - 2. During installation.
  - 3. 48 hours after installation.
- B. Install resilient products after other finishing operations, including painting, have been completed.

## PART 2 - PRODUCTS (Refer to "Base Code Schedule" in Drawings.)

### 2.1 COLORS

- A. Colors: As selected by Interior Designer.

### 2.2 RESILIENT WALL BASE

- A. Wall Base: ASTM F 1861 and as indicated on the Drawings.
- B. Outside Corners: Pre-formed.
- C. Inside Corners: Pre-formed.
- D. Surface: Smooth.

### 2.3 RESILIENT MOLDING ACCESSORY

- A. Description: Reducer for resilient flooring and carpet.
- B. Material: Vinyl.
- C. Profile and Dimensions: As indicated on the Drawings.

### 2.4 INSTALLATION MATERIALS

- A. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances, moisture content, and other conditions affecting performance.

1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.
2. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Prepare substrates according to manufacturer's written recommendations to ensure adhesion of resilient products.
- B. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.
  1. Do not install resilient products until they are the same temperature as the space where they are to be installed.

### 3.3 RESILIENT WALL BASE INSTALLATION

- A. Apply wall base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- B. Install wall base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.
- C. Tightly adhere wall base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- D. Do not stretch wall base during installation.
- E. Premolded Corners: Install premolded corners before installing straight pieces.

### 3.4 RESILIENT ACCESSORY INSTALLATION

- A. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor coverings that would otherwise be exposed.

### 3.5 CLEANING AND PROTECTION

- A. Perform the following operations immediately after completing resilient product installation:
  1. Remove adhesive and other blemishes from exposed surfaces.

END OF SECTION 09653





## SECTION 09680 - CARPET

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes the following:
  - 1. Direct glue-down broadloom carpet.
- B. Related Sections include the following:
  - 1. Division 9 Section "Resilient Wall Base and Accessories" for resilient wall base and accessories installed with carpet.

#### 1.2 SUBMITTALS

- A. Samples for Verification: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.
  - 1. Carpet: 24-inch-square Sample.
- B. Maintenance Data: For carpet. Include the following:
  - 1. Methods for maintaining carpet, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
  - 2. Precautions for cleaning materials and methods that could be detrimental to carpet.
- C. Warranties: Special warranties specified in this Section.

#### 1.3 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who is certified by the Floor Covering Installation Board or who can demonstrate compliance with its certification program requirements.
- B. Fire-Test-Response Characteristics: Provide products with the critical radiant flux classification indicated in Part 2, as determined by testing identical products per ASTM E 648 by an independent testing and inspecting agency acceptable to Authorities Having Jurisdiction.
- C. Preinstallation Conference: Conduct conference at Project site.

#### 1.4 DELIVERY, STORAGE, AND HANDLING

- A. Comply with CRI 104, Section 5, "Storage and Handling."

## 1.5 PROJECT CONDITIONS

- A. Comply with CRI 104, Section 7.2, "Site Conditions; Temperature and Humidity" and Section 7.12, "Ventilation."
- B. Environmental Limitations: Do not install carpet until wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- C. Do not install carpet over concrete slabs until slabs have cured, are sufficiently dry to bond with adhesive, and have pH range recommended by carpet manufacturer.
- D. Where demountable partitions or other items are indicated for installation on top of carpet, install carpet before installing these items.

## 1.6 WARRANTY

- A. Special Warranty for Carpet: Manufacturer's standard form in which manufacturer agrees to repair or replace components of carpet installation that fail in materials or workmanship within specified warranty period.
  - 1. Warranty does not include deterioration or failure of carpet due to unusual traffic, failure of substrate, vandalism, or abuse.
  - 2. Failures include, but are not limited to, more than 10 percent loss of face fiber, edge raveling, snags, runs, loss of tuft bind strength, excess static discharge, and delamination.
  - 3. Warranty Period: 5 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MULTI-LEVEL PATTERN LOOP

- A. Basis-of-Design:
  - 1. Shaw, Haven Tile, Pine 49300, Nylon, Ecoworx Backing, Class 1
  - 2. Shaw, Haven Tile, Punch 49705, Nylon, Ecoworx Backing, Class 1
  - 3. Shaw, Haven Tile, Chesnut 49770, Nylon, Ecoworx Backing, Class 1
  - 4. Interior Designer's approved equal.
- B. Width: 24 inches.
- C. Performance Characteristics: As follows:
  - 1. Critical Radiant Flux Classification: Not less than 0.45 W/sq. cm.
  - 2. Electrostatic Propensity: Less than 3.5 kV per AATCC 134.

### 2.2 INSTALLATION ACCESSORIES

- A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet manufacturer.

- B. Adhesives: Water-resistant, mildew-resistant, nonstaining type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet and is recommended or provided by carpet manufacturer.
- C. Seam Adhesive: Hot-melt adhesive tape or similar product recommended by carpet manufacturer for sealing and taping seams and butting cut edges at backing to form secure seams and to prevent pile loss at seams.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet performance. Examine carpet for type, color, pattern, and potential defects.
- B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710 and the following:
  - 1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by carpet manufacturer.
  - 2. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. General: Comply with CRI 104, Section 7.3, "Site Conditions; Floor Preparation," and with carpet manufacturer's written installation instructions for preparing substrates.
- B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch wide or wider, and protrusions more than 1/32 inch, unless more stringent requirements are required by manufacturer's written instructions.
- C. Broom and vacuum clean substrates to be covered immediately before installing carpet.

### 3.3 INSTALLATION

- A. Comply with CRI 104 and carpet manufacturer's written installation instructions for the following:
  - 1. Direct-Glue-Down Installation: Comply with CRI 104, Section 9, "Direct Glue-Down Installation."

- B. Comply with carpet manufacturer's written recommendations for seam locations and direction of carpet; maintain uniformity of carpet direction and lay of pile. At doorways, center seams under the door in closed position.
- C. Cut and fit carpet to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet manufacturer.
- D. Extend carpet into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
- E. Install pattern parallel to walls and borders to comply with CRI 104, Section 15, "Patterned Carpet Installations" and with carpet manufacturer's written recommendations.

#### 3.4 CLEANING AND PROTECTING

- A. Perform the following operations immediately after installing carpet:
  - 1. Remove excess adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet manufacturer.
  - 2. Remove yarns that protrude from carpet surface.
  - 3. Vacuum carpet using commercial machine with face-beater element.
- B. Protect installed carpet to comply with CRI 104, Section 16, "Protection of Indoor Installations."
- C. Protect carpet against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet manufacturer.

END OF SECTION 09680

## SECTION 09911 - PAINTING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes surface preparation and the application of paint systems on several substrates, as indicated on Drawings.
- B. Related Sections include the following:
  - 1. Division 5 Sections for shop priming of metal substrates with primers specified in this Section.

#### 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Initial Selection: For each type of topcoat product indicated.
- C. Samples for Verification: For each type of paint system and each color and gloss of topcoat indicated.
  - 1. Submit Samples on rigid backing, 8 inches square.
  - 2. Step coats on Samples to show each coat required for system.
  - 3. Label each coat of each Sample.
  - 4. Label each Sample for location and application area.
- D. Product List: For each product indicated, include the following:
  - 1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
  - 2. Printout of current "MPI Approved Products List" for each product category specified in Part 2, with the proposed product highlighted.

#### 1.4 QUALITY ASSURANCE

- A. MPI Standards:
  - 1. Products: Complying with MPI standards indicated and listed in "MPI Approved Products List."

2. Preparation and Workmanship: Comply with requirements in "MPI Architectural Painting Specification Manual" for products and paint systems indicated.
- B. Mockups: Apply benchmark samples of each paint system indicated and each color and finish selected to verify preliminary selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
1. Architect will select one surface to represent surfaces and conditions for application of each paint system specified in Part 3.
    - a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft.
    - b. Other Items: Architect will designate items or areas required.
  2. Final approval of color selections will be based on benchmark samples.
    - a. If preliminary color selections are not approved, apply additional benchmark samples of additional colors selected by Architect at no added cost to Owner.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures maintained constant.
1. Maintain containers in clean condition, free of foreign materials and residue.
  2. Remove rags and waste from storage areas daily.

#### 1.6 PROJECT CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.
- B. Do not apply paints in rain, fog, or mist; or to damp or wet surfaces.

### PART 2 - PRODUCTS (Refer to "Paint Code Schedule" on Drawings.)

#### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. ICI Paints (ICI).
  2. PPG Architectural Finishes, Inc. (PPG)
  3. The Sherwin-Williams Company (S-W).

#### 2.2 PAINT, GENERAL

- A. Material Compatibility:

1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

B. Colors: As selected by Interior Designer.

### 2.3 METAL PRIMERS

A. Waterborne Galvanized-Metal Primer: MPI #134.

1. ICI: Devoe Devflex WB DTM Primer Finish, 4020.
2. PPG: Pitt-Tech DTM High Performance Primer/Finish, 90-712.
3. S-W: Industrial & Marine DTM Acrylic Primer/Finish, B66W1.

### 2.4 QUICK-DRYING ENAMELS

A. Quick-Drying Enamel (Semigloss): MPI #81 (Gloss Level 5).

1. ICI: Devoe Devgard 4336.
2. PPG: High Performance Industrial Semi-Gloss Oil, 7-844.
3. S-W: Industrial & Marine Industrial Enamel, B54W Series.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.
- B. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- C. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.
  1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

### 3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.



- B. Remove plates, machined surfaces, and similar items already in place that are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
  - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
  - 2. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
- C. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulants.
  - 1. Remove incompatible primers and reprime substrate with compatible primers as required to produce paint systems indicated.
- D. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.
- E. Plaster Substrates: Do not begin paint application until plaster is fully cured and dry.

### 3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions.
  - 1. Use applicators and techniques suited for paint and substrate indicated.
  - 2. Paint surfaces behind movable items same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed items with prime coat only.
- B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

### 3.4 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

### 3.5 EXTERIOR PAINTING SCHEDULE

- A. Galvanized-Metal Substrates:
  - 1. Latex Over Water-Based Primer System: MPI EXT 5.3H.
    - a. Prime Coat: Waterborne galvanized-metal primer.
    - b. Intermediate Coat: Alkyd enamel matching topcoat.
    - c. Topcoat: Alkyd enamel (semigloss).

END OF SECTION 09911



SECTION 09912 – MECHANICAL SYSTEMS PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes surface preparation and field painting of exposed exterior and interior items and surfaces.

- 1. Surface preparation, priming, and finish coats specified in this Section are in addition to shop priming and surface treatment specified in other Sections.

- B. Paint exposed surfaces, except where these Specifications indicate that the surface or material is not to be painted or is to remain natural. If an item or a surface is not specifically mentioned, paint the item or surface the same as similar adjacent materials or surfaces. If a color of finish is not indicated, A/E will select from standard colors and finishes available.

- 1. Painting includes field painting of exposed bare and covered pipes and ducts (including color coding), hangers, exposed steel and iron supports, and surfaces of mechanical and electrical equipment that do not have a factory-applied final finish.

- C. Do not paint prefinished items, concealed surfaces, finished metal surfaces, operating parts, and labels.

- 1. Prefinished items include the following factory-finished components:

- a. Finished mechanical and electrical equipment.

- 2. Concealed surfaces include walls or ceilings in the following generally inaccessible spaces:

- a. Foundation spaces.
    - b. Furred areas.
    - c. Ceiling plenums.
    - d. Utility tunnels.
    - e. Pipe spaces.
    - f. Duct shafts.
    - g. Elevator shafts.

- 3. Finished metal surfaces include the following:

- a. Anodized aluminum.

- b. Stainless steel.
  - c. Chromium plate.
  - d. Copper and copper alloys.
  - e. Bronze and brass.
4. Operating parts include moving parts of operating equipment and the following:
- a. Valve and damper operators.
  - b. Linkages.
  - c. Sensing devices.
  - d. Motor and fan shafts.
5. Labels: Do not paint over UL, FMG, or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.

### 1.3 DEFINITIONS

- A. General: Standard coating terms defined in ASTM D 16 apply to this Section.
- 1. Flat refers to a lusterless or matte finish with a gloss range below 15 when measured at an 85-degree meter.
  - 2. Eggshell refers to low-sheen finish with a gloss range between 20 and 35 when measured at a 60-degree meter.
  - 3. Semigloss refers to medium-sheen finish with a gloss range between 35 and 70 when measured at a 60-degree meter.
  - 4. Full gloss refers to high-sheen finish with a gloss range more than 70 when measured at a 60-degree meter.

### 1.4 SUBMITTALS

- A. Product Data: For each paint system indicated. Include primers.
- 1. Material List: An inclusive list of required coating materials. Indicate each material and cross-reference specific coating, finish system, and application. Identify each material by manufacturer's catalog number and general classification.
  - 2. Manufacturer's Information: Manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each coating material.
- B. Samples for Initial Selection: For each type of finish-coat material indicated.
- 1. After color selection, A/E will furnish color chips for surfaces to be coated.

### 1.5 QUALITY ASSURANCE

- A. Applicator Qualifications: A firm or individual experienced in applying paints and coatings similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label and the following information:
  - 1. Product name or title of material.
  - 2. Product description (generic classification or binder type).
  - 3. Manufacturer's stock number and date of manufacture.
  - 4. Contents by volume, for pigment and vehicle constituents.
  - 5. Thinning instructions.
  - 6. Application instructions.
  - 7. Color name and number.
  - 8. VOC content.
- B. Store materials not in use in tightly covered containers in a well-ventilated area. Maintain storage containers in a clean condition, free of foreign materials and residue.

1.7 PROJECT CONDITIONS

- A. Do not apply paint in rain or when relative humidity exceeds 85 percent; or at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.
  - 1. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by manufacturer during application and drying periods.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide one of the products listed in other Part 2 articles.
- B. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:
  - 1. Benjamin Moore & Co. (Benjamin Moore).
  - 2. Coronado Paint Company (Coronado).
  - 3. ICI Dulux Paint Centers (ICI Dulux Paints).
  - 4. Kelly-Moore Paint Co. (Kelly-Moore).
  - 5. M. A. Bruder & Sons, Inc. (M. A. B. Paint).
  - 6. PPG Industries, Inc. (Pittsburgh Paints).
  - 7. Sherwin-Williams Co. (Sherwin-Williams).

## 2.2 PAINT MATERIALS, GENERAL

- A. Material Compatibility: Provide primers, and finish-coat materials that are compatible with one another and with the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
- B. Material Quality: Provide manufacturer's best-quality paint material of the various coating types specified that are factory formulated and recommended by manufacturer for application indicated. Paint-material containers not displaying manufacturer's product identification will not be acceptable.
  - 1. Proprietary Names: Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Furnish manufacturer's material data and certificates of performance for proposed substitutions.
- C. Chemical Components of Interior Paints and Coatings: Provide products that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24) and the following chemical restrictions:
  - 1. Flat Paints and Coatings: VOC content of not more than 50 g/L.
  - 2. Non-Flat Paints and Coatings: VOC content of not more than 150 g/L.
  - 3. Anticorrosive Coatings: VOC content of not more than 250 g/L.
  - 4. Aromatic Compounds: Paints and coatings shall not contain more than 1.0 percent by weight of total aromatic compounds (hydrocarbon compounds containing one or more benzene rings).
  - 5. Restricted Components: Paints and coatings shall not contain any of the following:
    - a. Acrolein.
    - b. Acrylonitrile.
    - c. Antimony.
    - d. Benzene.
    - e. Butyl benzyl phthalate.
    - f. Cadmium.
    - g. Di (2-ethylhexyl) phthalate.
    - h. Di-n-butyl phthalate.
    - i. Di-n-octyl phthalate.
    - j. 1,2-dichlorobenzene.
    - k. Diethyl phthalate.
    - l. Dimethyl phthalate.
    - m. Ethylbenzene.
    - n. Formaldehyde.
    - o. Hexavalent chromium.
    - p. Isophorone.
    - q. Lead.
    - r. Mercury.
    - s. Methyl ethyl ketone.
    - t. Methyl isobutyl ketone.
    - u. Methylene chloride.
    - v. Naphthalene.
    - w. Toluene (methylbenzene).

- x. 1,1,1-trichloroethane.
- y. Vinyl chloride.

D. Colors: Match A/E samples.

### 2.3 EXTERIOR PRIMERS

A. Exterior Ferrous-Metal Primer: Factory-formulated rust-inhibitive metal primer for exterior application.

1. Benjamin Moore; Moore's IMC Alkyd Metal Primer No. M06: Applied at a dry film thickness of not less than 2.0 mils (0.051 mm).
2. Coronado; 35-147 Rust Scat Alkyd Metal Primer: Applied at a dry film thickness of not less than 2.0 mils (0.051 mm).
3. ICI Dulux Paints; 4160-XXXX Devguard Multi-Purpose Tank & Structural Primer. Applied at a dry film thickness of not less than 2.0 mils (0.051 mm).
4. Kelly-Moore; 1711 Kel-Guard Alkyd White Rust Inhibitive Primer: Applied at a dry film thickness of not less than 2.0 mils (0.051 mm).
5. Kelly-Moore; 5725 DTM-Acrylic Metal Primer: Applied at a dry film thickness of not less than 1.8 mils (0.048 mm).
6. M. A. B. Paint; Rust-O-Lastic Anti-Corrosive Primer 073-132: Applied at a dry film thickness of not less than 2.0 mils (0.051 mm).
7. Pittsburgh Paints; 90-712 Pitt-Tech One Pack Interior/Exterior Primer Finish DTM Industrial Enamel: Applied at a dry film thickness of not less than 3.0 mils (0.076 mm).
8. Sherwin-Williams; Kem Kromik Universal Metal Primer B50NZ6/B50WZ1: Applied at a dry film thickness of not less than 3.0 mils (0.076 mm).

B. Exterior Galvanized Metal Primer: Factory-formulated galvanized metal primer for exterior application.

1. Benjamin Moore; Moore's IMC Acrylic Metal Primer No. M04: Applied at a dry film thickness of not less than 2.0 mils (0.051 mm).
2. Coronado; 36-11 Rust Scat Latex Metal Primer: Applied at a dry film thickness of not less than 1.4 mils (0.036 mm).
3. ICI Dulux Paints; 4020-XXXX Devflex DTM Flat Interior/Exterior Waterborne Primer & Finish: Applied at a dry film thickness of not less than 2.2 mils (0.056 mm).
4. ICI Dulux Paints; 4160-XXXX Devguard Multi-Purpose Tank & Structural Primer: Applied at a dry film thickness of not less than 2.0 mils (0.051 mm).
5. Kelly-Moore; 1722 Kel-Guard Acrylic Galvanized Iron Primer: Applied at a dry film thickness of not less than 1.8 mils (0.046 mm).
6. Kelly-Moore; 5725 DTM-Acrylic Metal Primer: Applied at a dry film thickness of not less than 1.8 mils (0.046 mm).
7. M. A. B. Paint; Rust-O-Lastic Hydro-Prime II Acrylic (DTM) Maintenance Primer 073-189: Applied at a dry film thickness of not less than 2.0 mils (0.051 mm).
8. Pittsburgh Paints; 90-709 Pitt-Tech One Pack Interior/Exterior Primer/Finish DTM Industrial Enamel: Applied at a dry film thickness of not less than 3.0 mils (0.076 mm).
9. Sherwin-Williams; primer not required over this substrate.
10. Sherwin-Williams; Galvite HS Paint B50WZ3: Applied at a dry film thickness of not less than 2.0 mils (0.051 mm).



- C. Exterior Aluminum Primer under Alkyd Finishes: Factory-formulated acrylic-based metal primer for exterior application.
1. Benjamin Moore; Moore's IMC Acrylic Metal Primer No. M04: Applied at a dry film thickness of not less than 2.0 mils (0.051 mm).
  2. Coronado; 180-11 High Performance Acrylic Metal Primer: Applied at a dry film thickness of not less than 2.0 mils (0.051 mm).
  3. ICI Dulux Paints; 4020-XXXX Devflex DTM Flat Interior/Exterior Waterborne Primer & Finish: Applied at a dry film thickness of not less than 2.2 mils (0.056 mm).
  4. Kelly-Moore; 1722 Kel-Guard Acrylic Galvanized Iron Primer: Applied at a dry film thickness of not less than 1.8 mils (0.046 mm).
  5. M. A. B. Paint; Rust-O-Lastic Hydro-Prime II Acrylic (DTM) Maintenance Primer 073-189: Applied at a dry film thickness of not less than 2.0 mils (0.051 mm).
  6. Pittsburgh Paints; 90-709 Pitt-Tech One Pack Interior/Exterior Primer/Finish DTM Industrial Enamel: Applied at a dry film thickness of not less than 3.0 mils (0.076 mm).
  7. Sherwin-Williams; DTM Wash Primer B71Y1: Applied at a dry film thickness of not less than 2.5 mils (0.064 mm).

#### 2.4 INTERIOR PRIMERS

- A. Interior Ferrous-Metal Primer: Factory-formulated quick-drying rust-inhibitive alkyd-based metal primer.
1. Benjamin Moore; Moore's IMC Alkyd Metal Primer No. M06: Applied at a dry film thickness of not less than 2.0 mils (0.051 mm).
  2. Coronado; 35-147 Rust Scat Alkyd Metal Primer: Applied at a dry film thickness of not less than 2.0 mils (0.051 mm).
  3. ICI Dulux Paints; 4130-6130 Devshield Rust Penetrating Metal Primer: Applied at a dry film thickness of not less than 2.2 mils (0.056 mm).
  4. ICI Dulux Paints; 4160-6130 Devguard Multi-Purpose Tank & Structural Primer: Applied at a dry film thickness of not less than 2.0 mils (0.051 mm).
  5. Kelly-Moore; 1711 Kel-Guard Alkyd White Rust Inhibitive Primer: Applied at a dry film thickness of not less than 2.0 mils (0.051 mm).
  6. M. A. B. Paint; Rust-O-Lastic Anti-Corrosive Primer 073-132: Applied at a dry film thickness of not less than 2.0 mils (0.051 mm).
  7. Pittsburgh Paints; 90-709 Pitt-Tech One Pack Interior/Exterior Primer/Finish DTM Industrial Enamel: Applied at a dry film thickness of not less than 1.5 mils (0.038 mm).
  8. Sherwin-Williams; Kem Kromik Universal Metal Primer B50NZ6/B50WZ1: Applied at a dry film thickness of not less than 3.0 mils (0.076 mm).
- B. Interior Zinc-Coated Metal Primer: Factory-formulated galvanized metal primer.
1. Benjamin Moore; Moore's IMC Acrylic Metal Primer No. M04: Applied at a dry film thickness of not less than 2.0 mils (0.051 mm).
  2. Coronado; 36-11 Rust Scat Acrylic Metal Primer: Applied at a dry film thickness of not less than 2.0 mils (0.051 mm).
  3. ICI Dulux Paints; 4160-6130 Devguard Multi-Purpose Tank & Structural Primer: Applied at a dry film thickness of not less than 2.0 mils (0.051 mm).

4. Kelly-Moore; 1722 Kel-Guard Acrylic Galvanized Iron Primer: Applied at a dry film thickness of not less than 1.8 mils (0.046 mm).
5. M. A. B. Paint; Rust-O-Lastic Hydro-Prime II Acrylic (DTM) Maintenance Primer 073-189: Applied at a dry film thickness of not less than 2.0 mils (0.051 mm).
6. Pittsburgh Paints; 90-709 Pitt-Tech One Pack Interior/Exterior Primer/Finish DTM Industrial Enamel: Applied at a dry film thickness of not less than 3.0 mils (0.076 mm).
7. Sherwin-Williams; primer not required over this substrate.
8. Sherwin-Williams; Galvite HS B50WZ30: Applied at a dry film thickness of not less than 3.0 mils (0.076 mm).

## 2.5 EXTERIOR FINISH COATS

- A. Exterior Flat Acrylic Paint: Factory-formulated flat acrylic-emulsion latex paint for exterior application.
  1. Benjamin Moore; Moorcraft Super Spec Flat Latex House Paint No. 171: Applied at a dry film thickness of not less than 1.2 mils (0.030 mm).
  2. Coronado; 8-Line Supreme Acrylic Latex Flat: Applied at a dry film thickness of not less than 1.3 mils (0.033 mm).
  3. ICI Dulux Paints; 2200-XXXX Dulux Professional Exterior 100 Percent Acrylic Flat Finish: Applied at a dry film thickness of not less than 1.4 mils (0.036 mm).
  4. Kelly-Moore; 1205 Color Shield Exterior Flat Acrylic House Paint: Applied at a dry film thickness of not less than 1.9 mils (0.048 mm).
  5. M. A. B. Paint; Fresh Kote Latex House Paint 409 Line: Applied at a dry film thickness of not less than 1.7 mils (0.043 mm).
  6. Pittsburgh Paints; 6-600 Series SpeedHide Exterior House Paint Flat Latex: Applied at a dry film thickness of not less than 1.3 mils (0.033 mm).
  7. Sherwin-Williams; A-100 Exterior Latex Flat House & Trim Paint A6 Series: Applied at a dry film thickness of not less than 1.3 mils (0.033 mm).
- B. Exterior Full-Gloss Alkyd Enamel: Factory-formulated full-gloss alkyd enamel for exterior application.
  1. Benjamin Moore; Moore's IMC Urethane Alkyd Enamel M22: Applied at a dry film thickness of not less than 2.0 mils (0.051 mm).
  2. Coronado; 1223 Line Super Kote 5000 High Gloss Alkyd Enamel: Applied at a dry film thickness of not less than 1.5 mils (0.038 mm).
  3. ICI Dulux Paints; 4308-XXXX Devguard Alkyd Industrial Gloss Enamel: Applied at a dry film thickness of not less than 2.0 mils (0.051 mm).
  4. Kelly-Moore; 1700 Kel-Guard Gloss Alkyd Rust Inhibitive Enamel: Applied at a dry film thickness of not less than 2.0 mils (0.051 mm).
  5. M. A. B. Paint; Rust-O-Lastic Finish Coating 074 Line: Applied at a dry film thickness of not less than 2.0 mils (0.051 mm).
  6. Pittsburgh Paints; 7-814 Pittsburgh Paints Industrial Gloss-Oil Interior/Exterior Enamel: Applied at a dry film thickness of not less than 1.5 mils (0.038 mm).
  7. Sherwin-Williams; Industrial Enamel B-54 Series: Applied at a dry film thickness of not less than 2.0 mils (0.051 mm).

## 2.6 INTERIOR FINISH COATS

- A. Interior Flat Acrylic Paint: Factory-formulated flat acrylic-emulsion latex paint for interior application.
1. Benjamin Moore; Moorecraft Super Spec Latex Flat No. 275: Applied at a dry film thickness of not less than 1.2 mils (0.031 mm).
  2. Coronado; 28 Line Super Kote 5000 Latex Flat Paint: Applied at a dry film thickness of not less than 1.2 mils (0.031 mm).
  3. ICI Dulux Paints; 1200-XXXX Dulux Professional Velvet Matte Interior Flat Latex Wall & Trim Finish: Applied at a dry film thickness of not less than 1.4 mils (0.036 mm).
  4. Kelly-Moore; 450 Pro-Wall Interior Flat Latex Wall Paint: Applied at a dry film thickness of not less than 1.8 mils (0.046 mm).
  5. M. A. B. Paint; Fresh Kote Latex Flat 402 Line: Applied at a dry film thickness of not less than 1.5 mils (0.038 mm).
  6. Pittsburgh Paints; 6-70 Line SpeedHide Interior Wall Flat-Latex Paint: Applied at a dry film thickness of not less than 1.0 mil (0.025 mm).
  7. Sherwin-Williams; ProMar 200 Interior Latex Flat Wall Paint B30W200 Series: Applied at a dry film thickness of not less than 1.4 mils (0.036 mm).
- B. Interior Semigloss Alkyd Enamel: Factory-formulated semigloss alkyd enamel for interior application.
1. Benjamin Moore; Moorcraft Super Spec Alkyd Semi-Gloss Enamel No. 271: Applied at a dry film thickness of not less than 1.4 mils (0.036 mm).
  2. Coronado; 27-Line Super Kote 5000 Alkyd Semi-Gloss Enamel: Applied at a dry film thickness of not less than 2.0 mils (0.051 mm).
  3. ICI Dulux Paints; 1516-XXXX Ultra-Hide Alkyd Semi-Gloss Interior Wall & Trim Enamel: Applied at a dry film thickness of not less than 1.7 mils (0.043 mm).
  4. Kelly-Moore; 1630--Kel-Cote Interior Alkyd Semi-Gloss Enamel: Applied at a dry film thickness of not less than 2.2 mils (0.056 mm).
  5. M. A. B. Paint; Fresh Kote Semi-Gloss 403 Line: Applied at a dry film thickness of not less than 2.0 mils (0.051 mm).
  6. Pittsburgh Paints; 6-1110 Series SpeedHide Interior Enamel Wall & Trim Semi-Gloss Oil: Applied at a dry film thickness of not less than 1.4 mils (0.036 mm).
  7. Sherwin-Williams; ProMar 200 Interior Alkyd Semi-Gloss Enamel B34W200 Series: Applied at a dry film thickness of not less than 1.7 mils (0.043 mm).

## PART 3 - EXECUTION

## 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for paint application.
1. Proceed with paint application only after unsatisfactory conditions have been corrected and surfaces receiving paint are thoroughly dry.
  2. Start of painting will be construed as Applicator's acceptance of surfaces and conditions within a particular area.

## 3.2 PREPARATION

- A. General: Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted. If removal is impractical or impossible because of size or weight of the item, provide surface-applied protection before surface preparation and painting.
  - 1. After completing painting operations in each space or area, reinstall items removed using workers skilled in the trades involved.
- B. Cleaning: Before applying paint or other surface treatments, clean substrates of substances that could impair bond of the various coatings. Remove oil and grease before cleaning.
  - 1. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.
- C. Surface Preparation: Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition and as specified.
  - 1. Provide barrier coats over incompatible primers or remove and reprime.
  - 2. Ferrous Metals: Clean ungalvanized ferrous-metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with SSPC's recommendations.
    - a. Blast steel surfaces clean as recommended by paint system manufacturer and according to SSPC-SP 6/NACE No. 3.
    - b. Treat bare and sandblasted or pickled clean metal with a metal treatment wash coat before priming.
    - c. Touch up bare areas and shop-applied prime coats that have been damaged. Wire-brush, clean with solvents recommended by paint manufacturer, and touch up with same primer as the shop coat.
  - 3. Galvanized Surfaces: Clean galvanized surfaces with nonpetroleum-based solvents so surface is free of oil and surface contaminants. Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods.
- D. Material Preparation: Mix and prepare paint materials according to manufacturer's written instructions.
  - 1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.
  - 2. Stir material before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into material. If necessary, remove surface film and strain material before using.
  - 3. Use only thinners approved by paint manufacturer and only within recommended limits.

## 3.3 APPLICATION

- A. General: Apply paint according to manufacturer's written instructions. Use applicators and techniques best suited for substrate and type of material being applied.
1. Paint colors, surface treatments, and finishes are indicated in the paint schedules.
  2. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.
  3. Provide finish coats that are compatible with primers used.
  4. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, grilles, convector covers, covers for finned-tube radiation, and similar components are in place. Extend coatings in these areas, as required, to maintain system integrity and provide desired protection.
  5. Paint interior surfaces of ducts with a flat, nonspecular black paint where visible through registers or grilles.
  6. Paint back sides of access panels and removable or hinged covers to match exposed surfaces. Delete first subparagraph below if casework is prefinished.
  7. Sand lightly between each succeeding enamel coat.
- B. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.
1. The number of coats and film thickness required are the same regardless of application method. Do not apply succeeding coats until previous coat has cured as recommended by manufacturer. If sanding is required to produce a smooth, even surface according to manufacturer's written instructions, sand between applications.
  2. Omit primer over metal surfaces that have been shop primed and touchup painted.
  3. If undercoats, stains, or other conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance. Give special attention to ensure that edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.
  4. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until paint has dried to where it feels firm, and does not deform or feel sticky under moderate thumb pressure, and until application of another coat of paint does not cause undercoat to lift or lose adhesion.
- C. Application Procedures: Apply paints and coatings by brush, roller, spray, or other applicators according to manufacturer's written instructions.
1. Brushes: Use brushes best suited for type of material applied. Use brush of appropriate size for surface or item being painted.
  2. Spray Equipment: Use airless spray equipment with orifice size as recommended by manufacturer for material and texture required.
- D. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer's recommended spreading rate to achieve dry film thickness indicated. Provide total dry film thickness of the entire system as recommended by manufacturer.
- E. Mechanical and Electrical Work: Painting of mechanical and electrical work is limited to items exposed in equipment rooms and occupied spaces.

- F. Mechanical items to be painted include, but are not limited to, the following:
  - 1. Uninsulated metal piping.
  - 2. Uninsulated plastic piping.
  - 3. Pipe hangers and supports.
  - 4. Tanks that do not have factory-applied final finishes.
  - 5. Visible portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets.
  - 6. Duct, equipment, and pipe insulation having "all-service jacket" or other paintable jacket material.
  - 7. Mechanical equipment that is indicated to have a factory-primed finish for field painting.
- G. Electrical items to be painted include, but are not limited to, the following:
  - 1. Switchgear.
  - 2. Panelboards.
  - 3. Electrical equipment that is indicated to have a factory-primed finish for field painting.
- H. Prime Coats: Before applying finish coats, apply a prime coat, as recommended by manufacturer, to material that is required to be painted or finished and that has not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn-through or other defects due to insufficient sealing.
- I. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with requirements.

### 3.4 CLEANING

- A. Cleanup: At the end of each workday, remove empty cans, rags, rubbish, and other discarded paint materials from Project site.
  - 1. After completing painting, clean glass and paint-spattered surfaces. Remove spattered paint by washing and scraping without scratching or damaging adjacent finished surfaces.

### 3.5 PROTECTION

- A. Protect work of other trades, whether being painted or not, against damage from painting. Correct damage by cleaning, repairing or replacing, and repainting, as approved by Architect.
- B. Provide "Wet Paint" signs to protect newly painted finishes. After completing painting operations, remove temporary protective wrappings provided by others to protect their work.
  - 1. After work of other trades is complete, touch up and restore damaged or defaced painted surfaces.
  - 2. Comply with procedures specified in PDCA P1.

EXTERIOR PAINT SCHEDULE

- C. Ferrous Metal: Provide the following finish systems over exterior ferrous metal. Primer is not required on shop-primed items.
  - 1. Full-Gloss Alkyd-Enamel Finish: Two finish coats over a rust-inhibitive primer.
    - a. Primer: Exterior ferrous-metal primer.
    - b. Finish Coats: Exterior full-gloss alkyd enamel.
  
- D. Zinc-Coated Metal: Provide the following finish systems over exterior zinc-coated metal surfaces:
  - 1. Full-Gloss Alkyd-Enamel Finish: Two finish coats over a galvanized metal primer.
    - a. Primer: Exterior galvanized metal primer.
    - b. Finish Coats: Exterior full-gloss alkyd enamel.
  
- E. Aluminum: Provide the following finish systems over exterior aluminum surfaces:
  - 1. Full-Gloss Alkyd-Enamel Finish: Two finish coats over a primer.
    - a. Primer: Exterior aluminum primer under alkyd finishes.
    - b. Finish Coats: Exterior full-gloss alkyd enamel.

3.6 INTERIOR PAINT SCHEDULE

- A. Ferrous Metal: Provide the following finish systems over ferrous metal:
  - 1. Full-Gloss Alkyd-Enamel Finish: Two finish coats over a primer.
    - a. Primer: Interior ferrous-metal primer.
    - b. Finish Coats: Interior full-gloss alkyd enamel for wood and metal surfaces.
  
- B. Zinc-Coated Metal: Provide the following finish systems over interior zinc-coated metal surfaces:
  - 1. Full-Gloss Alkyd-Enamel Finish: Two finish coats over a primer.
    - a. Primer: Interior zinc-coated metal primer.
    - b. Finish Coats: Interior full-gloss alkyd enamel for wood and metal surfaces.
  
- C. All-Service Jacket over Insulation: Provide the following finish system on cotton or canvas insulation covering:
  - 1. Flat Acrylic Finish: Two finish coats. Add fungicidal agent to render fabric mildew proof.
    - a. Finish Coats: Interior flat latex-emulsion size.

END OF SECTION 09912





## SECTION 09931 - WOOD STAINS AND TRANSPARENT FINISHES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes surface preparation and the application of wood finishes on the following substrates:
  - 1. Interior Substrates:
    - a. Dressed lumber (interior architectural woodwork).
- B. Related Sections include the following:
  - 1. Division 9 Section "Painting" for surface preparation and application of standard paint systems on interior substrates.

#### 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Verification: For each type of finish system and in each color and gloss of finish indicated.
  - 1. Submit Samples on representative samples of actual wood substrates, 8 inches square.
  - 2. Label each Sample for location and application area.
- C. Product List: For each product indicated, include the following:
  - 1. Cross-reference to finish system and locations of application areas. Use same designations indicated on Drawings and in schedules.
  - 2. Printout of MPI's current "MPI Approved Products List" for each product category specified in Part 2, with the product proposed for use highlighted.

#### 1.4 QUALITY ASSURANCE

- A. MPI Standards:
  - 1. Products: Complying with MPI standards indicated and listed in its "MPI Approved Products List."

2. Preparation and Workmanship: Comply with requirements in "MPI Architectural Painting Specification Manual" for products and finish systems indicated.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures maintained constant.
  1. Maintain containers in clean condition, free of foreign materials and residue.
  2. Remove rags and waste from storage areas daily.

#### 1.6 PROJECT CONDITIONS

- A. Apply finishes only when temperature of surfaces to be finished and ambient air temperatures are between 50 and 95 deg F.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Basis-of-Design Products: Paint systems are based on the products of ICI Paints. Subject to compliance with requirements, provide the named products or equivalent products by one of the following:
  1. Pittsburgh Paints.
  2. Sherwin-Williams Co.

#### 2.2 MATERIALS, GENERAL

- A. Material Compatibility:
  1. Provide materials for use within each finish system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
  2. For each coat in a finish system, provide products recommended in writing by manufacturers of topcoat for use in finish system and on substrate indicated.
- B. Stain Colors: As selected by Interior Designer.

#### 2.3 STAINS

- A. Interior Wood Stain (Semitransparent): MPI #90.
  1. ICI Paints, 1700 WoodPride Solventborne Wood Finishing Stain.

## 2.4 POLYURETHANE FINISHES

- A. Interior, Oil-Modified, Clear Urethane (Satin): MPI #57, Gloss Level 4.
  - 1. ICI Paints, 1902 WoodPride Interior Satin Polyurethane Varnish.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.
  - 1. Maximum Moisture Content of Wood Substrates: 15 percent when measured with an electronic moisture meter.
  - 2. Verify compatibility with and suitability of substrates, including compatibility with existing finishes.
  - 3. Begin finish application only after unsatisfactory conditions have been corrected and surfaces are dry.
  - 4. Beginning application of finish system constitutes Contractor's acceptance of substrate and conditions.

### 3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.
- B. Remove plates, machined surfaces, and similar items already in place that are not to be finished. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and finishing.
  - 1. After completing finishing operations, reinstall items that were removed; use workers skilled in the trades involved. Remove surface-applied protection if any.
- C. Clean and prepare surfaces to be finished according to manufacturer's written instructions for each particular substrate condition and as specified.
  - 1. Remove surface dirt, oil, or grease by washing with a detergent solution; rinse thoroughly with clean water and allow to dry. Remove grade stamps and pencil marks by sanding lightly. Remove loose wood fibers by brushing.
  - 2. Countersink steel nails, if used, and fill with putty tinted to final color to eliminate rust leach stains.

### 3.3 APPLICATION

- A. Apply finishes according to manufacturer's written instructions.
  - 1. Use applicators and techniques suited for finish and substrate indicated.

2. Finish surfaces behind movable equipment and furniture same as similar exposed surfaces.
- B. Apply finishes to produce surface films without cloudiness, holidays, lap marks, brush marks, runs, ropiness, or other surface imperfections.

### 3.4 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing finish application, clean spattered surfaces. Remove spattered materials by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from finish application. Correct damage by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced finished wood surfaces.

### 3.5 INTERIOR WOOD-FINISH-SYSTEM SCHEDULE

- A. Interior Architectural Woodwork Substrates:
1. Polyurethane Varnish Over Stain System: MPI INT 6.3E.
    - a. Stain Coat: Interior wood stain (semitransparent).
    - b. Two Finish Coats: Interior, oil-modified, clear urethane (satin).

END OF SECTION 09931

## SECTION 09963 - ELASTOMERIC COATINGS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes surface preparation and application of elastomeric coatings to exterior surfaces.

#### 1.3 DEFINITIONS

- A. General: Standard coating terms defined in ASTM D 16 apply to this Section.
- B. Stucco: A Portland cement-based plaster used on exterior surfaces.

#### 1.4 PERFORMANCE REQUIREMENTS

- A. Provide elastomeric coatings that comply with performance requirements specified in MPI 113.
- B. Provide elastomeric coating systems with the following properties as determined by test methods indicated:
  - 1. Elongation: Not less than 280 percent at 77 deg F and not less than 50 percent at 0 deg F according to ASTM D 412.
  - 2. Accelerated Weathering: No cracking, peeling, blistering, chalking, or visual deterioration after 1000 hours when tested according to procedures in ASTM G 155.
  - 3. Low-Temperature Flexibility: No crack formation when tested according to ASTM D 1737.
  - 4. Moisture-Vapor Transmission: Not less than 2.0 perms according to ASTM D 1653.
  - 5. Wind-Driven Rain Resistance: No water penetration according to procedures in FS TT-C-555.
  - 6. Minimum Solids Content by Volume: Not less than 45 percent.

#### 1.5 SUBMITTALS

- A. Product Data: For each elastomeric coating system specified. Include crack fillers, block fillers, and primers.

1. **Material List:** An inclusive list of required coating materials. Indicate each material and cross-reference the specific coating, finish system, and application. Identify each material by manufacturer's catalog number and general classification.
  2. **Manufacturer's Information:** Technical information including label analysis and instructions for handling, storing, and applying each coating material.
- B. **Samples for Initial Selection:** For each type of finish-coat material indicated.
1. After color selection, Architect will furnish color chips indicating colors selected.
- C. **Samples for Verification:** For each color and material to be applied, with texture to simulate actual conditions, on representative Samples of actual substrate.
1. Provide stepped Samples, defining each separate coat, including block fillers and primers. Use representative colors when preparing Samples for review. Resubmit until required sheen, color, and texture are achieved.
  2. Provide a list of materials and applications for each coat of each Sample. Label each Sample for location and application.
    - a. **Stucco:** 4-inch square Samples of actual substrate material for each color and texture.

## 1.6 QUALITY ASSURANCE

- A. **Applicator Qualifications:** A firm or individual experienced in applying elastomeric coating systems similar in material and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.
- B. **Source Limitations:** Obtain crack fillers primers and other undercoat materials from same manufacturer as finish coats.
- C. **Benchmark Samples (Mockups):** Provide full-coat benchmark finish samples for each type of coating on each substrate required. Comply with procedures specified in PDCA P5. Duplicate finish of approved sample submittals.
1. Architect will select one stucco exterior wall surface to represent surfaces and conditions for application of elastomeric coatings.
    - a. **Wall Surfaces:** Prepare samples on at least 100 sq. ft. of wall surface.
  2. Apply benchmark samples according to requirements for the completed Work. Provide required sheen, color, and texture on each surface.
  3. Approved benchmark samples will be used to evaluate coating systems.
  4. Obtain Architect's approval of benchmark samples before starting application of coatings.
  5. Final approval of colors will be from benchmark samples.

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label, and the following information:

1. Product name or title of material.
2. Manufacturer's stock number and date of manufacture.
3. Contents by volume, for pigment and vehicle constituents.
4. Thinning instructions (if permitted).
5. Application instructions.
6. Color name and number.
7. Handling instructions and precautions.
8. VOC content.

B. Store materials not in use in tightly covered containers in a well-ventilated area. Maintain storage containers in a clean condition, free of foreign materials and residue.

1. Keep storage area neat and orderly. Remove oily rags and waste daily.

## 1.8 PROJECT CONDITIONS

A. Apply coatings only when temperature of surfaces to be coated and surrounding air temperatures are between 50 and 90 deg F, unless otherwise permitted by manufacturer's written instructions.

B. Do not apply coatings in rain, fog, or mist; when relative humidity exceeds 85 percent; or to damp or wet surfaces.

1. Allow wet surfaces to dry thoroughly and attain temperature and conditions specified before starting or continuing coating operation.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide one of the products indicated in other Part 2 articles.

B. Manufacturers Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:

1. ICI Dulux Paint Centers, Inc. (ICI Dulux Paint).
2. PPG Industries, Inc.; Pittsburgh Paints (Pittsburgh Paints).
3. Sonneborn, Div. of ChemRex, Inc. (Sonneborn).

### 2.2 ELASTOMERIC COATING MATERIALS, GENERAL

A. Material Compatibility: Provide crack fillers, block fillers, primers, elastomeric finish-coat materials, and related materials that are compatible with one another and substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.



- B. Material Quality: Provide manufacturer's best-quality elastomeric coating materials that are factory formulated, comply with requirements in FS TT-C-555, and are recommended by manufacturer for the application indicated. Material containers not displaying manufacturer's product identification are not acceptable.
- C. Colors and Textures: Match Architect's sample.

### 2.3 CRACK FILLERS

- A. Crack Fillers: Factory-formulated acrylic emulsion crack fillers compatible with substrate and finish-coat materials indicated.
  - 1. Crack Filler for Cracks up to 1/16 Inch:
    - a. ICI Dulux Paint; Decra-Flex Smooth Brush Grade Elastomeric Patching Compound.
    - b. Pittsburgh Paints; Battering Grade Vinyl Sealant 236-2414.
    - c. Sonneborn; Hydrocide 750 Brush Grade or Knife Grade Patching Compound.
  - 2. Crack Filler for Cracks More Than 1/16 Inch:
    - a. ICI Dulux Paint; Decra-Flex Smooth Knife Grade Elastomeric Patching Compound.
    - b. Pittsburgh Paints; Regular Grade Vinyl Sealant 236-2397.
    - c. Sonneborn; Hydrocide 750 Knife Grade Patching Compound.

### 2.4 PRIMERS

- A. Stucco Primer: Factory-formulated stucco primer.
  - 1. ICI Dulux Paint; Aquacrylic GRIPPER 3210 Acrylic Primer: Applied at a dry film thickness of not less than 1.3 mils.
  - 2. Pittsburgh Paints; primer not required.
  - 3. Sonneborn; primer not required.

### 2.5 ELASTOMERIC FINISH-COAT MATERIALS

- A. Smooth Elastomeric Finish: Smooth, factory-formulated, 100 percent acrylic elastomeric coating.
  - 1. ICI Dulux Paint; Decra-Flex 2260-XXXX Smooth Elastomeric Coating System: Applied at a dry film thickness of not less than 6.0 mils.
  - 2. Pittsburgh Paints; Pitt-Flex Exterior Masonry Coating 100 Percent Acrylic Elastomeric 4-110: Applied at a dry film thickness of not less than 5.5 mils.
  - 3. Sonneborn; Sonocoat Colorflex Waterproof Elastomeric Coating: Applied at a dry film thickness of not less than 8.0 mils.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for coating application. Comply with procedures specified in PDCA P4.
  - 1. Proceed with coating application only after unsatisfactory conditions have been corrected and surfaces are thoroughly dry.
  - 2. Start of coating application will be construed as Applicator's acceptance of surface conditions.

### 3.2 PREPARATION

- A. General: Remove hardware and hardware accessories, plates, machined surfaces, light fixtures, and similar items already installed that are not to be coated. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and coating.
  - 1. After completing coating operations, reinstall items removed, using workers skilled in trades involved.
- B. Cleaning: Before applying coatings or other surface treatments, clean substrates of substances that could impair bond of coating systems. Remove oil and grease before cleaning.
  - 1. Schedule cleaning and coating application so dust and other contaminants from cleaning process will not fall on wet, newly coated surfaces.
- C. Surface Preparation: Clean and prepare surfaces to be coated according to manufacturer's written instructions for particular substrate conditions and as specified.
  - 1. Cementitious Surfaces: Prepare stucco, and similar surfaces to receive elastomeric coatings. Remove efflorescence, chalk, dust, dirt, release agents, grease, oils, and similar impediments to good adhesion by water blasting followed by a clear water rinse.
    - a. Remove mildew and neutralize surfaces according to manufacturer's written instructions before patching materials are applied.
    - b. Determine alkalinity and moisture content of surfaces to be coated by performing appropriate tests. If surfaces are sufficiently alkaline to cause finish paint to blister and burn, correct this condition before application. Do not apply coatings over surfaces where moisture content exceeds that permitted in manufacturer's written instructions.
  - 2. Crack Repair: Fill cracks according to manufacturer's written instructions before coating surfaces.
  - 3. Deep Hairline Cracks: Remove dust and dirt from around cracks. Remove mildew by sterilizing before filling. Apply manufacturer's recommended primer to cracks before patching. If shrinkage occurs after applying crack filler, apply additional filler material to cracks before initial application of elastomeric coatings.

- a. Cracks up to 1/16 Inch: Clean surface around cracks. Apply crack filler primer penetrating cracks as deeply as possible, overflowing crack 2 inches on each side. When crack filler primer is dry, apply manufacturer's recommended sealant, forced well into cracks using a brush, putty knife, or trowel. Smooth edges of primed area around cracks. Allow for sealant shrinkage when applying.
  - b. Cracks up to 3/8 Inch: Open cracks to 1/4 to 3/8 inch wide and 1/8 inch deep. Clean cracks and surrounding area removing dust, dirt, and other impurities. Apply crack filler primer recommended by manufacturer with a brush to obtain uniform coverage and spread approximately 2 inches on each side of cracks. Fill cracks with manufacturer's recommended crack filler applied with a putty knife or trowel, and allow for shrinkage. If excessive shrinkage occurs, reapply crack filler.
- D. Material Preparation: Mix and prepare materials according to coating manufacturer's written instructions.
1. Maintain containers used in mixing and applying elastomeric coatings in a clean condition, free of foreign materials and residue.
  2. Stir materials before application to produce a mixture of uniform density. Stir as required during application. If surface film forms, do not stir film into material. If necessary, remove film and strain coating material before using.
  3. If manufacturer permits thinning, use only thinners recommended by manufacturer, and only within recommended limits.

### 3.3 APPLICATION

- A. General: Apply elastomeric coatings according to manufacturer's written instructions. Use applicators and techniques best suited for substrate and type of material being applied.
- B. Scheduling Coating: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.
1. Number of coats and film thickness required are same regardless of application method. Do not apply succeeding coats until previous coat has cured as recommended by manufacturer.
  2. If undercoats or other conditions show through final coat, apply additional coats until coating film is of uniform finish, color, and appearance. Ensure that surfaces, including edges, corners, crevices, welds, and exposed fasteners, receive a dry film thickness equivalent to that of flat surfaces.
  3. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until coating has dried to where it feels firm, does not deform or feel sticky under moderate thumb pressure, and where application of another coat does not cause undercoat to lift or lose adhesion.
- C. Application Procedures: Apply elastomeric coatings by brush, roller, or spray according to manufacturer's written instructions.
1. Brushes: Use brushes best suited for material being applied.

2. Rollers: Use professional-quality quick-release rollers of carpet, velvet back, or high-pile sheep's wool covers with a 1- to 1-1/4-inch nap as recommended by manufacturer for material and texture required.
  3. Spray Equipment: Use airless spray equipment with orifice size as recommended by manufacturer for material and texture required.
- D. Minimum Coating Thickness: Apply each material no thinner than manufacturer's recommended spreading rate to achieve dry film thickness indicated. Provide total dry film thickness as recommended by manufacturer.
1. Wherever spray application is used, apply each coat to provide equivalent hiding of brush-applied coats. Do not double back with spray equipment, building up film thickness of two coats in one pass.
- E. Prime Coats: If recommended by manufacturer, apply a primer to material being coated before applying finish coats.
- F. Brush Application: Brush out and work brush coats into surfaces in an even film. Eliminate cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections. Neatly draw glass lines and color breaks.
- G. Roller Application: Keep cover wet at all times; do not dry roll. Work in sections. Lay on required amount of material, working material into grooves and rough areas; then level material, working it into surface.
- H. Spray Application: Use spray equipment for application only when permitted by manufacturer's written instructions and authorities having jurisdiction.
- I. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or recoat work not complying with specified requirements.

### 3.4 CLEANING

- A. Cleanup: At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
1. After completing coating work, clean glass and spattered surfaces. Remove spattered coatings by washing, scraping, or other methods, being careful not to scratch or damage adjacent finished surfaces.

### 3.5 PROTECTION

- A. Protect work of other trades from damage whether being coated or not. Correct damage by cleaning, repairing, replacing, and recoating as approved by Architect. Leave in an undamaged condition.
- B. Provide "Wet Paint" signs to protect newly coated finishes. Remove temporary protective wrappings provided by others to protect their work after completing coating operations.

1. After construction activities of other trades are complete, touch up and restore damaged or defaced coated surfaces. Comply with procedures specified in PDCA P1.

### 3.6 COATING SCHEDULE

- A. Stucco (Portland Cement Plaster): Provide the following elastomeric coating systems over exterior stucco surfaces:
  1. Smooth Elastomeric Finish: One finish coat(s) over a primer if required by manufacturer.
    - a. Primer: Stucco primer.
    - b. Finish Coats: Smooth elastomeric finish.

END OF SECTION 09963

## SECTION 10191 - CURTAINS AND TRACKS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes the following (as indicated in Drawings):
  - 1. Curtain tracks and curtain carriers.
  - 2. IV tracks and hangers.
  - 3. Cubicle curtains.
  - 4. Shower curtains.
- B. Related Sections include the following:
  - 1. Division 6 Section "Miscellaneous Carpentry" for wood blocking for mounting items requiring anchorage.

#### 1.3 DEFINITION

- A. IV: Intravenous.

#### 1.4 PERFORMANCE REQUIREMENTS

- A. Curtains: Provide curtain fabrics with the following characteristics:
  - 1. Fabrics are launderable to a temperature of not less than 160 deg F 90 deg F.
  - 2. Fabrics are flame resistant and are identical to those that have passed NFPA 701 when tested by a testing and inspecting agency acceptable to authorities having jurisdiction.
    - a. Identify fabrics with appropriate markings of applicable testing and inspecting agency.

#### 1.5 SUBMITTALS

- A. Product Data: Include durability, laundry temperature limits, fade resistance, and fire-test-response characteristics for each type of curtain fabric indicated.
  - 1. Include data on each type of applied curtain treatment.

- B. Shop Drawings: Show layout and types of cubicles and shower stalls, sizes of curtains, number of carriers, anchorage details, and conditions requiring accessories. Indicate dimensions taken from field measurements.
  - 1. Include details on blocking above ceiling.
- C. Samples for Initial Selection: For each type of curtain material indicated.
- D. Samples for Verification: For each type of product required, prepared on Samples of size indicated below.
  - 1. Curtain Fabric: 12-inch- square swatch or larger as required to show complete pattern repeat, from dye lot used for the Work, with specified treatments applied. Mark top and face of material.
  - 2. Mesh Top: Not less than 4 inches square.
  - 3. Curtain Track: Not less than 4 inches long.
  - 4. Curtain Carrier: Full-size unit.
  - 5. IV Track: Not less than 4 inches long.
- E. Curtain and Track Schedule: Use designations as indicated on Drawings.

## 1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install cubicles or shower curtains until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

## PART 2 - PRODUCTS

### 2.1 CURTAIN TRACKS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. General Cubicle Company, Inc.
  - 2. Imperial Fastener Company, Inc.
  - 3. InPro Corporation.
  - 4. Salsbury Industries.
- B. Extruded-Aluminum Track: Not less than 1-1/4 inches wide by 3/4 inch high; with minimum wall thickness of 0.050 inch.
  - 1. Curved Track: Factory-fabricated, 12-inch- radius bends.
  - 2. Finish: Clear anodized.
- C. Track Accessories: Fabricate splices, end caps, connectors, end stops, coupling and joining sleeves, wall flanges, brackets, ceiling clips, and other accessories from same material and with same finish as track.

1. End Stop: Removable with carrier hook.
- D. Curtain Carriers: Two nylon rollers and nylon axle with chrome-plated steel hook.
- E. Exposed Fasteners: Stainless steel.
- F. Concealed Fasteners: Hot-dip galvanized.

## 2.2 IV SUPPORT SYSTEMS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. General Cubicle Company, Inc.
  2. Imperial Fastener Company, Inc.
  3. InPro Corporation.
  4. Salsbury Industries.
- C. Extruded-Aluminum IV Track: Not less than 1-1/4 inches wide by 3/4 inch high; with minimum wall thickness of 0.058 inch.
  1. Finish: Clear anodized.
- D. IV Carriers: Four nylon rollers and steel or stainless-steel axles, with ball bearings, with hanger loop fabricated from 1/4-inch- diameter stainless steel.
- E. Stationary IV Hangers: 24-inch overall height with stainless-steel shaft; with 4 nonfolding 1/4-inch stainless-steel arms with loops, a stainless-steel bottom loop, and a stainless-steel top loop to attach to carrier.

## 2.3 CURTAINS

- A. Cubicle Curtain Fabric: Curtain manufacturer's standard, 100 percent polyester, inherently and permanently flame resistant, stain resistant, and antimicrobial.
  1. Products: As selected by Interior Designer.

## 2.4 SHOWER CURTAINS

- A. Basis-of-Design: Behavioral Safety Products Super BioStat material featuring “no scum” side and bottom edges with triple-ply twisted nylon stitching. Mildew-Resistant, anti-bacterial, and anti-microbial, heavy gauge (0.015 inch) reinforced curtain with pop out shower carriers.
  1. Suicide Resistant: Three eyelets in the 36” width, to reduce the total amount of load required to release the curtain.
  2. Color: As selected by Architect.



3. Products: Architect approved equivalent.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances, and other conditions affecting performance of work.
  1. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. General: Install tracks level and plumb, according to manufacturer's written instructions.
- B. Up to 16 feet in length, provide track fabricated from 1 continuous length.
  1. Curtain Track Mounting: Surface.
  2. IV Track Mounting: Surface.
- C. Surface Track Mounting: Fasten surface-mounted tracks at intervals of not less than 24 inches. Fasten support at each splice and tangent point of each corner. Center fasteners in track to ensure unencumbered carrier operation. Attach track to ceiling as follows:
  1. Mechanically fasten to furring through suspended ceiling with screw and tube spacer.
- D. IV Hangers: Unless otherwise indicated, install one IV hook on each IV track and hang one IV hanger.
- E. Curtain Carriers: Provide curtain carriers adequate for 4-inch spacing along full length of curtain plus an additional carrier.
- F. Curtains: Hang curtains on each curtain track.

### 3.3 PROTECTION

- A. Protect installed recessed track openings with nonresidue adhesive tape to prevent construction debris from impeding carrier operation. Remove tape prior to Substantial Completion.

END OF SECTION 10191

## SECTION 10265 - IMPACT-RESISTANT WALL PROTECTION

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Wall guards.
  - 2. Handrails.
  - 3. Corner guards.
  - 4. End-wall guards.
  - 5. Exterior wall padding.
- B. Related Sections include the following:
  - 1. Division 6 Section "Miscellaneous Carpentry" and Section "Interior Architectural Woodwork".

#### 1.3 SUBMITTALS

- A. Product Data: Include physical characteristics, such as durability, resistance to fading, and flame resistance, for each impact-resistant wall protection system component indicated.
- B. Shop Drawings: Show locations, extent, and installation details of each impact-resistant wall protection system component. Show methods of attachment to adjoining construction.
- C. Samples for Verification: For the following products, showing the full range of color and texture variations expected in each impact-resistant wall protection system component. Prepare Samples from the same material to be used for the Work.
  - 1. Wall and Corner Guards: 12-inch- long Samples of each type of impact-resistant wall protection system component required. Include examples of joinery, corners, and field splices.
- D. Maintenance Data: For each impact-resistant wall protection system component to include in maintenance manuals specified in Division 1.
  - 1. Include recommended methods and frequency for maintaining optimum condition of vinyl plastic covers and exterior foam, under anticipated traffic and use conditions. Include precautions against using cleaning materials and methods that may be detrimental to vinyl finishes and performance.

## 1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has completed installation of impact-resistant wall protection system components similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- B. Source Limitations: Obtain each color, grade, finish, and type of impact-resistant wall protection system component from a single source with resources to provide components of consistent quality in appearance and physical properties.
- C. Fire-Test-Response Characteristics: Provide wall guard, handrail and corner guard system components with the following surface-burning characteristics, as determined by testing materials identical to those required in this Section per ASTM E 84 by a testing and inspecting agency acceptable to Authorities Having Jurisdiction. Identify impact-resistant wall protection system components with appropriate markings of applicable testing and inspecting agency.
  - 1. Flame Spread: 25 or less.
  - 2. Smoke Developed: 450 or less.
- D. Fire-Test-Response Characteristics: Provide exterior wall padding system components that meet CA 117 T.B. fire retardant standards.
- E. Impact Strength: Provide impact-resistant wall protection system components with a minimum impact resistance of 25.4 ft-lbf/in. of width when tested according to ASTM D 256, Test Method A.

## 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store wall surface-protection materials in original undamaged packages and containers inside a well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.
  - 1. Maintain room temperature within the storage area at not less than 70 deg F.
  - 2. Store rigid plastic corner-guard covers in a vertical position, and rigid plastic wall guard and handrail covers in a horizontal position for a minimum of 72 hours.

## 1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install interior wall surface-protection system components until the space is enclosed and weatherproof and ambient temperature within the building is maintained at not less than 70 deg F for not less than 72 hours before beginning installation. Do not install rigid plastic wall surface-protection systems until that temperature has been attained and is stabilized.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Basis-of-Design Products: As indicated.

## 2.2 MATERIALS

- A. Extruded Rigid Plastic: Textured, chemical- and stain-resistant, high-impact-resistant, PVC or acrylic-modified vinyl plastic; thickness as indicated; with a minimum impact resistance of 25.4 ft-lbf/in. of width when tested according to ASTM D 256, Test Method A.
  - 1. Color and Texture: As selected by Interior Designer.
- B. Aluminum Extrusions: Provide alloy and temper recommended by the manufacturer for the type of use and finish indicated, but with not less than the strength and durability properties specified in ASTM B 221 for alloy 6063-T5.
- C. Fasteners: Provide aluminum, nonmagnetic stainless-steel, or other noncorrosive metal screws, bolts, and other fasteners compatible with aluminum components, hardware, anchors, and other items being fastened. Use theftproof fasteners where exposed to view.

## 2.3 WALL GUARDS

- A. Crash-Rail-Type Wall Guards: Heavy-duty assembly consisting of a snap-on-type rigid plastic cover installed over a continuous aluminum retainer mounted at height indicated.
  - 1. Basis-of-Design: 700 (8 inches high nominal) and 500 (3 inches high), IPC, or an equivalent product of one of the following:
    - a. Construction Specialties, Inc.
    - b. Koroseal Wall Protection Systems.
    - c. Pauling Corp.
  - 2. Cover: Extruded, rigid plastic, minimum 0.110 inch thick, in profile indicated.
  - 3. Retainer: Continuous, one-piece, extruded-aluminum retainer; minimum 0.0625 inch thick; with continuous rubber or vinyl bumper cushion centered in the extrusion.
    - a. Mounting Type: Surface mounted flush on wall.
  - 4. Accessories: Provide prefabricated, injection-molded end caps and inside and outside corners with concealed splices, cushions, mounting hardware, and other accessories as required.
    - a. End caps and inside and outside corners shall match plastic cover color and shall be field adjustable for close alignment with snap-on plastic covers.
- B. Bumper Guards: Assembly consisting of continuous snap-on cover installed over continuous retainer.
  - 1. Basis-of-Design Product: The design for rub rails is "Series 1000" by Boston Retail Products, or an equivalent product of the following:
    - a. IPC.

2. Cover: Extruded flexible vinyl, minimum 0.078-inch wall thickness; as follows:
  - a. Profile: Small rounded profile, nominal 1-1/8 inches high by 7/8 inch deep.
  - b. Color: As indicated in the "Accessories Code Schedule" on the Drawings.
3. Retainer: Minimum 0.0625-inch- thick, 1-piece, extruded aluminum.
  - a. Mounting: Surface mounted directly to vertical surfaces of interior architectural woodwork.
4. End Caps and Corners: Prefabricated, injection-molded plastic; color matching cover; field adjustable for close alignment with snap-on cover.
5. Accessories: Concealed splices and mounting hardware.

## 2.4 HANDRAILS

- A. Bumper-Rail-Type Handrails: Impact-resistant, resilient handrail assembly consisting of a snap-on plastic cover installed over a continuous aluminum retainer mounted at height indicated. Comply with ANSI/CABO A117.1.
  1. Basis-of-Design: 800; IPC, or an equivalent product of one of the following:
    - a. Construction Specialties, Inc.
    - b. Koroseal Wall Protection Systems.
    - c. Pauling Corp.
  2. Cover: Extruded, rigid plastic, minimum 0.078 inch thick, in dimensions and profiles indicated.
  3. Retainer: Continuous, one-piece, extruded-aluminum retainer; minimum 0.081 inch thick; with continuous rubber or vinyl bumper cushion centered in the extrusion.
  4. Mounting Bracket: Extended mounting on high-impact, prefabricated, injection-molded, plastic mounting brackets. Provide mounting hardware and other accessories as required.
  5. Accessories: Provide prefabricated, injection-molded end caps and inside and outside corners with concealed splices, cushions, and other accessories as required.
    - a. End caps and inside and outside corners shall match plastic cover color and shall be field adjustable for close alignment with snap-on plastic covers.

## 2.5 CORNER GUARDS

- A. Surface-Mounted, Resilient Plastic Corner Guards: Surface-mounted, resilient plastic corner-guard assembly consisting of a snap-on-type plastic cover installed over a continuous aluminum retainer, height as indicated.
  1. Basis-of-Design: 150 (3 inch wings), IPC, or an equivalent product of one of the following:
    - a. Construction Specialties, Inc.
    - b. Koroseal Wall Protection Systems.
    - c. Pauling Corp.

2. Cover: Extruded, rigid plastic, minimum 0.078 inch thick, in dimensions and profiles indicated.
  - a. Corner Radius: 1/4 inch.
3. Retainer: Continuous, one-piece, extruded-aluminum retainer; minimum 0.062 inch thick.
4. Accessories: Provide prefabricated, injection-molded top cap and aluminum base with concealed splices, cushions, mounting hardware, and other accessories as required.
  - a. Top caps shall match color of plastic covers and shall be field adjustable for close alignment with snap-on plastic covers.

## 2.6 END-WALL GUARDS

- A. Flush-Mounted, Resilient, Plastic End-Wall Guard: Assembly consisting of snap-on plastic cover that is flush with adjacent wall surface and that covers entire end of wall, installed over continuous retainer; including mounting hardware.
  1. Basis-of-Design Product: Model 140D by IPC or a comparable product by one of the following:
    - a. Construction Specialties, Inc.
    - b. Pawling Corporation.
  2. Cover: Extruded rigid plastic, minimum 0.060-inch wall thickness; in dimensions and profiles indicated on Drawings.
    - a. Profile: Nominal 2-inch- long leg and 1/4-inch corner radius.
  3. Retainer: Minimum 0.070-inch- thick, 1-piece, extruded aluminum.

## 2.7 EXTERIOR WALL PADDING

- A. Green Polyester Foam Padding: Assembly consisting of 2" thick soft foam, 3/4" exterior grade plywood back, bottom breather strips for drainage, hypoallergenic, mold proof, fire retardant, phthalate-free PVC coated vinyl covering.
  1. Basis-of-Design Product: Jaypro Sports Equipment EnviroSafe Field Wall Padding or a comparable product approved by Architect as equivalent.
  2. Profile: 4' wide x 6' tall panels.

## 2.8 FABRICATION

- A. General: Fabricate impact-resistant exterior wall padding; and interior wall and door protection systems to comply with requirements indicated for design, dimensions, details, finish, and member sizes, including thicknesses of components.

- B. Preassemble components in the shop to greatest extent possible to minimize field assembly. Disassemble only as necessary for shipping and handling.
- C. Fabricate components with tight seams and joints with exposed edges rolled. Provide surfaces free of wrinkles, chips, dents, uneven coloration, and other imperfections. Fabricate members and fittings to produce flush, smooth, and rigid hairline joints.
- D. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors for interconnecting members to other construction.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas and conditions in which impact-resistant exterior wall padding, interior wall protection system components and impact-resistant wall covering materials will be installed.
  - 1. Complete finishing operations, including painting, before installing impact-resistant system components.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. General: Before installation, clean substrate to remove dust, debris, and loose particles.

### 3.3 INSTALLATION

- A. Install impact-resistant system components level, plumb, and true to line without distortions.
  - 1. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.
- B. Install aluminum retainers, mounting brackets, and other accessories according to the manufacturer's written instructions.

### 3.4 CLEANING

- A. General: Immediately on completion of installation, clean plastic covers and accessories using a standard ammonia-based household cleaning agent. Clean metal components and wall padding foam according to the manufacturer's written instructions.
- B. Remove surplus materials, rubbish, and debris, resulting from installation, on completion of work and leave installation areas in neat, clean condition.

END OF SECTION 10265

## SECTION 10505 - METAL LOCKERS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Standard metal lockers.

#### 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of metal locker.
- B. Shop Drawings: For metal lockers. Include plans, elevations, sections, details, and attachments to other work.
  - 1. Show locker trim and accessories.
  - 2. Include locker identification system and numbering sequence.
- C. Samples for Initial Selection: For units with factory-applied color finishes.

#### 1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain metal lockers and accessories from single source from single manufacturer.
- B. Regulatory Requirements: Where metal lockers are indicated to comply with accessibility requirements, comply with the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities".
- C. Preinstallation Conference: Conduct conference at Project site.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver metal lockers until spaces to receive them are clean, dry, and ready for their installation.



## 1.6 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of work specified in other Sections to ensure that metal lockers can be supported and installed as indicated.

## 1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal lockers that fail in materials or workmanship, excluding finish, within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Structural failures.
    - b. Faulty operation of latches and other door hardware.
  - 2. Damage from deliberate destruction and vandalism is excluded.
  - 3. Warranty Period for Knocked-Down Metal Lockers: Two years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B, suitable for exposed applications.
- B. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with A60 zinc-iron, alloy (galvannealed) coating designation.
- C. Fasteners: Zinc- or nickel-plated steel, slotless-type, exposed bolt heads; with self-locking nuts or lock washers for nuts on moving parts.
- D. Anchors: Material, type, and size required for secure anchorage to each substrate.

### 2.2 STANDARD METAL LOCKERS

- A. Products: Subject to compliance with requirements, provide the following:
  - 1. Art Metal Products; Standard K.D. Lockers.
  - 2. ASI Storage Solutions Inc.; Traditional Collection.
  - 3. Republic Storage Systems Company; Standard Lockers.
  - 4. Shanahan's Manufacturing Limited; Deluxe Series Lockers.
- B. Locker Arrangement: Double tier.
- C. Material: Cold-rolled steel sheet.

- D. Body: Assembled by riveting or bolting body components together. Fabricate from unperforated steel sheet as follows:
1. Tops, Bottoms, and Intermediate Dividers: 0.024-inch nominal thickness, with single bend at sides.
  2. Backs and Sides: 0.024-inch nominal thickness, with full-height, double-flanged connections.
  3. Shelves: 0.024-inch nominal thickness, with double bend at front and single bend at sides and back.
- E. Frames: Channel formed; fabricated from 0.060-inch nominal-thickness steel sheet; lapped and factory welded at corners; with top and bottom main frames factory welded into vertical main frames. Form continuous, integral door strike full height on vertical main frames.
1. Cross Frames between Tiers: Channel formed and fabricated from same material as main frames; welded to vertical main frames.
- F. Doors: One piece; fabricated from 0.060-inch nominal-thickness steel sheet; formed into channel shape with double bend at vertical edges and with right-angle single bend at horizontal edges.
1. Doors less than 12 inches wide may be fabricated from 0.048-inch nominal-thickness steel sheet.
  2. Doors for box lockers less than 15 inches wide may be fabricated from 0.048-inch nominal-thickness steel sheet.
  3. Reinforcement: Manufacturer's standard reinforcing angles, channels, or stiffeners for doors more than 15 inches wide; welded to inner face of doors.
  4. Stiffeners: Manufacturer's standard full-height stiffener fabricated from 0.048-inch nominal-thickness steel sheet; welded to inner face of doors.
  5. Door Style: Vented panel as follows:
    - a. Louvered Vents: No fewer than six louver openings at top and bottom for single-tier lockers.
- G. Hinges: Welded to door and attached to door frame with no fewer than two factory-installed rivets per hinge that are completely concealed and tamper resistant when door is closed; fabricated to swing 180 degrees.
1. Knuckle Hinges: Steel, full loop, five or seven knuckles, tight pin; minimum 2 inches high. Provide no fewer than three hinges for each door more than 42 inches high.
- H. Recessed Door Handle and Latch: Stainless-steel cup with integral door pull, recessed so locking device does not protrude beyond face of door; pry and vandal resistant.
1. Multipoint Latching: Finger-lift latch control designed for use with built-in combination locks, built-in key locks, or padlocks; positive automatic latching and prelocking.
    - a. Latch Hooks: Equip doors less than 48 inches high with two latch hooks; fabricated from 0.105-inch nominal-thickness steel sheet; welded or riveted to full-height door strikes; with resilient silencer on each latch hook.

- b. Latching Mechanism: Manufacturer's standard, rattle-free latching mechanism and moving components isolated with vinyl or nylon to prevent metal-to-metal contact, and incorporating a prelocking device that allows locker door to be locked while door is open and then closed without unlocking or damaging lock or latching mechanism.
- I. Equipment: Equip each metal locker with identification plate and the following unless otherwise indicated:
  - 1. Double-Tier Units: One double-prong ceiling hook and two single-prong wall hooks.
- J. Accessories:
  - 1. Legs: 6 inches high; formed by extending vertical frame members, or fabricated from 0.075-inch nominal-thickness steel sheet; welded to bottom of locker.
    - a. Closed Front and End Bases: Fabricated from 0.036-inch nominal-thickness steel sheet.
  - 2. Continuous Sloping Tops: Fabricated from 0.036-inch nominal-thickness steel sheet.
    - a. Closures: Vertical-end type.
  - 3. Recess Trim: Fabricated from 0.048-inch nominal-thickness steel sheet.
  - 4. Filler Panels: Fabricated from manufacturer's standard thickness, but not less than 0.036-inch nominal-thickness steel sheet.
  - 5. Finished End Panels: Fabricated from 0.024-inch nominal-thickness steel sheet.
- K. Finish: Baked enamel or powder coat.
  - 1. Color(s): As selected by Architect from manufacturer's full range.

## 2.3 FABRICATION

- A. Fabricate metal lockers square, rigid, and without warp and with metal faces flat and free of dents or distortion. Make exposed metal edges safe to touch and free of sharp edges and burrs.
  - 1. Form body panels, doors, shelves, and accessories from one-piece steel sheet unless otherwise indicated.
  - 2. Provide fasteners, filler plates, supports, clips, and closures as required for complete installation.
- B. Fabricate each metal locker with an individual door and frame; individual top, bottom, and back; and common intermediate uprights separating compartments. Factory weld frame members of each metal locker together to form a rigid, one-piece assembly.
- C. Knocked-Down Construction: Fabricate metal lockers using nuts, bolts, screws, or rivets for nominal assembly at Project site.
- D. Accessible Lockers: Fabricate as follows:

1. Where hooks, coat rods, or additional shelves are provided, locate no higher than 48 inches above the floor.
- E. Hooks: Manufacturer's standard ball-pointed type, aluminum or steel; zinc plated.
- F. Identification Plates: Manufacturer's standard, etched, embossed, or stamped aluminum plates, with numbers and letters at least 3/8 inch high.
- G. Continuous Base: Formed into channel or zee profile for stiffness, and fabricated in lengths as long as practical to enclose base and base ends of metal lockers; finished to match lockers.
- H. Continuous Sloping Tops: Fabricated in lengths as long as practical, without visible fasteners at splice locations; finished to match lockers.
- I. Recess Trim: Fabricated with minimum 2-1/2-inch face width and in lengths as long as practical; finished to match lockers.
- J. Filler Panels: Fabricated in an unequal leg angle shape; finished to match lockers. Provide slip-joint filler angle formed to receive filler panel.
- K. Finished End Panels: Designed for concealing unused penetrations and fasteners, except for perimeter fasteners, at exposed ends of nonrecessed metal lockers; finished to match lockers.

## 2.4 STEEL SHEET FINISHES

- A. Factory finish steel surfaces and accessories except stainless-steel and chrome-plated surfaces.
- B. Baked-Enamel Finish: Immediately after cleaning, pretreating, and phosphatizing, apply manufacturer's standard thermosetting baked-enamel finish. Comply with paint manufacturer's written instructions for application, baking, and minimum dry film thickness.
- C. Powder-Coat Finish: Immediately after cleaning and pretreating, electrostatically apply manufacturer's standard, baked-polymer, thermosetting powder finish. Comply with resin manufacturer's written instructions for application, baking, and minimum dry film thickness.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine walls, floors, and support bases, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. General: Install level, plumb, and true; shim as required, using concealed shims.
  - 1. Anchor locker runs at ends and at intervals recommended by manufacturer, but not more than 36 inches o.c. Using concealed fasteners, install anchors through backup reinforcing plates, channels, or blocking as required to prevent metal distortion.
  - 2. Anchor single rows of metal lockers to walls near top and bottom of lockers.
  - 3. Anchor back-to-back metal lockers to floor.
- B. Knocked-Down Metal Lockers: Assemble with standard fasteners, with no exposed fasteners on door faces or face frames.
- C. Equipment and Accessories: Fit exposed connections of trim, fillers, and closures accurately together to form tight, hairline joints, with concealed fasteners and splice plates.
  - 1. Attach hooks with at least two fasteners.
  - 2. Attach door locks on doors using security-type fasteners.
  - 3. Identification Plates:
    - a. Attach plates to each locker door, near top, centered, with at least two aluminum rivets.
  - 4. Attach recess trim to recessed metal lockers with concealed clips.
  - 5. Attach sloping-top units to metal lockers, with closures at exposed ends.
  - 6. Attach finished end panels with fasteners only at perimeter to conceal exposed ends of nonrecessed metal lockers.

### 3.3 ADJUSTING, CLEANING, AND PROTECTION

- A. Clean, lubricate, and adjust hardware. Adjust doors and latches to operate easily without binding.
- B. Protect metal lockers from damage, abuse, dust, dirt, stain, or paint. Do not permit use during construction.
- C. Touch up marred finishes, or replace metal lockers that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by locker manufacturer.

END OF SECTION 10505

## SECTION 10522 - FIRE EXTINGUISHER CABINETS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Fire protection cabinets for the following:
    - a. Portable fire extinguishers.
- B. Related Sections:
  - 1. Division 10 Section "Fire Extinguishers."

#### 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for fire protection cabinets.
  - 1. Fire Protection Cabinets: Include roughing-in dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type, trim style, and panel style.
- B. Shop Drawings: For fire protection cabinets. Include plans, elevations, sections, details, and attachments to other work.
- C. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:
  - 1. Size: 6 by 6 inches square.

#### 1.4 COORDINATION

- A. Coordinate size of fire protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.
- B. Coordinate sizes and locations of fire protection cabinets with wall depths.

## 1.5 SEQUENCING

### PART 2 - PRODUCTS

#### 2.1 MATERIALS

- A. Aluminum: Alloy and temper recommended by aluminum producer and manufacturer for type of use and finish indicated, and as follows:
  - 1. Sheet: ASTM B 209.
  - 2. Extruded Shapes: ASTM B 221.
- B. Tempered Float Glass: ASTM C 1048, Kind FT, Condition A, Type I, Quality q3, 3 mm thick, Class 1 (clear).

#### 2.2 FIRE PROTECTION CABINET

- A. Cabinet Type: Suitable for fire extinguisher.
  - 1. Basis-of-Design Products: The design for fire extinguisher cabinets is based on “Academy 1025V17” by J. L. Industries, Inc., a division of Activar Construction Products Group. Subject to compliance with requirements, provide the named product or an equivalent product of one of the following:
    - a. Larsen's Manufacturing Company.
    - b. Potter Roemer LLC.
- B. Cabinet Construction: Nonrated.
- C. Cabinet Material: Aluminum sheet.
- D. Recessed Cabinet: Cabinet box recessed in walls of sufficient depth to suit style of trim indicated.
  - 1. Exposed Flat Trim: One-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend).
- E. Cabinet Trim Material: Aluminum sheet.
- F. Door Material: Aluminum sheet.
- G. Door Style: Vertical duo panel with frame.
- H. Door Glazing: Tempered float glass (clear).
- I. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.

1. Provide projecting door pull and friction latch.
2. Provide continuous hinge, of same material and finish as trim, permitting door to open 180 degrees.

J. Accessories:

1. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
2. Identification: Lettering complying with Authorities Having Jurisdiction for letter style, size, spacing, and location. Locate as directed by Architect.
  - a. Identify fire extinguisher in fire protection cabinet with the words "FIRE EXTINGUISHER."
    - 1) Location: Applied to cabinet door.
    - 2) Application Process: Pressure-sensitive vinyl letters.
    - 3) Lettering Color: Black.
    - 4) Orientation: Vertical.

K. Finishes:

1. Aluminum: Clear anodic.

## 2.3 FABRICATION

- A. Fire Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.
  1. Weld joints and grind smooth.
  2. Provide factory-drilled mounting holes.
- B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles selected.
  1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum 1/2 inch thick.
  2. Miter and weld perimeter door frames.
- C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

## 2.4 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.



## 2.5 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine walls and partitions for suitable framing depth and blocking where recessed cabinets will be installed.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Prepare recesses for recessed fire protection cabinets as required by type and size of cabinet and trim style.

### 3.3 INSTALLATION

- A. General: Install fire protection cabinets in locations and at mounting heights indicated or, if not indicated, at heights indicated below:
  - 1. Fire Protection Cabinets: 54 inches above finished floor to top of cabinet.
- B. Fire Protection Cabinets: Fasten cabinets to structure, square and plumb.
- C. Identification: Apply vinyl lettering at locations indicated.

### 3.4 ADJUSTING AND CLEANING

- A. Remove temporary protective coverings and strippable films, if any, as fire protection cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.
- B. Adjust fire protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.
- C. On completion of fire protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.
- D. Replace fire protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 10522

## SECTION 10523 - FIRE EXTINGUISHERS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes portable, hand-carried fire extinguishers and mounting brackets for fire extinguishers.
- B. Related Sections:
  - 1. Division 10 Section "Fire Extinguisher Cabinets."

#### 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher and mounting brackets.
- B. Operation and Maintenance Data: For fire extinguishers to include in maintenance manuals.

#### 1.4 QUALITY ASSURANCE

- A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."
- B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to Authorities Having Jurisdiction.
  - 1. Provide fire extinguishers approved, listed, and labeled by UL.

#### 1.5 COORDINATION

- A. Coordinate type and capacity of fire extinguishers with fire protection cabinets to ensure fit and function.

## PART 2 - PRODUCTS

### 2.1 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

- A. Fire Extinguishers: Type, size, and capacity for each fire protection cabinet and mounting bracket indicated.
  - 1. Basis-of-Design Products: The design for fire extinguisher is based on “Cosmic 10E” by J. L. Industries, Inc.; a division of Activar Construction Products Group. Subject to compliance with requirements, provide the named product or an equivalent product by one of the following:
    - a. Amerex Corporation.
    - b. Ansul Incorporated; Tyco International Ltd.
    - c. Larsen's Manufacturing Company.
    - d. Potter Roemer LLC.
  - 2. Valves: Manufacturer's standard.
  - 3. Handles and Levers: Manufacturer's standard.
  - 4. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B and bar coding for documenting fire extinguisher location, inspections, maintenance, and recharging.
- B. Multipurpose Dry-Chemical Type in Steel Container: UL-rated 4-A:60-B:C, 10-lb nominal capacity, with monoammonium phosphate-based dry chemical in enameled-steel container.

### 2.2 MOUNTING BRACKETS

- A. Mounting Brackets: Manufacturer's standard steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or black baked-enamel finish.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Amerex Corporation.
    - b. Ansul Incorporated; Tyco International Ltd.
    - c. J. L. Industries, Inc.; a division of Activar Construction Products Group.
    - d. Larsen's Manufacturing Company.
    - e. Potter Roemer LLC.
- B. Identification: Lettering complying with Authorities Having Jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.
  - 1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.
    - a. Orientation: Vertical.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine fire extinguishers for proper charging and tagging.
  - 1. Remove and replace damaged, defective, or undercharged fire extinguishers.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. General: Install fire extinguishers and mounting brackets in locations indicated and in compliance with requirements of Authorities Having Jurisdiction.
  - 1. Mounting Brackets: 54 inches above finished floor to top of fire extinguisher.
- B. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

END OF SECTION 10523



## SECTION 10801 - TOILET AND BATH ACCESSORIES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Toilet accessories for private-use toilets.
  - 2. Toilet accessories at sinks and lavatories.
  - 3. Toilet accessories at janitor closets.

#### 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include the following:
  - 1. Construction details and dimensions.
  - 2. Anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
  - 3. Material and finish descriptions.
  - 4. Manufacturer's warranty.
- B. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.
  - 1. Identify locations using room designations indicated on Drawings.
  - 2. Identify products using designations indicated on Drawings.
- C. Maintenance Data: For toilet and bath accessories to include in maintenance manuals.

#### 1.4 QUALITY ASSURANCE

- A. Source Limitations: For products listed together in the same articles in Part 2, provide products of same manufacturer unless otherwise approved by Architect.

#### 1.5 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.

## 1.6 WARRANTY

- A. Special Mirror Warranty: Manufacturer's standard form in which manufacturer agrees to replace mirrors that develop visible silver spoilage defects and that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: 15 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Stainless Steel: ASTM A 666, Type 304, 0.0312-inch minimum nominal thickness, unless otherwise indicated.
- B. Steel Sheet: ASTM A 1008/A 1008M, Designation CS (cold rolled, commercial steel), 0.0359-inch minimum nominal thickness.
- C. Galvanized Steel Sheet: ASTM A 653/A 653M, with G60 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 Number SC 2 (moderate service).
- G. Mirrors: ASTM C 1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.

### 2.2 WASHROOM ACCESSORIES

- A. Product Schedule: Refer to "Toilet Accessories Schedule" on the Drawings.
- B. Basis-of-Design: The design for accessories is based on products of Bobrick Washroom Equipment, Inc., Norva Plastics, Oddball Industries and Behavioral Safety Products. Subject to compliance with requirements, provide the named products or a comparable product by one of the following:
  - 1. A & J Washroom Accessories, Inc.
  - 2. American Specialties, Inc.
  - 3. Bradley Corporation.
  - 4. Architect's approved equivalent.
- C. Grab Bars:
  - 1. Mounting: Flanges with concealed fasteners.
  - 2. Material: Stainless steel, 0.05 inch thick.

- a. Finish: Smooth, No. 4, satin finish on ends and slip-resistant texture in grip area.
- 3. Outside Diameter: 1-1/2 inches.
- 4. Configuration and Length: As indicated in Drawings.

## 2.3 FABRICATION

- A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.
- B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

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

### 3.2 ADJUSTING AND CLEANING

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

END OF SECTION 10801





## SECTION 12484 - FLOOR MATS AND FRAMES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Roll-up vinyl-tread rail floor mats with architectural aluminum hinge rail connectors.
- B. Related Sections include the following:
  - 1. Division 3 Section "Cast-in-Place Concrete" for concrete work, including forming, placing, and finishing concrete floor slabs, and for concrete materials for grouting and filling around and under recessed mats and frames.

#### 1.3 SUBMITTALS

- A. Product Data: Include manufacturer's specifications and installation instructions, construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of floor mat and frame specified.
- B. Shop Drawings: For floor mats and frames. Show assembly, joint locations, installation details, layout, plans, elevations, sections, details of patterns or designs, accessories, anchors, and attachments to other Work.
  - 1. Coordinate Shop Drawings showing oversized recess for deferred installation of frames with concrete work.
- C. Samples: 12-inch- square assembled sections of floor mats, frame members, and tread rails with tread surface, as selected by Architect, showing each type of metal finish and color of exposed floor mats, tread rails, frames, and accessories required.
- D. Maintenance Data: For cleaning and maintaining floor mats to include in maintenance manuals.

#### 1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain floor mats and frames through one source from a single manufacturer.

- B. Accessibility Requirements: In addition to requirements of Authorities Having Jurisdiction, provide installed floor mats that comply with Section 4.5 in the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)."

## 1.5 PROJECT CONDITIONS

- A. Field Measurements: Verify blocked-out openings in floors by field measurements before fabrication and indicate measurements on Shop Drawings.
  - 1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish opening dimensions and proceed with fabricating floor mats and frames without field measurements. Coordinate floor construction to ensure that actual opening dimensions correspond to established dimensions.

## 1.6 COORDINATION

- A. Coordinate size and location of oversized recesses in concrete work to receive floor mats and frames. Defer frame installations until building enclosure is completed and related interior finish work is in progress. Concrete, reinforcement, and formwork requirements are specified in Division 3.
- B. Coordinate integral installation of recessed frames and anchors with placing of concrete slab so frames are positioned accurately.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Roll-up Vinyl Rail Hinged Mats:
    - a. "Pedimat," Construction Specialties, Inc.
    - b. Architect approved equivalent.

### 2.2 METAL FRAME MATERIALS

- A. Extruded Aluminum: ASTM B 221, alloy 6061-T6 or alloy 6063-T6, or T52 as standard with manufacturer.

### 2.3 CONCRETE FILL AND GROUT MATERIALS

- A. Provide concrete materials complying with Division 3 for grout and fill around and under recessed mats and frames that produce concrete equivalent in strength to cast-in-place concrete slabs. For concrete fill, adjust aggregate size to not exceed one-third fill thickness.

## 2.4 FLOOR MATS

- A. Interior Roll-up Vinyl-Rail Hinged Mats: Vinyl-acrylic tread rails with slotted or perforated vinyl hinges to form 2-inch- wide by 3/8-inch- thick, tread rail modules. Provide 1/4-inch-high, 28-oz./sq. yd. weight, level-cut, nylon-pile, fusion-bonded carpet tread inserts.

- 1. Carpet Color: As selected by Interior Designer.

- B. Exterior Roll-up Vinyl-Rail Hinged Mats: Vinyl-acrylic tread rails with slotted or perforated vinyl hinges to form 2-inch- wide by 3/8-inch- thick, tread rail modules. Provide ribbed-design-surface, resilient vinyl tread inserts.

- 1. Carpet Color: As selected by Interior Designer.

## 2.5 FABRICATION

- A. General: Where possible, verify sizes by field measurement before shop fabrication.
- B. Floor Mats: Shop fabricate units to greatest extent possible in sizes as indicated. If not otherwise indicated, provide single unit for each mat installation; do not exceed manufacturer's recommended maximum sizes for units that are removed for maintenance and cleaning. Where joints in mats are necessary, space symmetrically and away from normal traffic lanes. Miter corner joints in framing elements with hairline joints or provide prefabricated corner units without joints.
- C. Recessed Metal Mat Frames: Extruded aluminum, of size and style to fit floor mat type specified, for permanent recessed installation, complete with corner pins or reinforcement and anchorage devices.

- 1. Fabricate edge-frame members in single lengths or, where frame dimensions exceed maximum available lengths, provide minimum number of pieces possible, with hairline joints equally spaced and pieces spliced together by straight connecting pins.

## 2.6 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

## 2.7 ALUMINUM FINISHES

- A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- B. Class I, Clear Anodic Finish: AA-M12C22A41 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018mm or thicker) complying with AAMA 611.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, floor conditions, and floor recesses for compliance with requirements for location, sizes, minimum recess depth, and other conditions affecting installation of floor mats and frames.
  - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Install recessed mat frames to comply with manufacturer's written instructions. Set mat tops at height recommended by manufacturer for most effective cleaning action; coordinate top of mat surfaces with bottom of doors that swing across mats to provide clearance between door and mat.
  - 1. Install necessary shims, spacers, and anchorages for proper location and secure attachment of frames.
  - 2. Install grout and fill around frames and, if required to set mat tops at proper elevations, in recesses under mats. Finish grout and fill smooth and level.

### 3.3 PROTECTION

- A. After completing frame installation and concrete work, provide temporary filler of plywood or fiberboard in recesses and cover frames with plywood protective flooring. Maintain protection until construction traffic has ended and Project is near Substantial Completion.

END OF SECTION 12484

SECTION 13915 - FIRE SUPPRESSION SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes fire-suppression piping and equipment for the following building systems:
  - 1. Automatic wet-type, branches for sprinklers.

1.3 DEFINITIONS

- A. Hose Connection: Valve with threaded outlet matching fire hose coupling thread for attaching fire hose.
- B. Hose Station: Hose connection, fire hose rack, and fire hose.
- C. Working Plans: Documents, including drawings, calculations, and material specifications prepared according to NFPA 13 and NFPA 14 for obtaining approval from authorities having jurisdiction.

1.4 SYSTEM PERFORMANCE REQUIREMENTS

- A. Design standpipes and obtain approval from authorities having jurisdiction. Include minimum residual pressures at hydraulically remote outlets according to the following:
  - 1. NPS 2-1/2 Hose Connections: 100 psig.
- B. Design sprinkler piping according to the following and obtain approval from authorities having jurisdiction:
  - 1. Include 20 percent margin of safety for available water flow and pressure.
  - 2. Include losses through water-service piping, valves, and backflow preventers.
  - 3. Sprinkler Occupancy Hazard Classifications.
    - a. As stated on drawings.
  - 4. Minimum Density for Automatic-Sprinkler Piping Design: As follows: See drawings.
  - 5. Maximum Protection Area per Sprinkler: As follows: See drawings.
- C. Components and Installation: Capable of producing piping systems with 175-psig minimum working-pressure rating, unless otherwise indicated.

1.5 SUBMITTALS

- A. Product Data: For the following:

1. Pipe and fitting materials and methods of joining for sprinkler piping.
  2. Pipe hangers and supports.
  3. Piping seismic restraints.
  4. Valves, including specialty valves, accessories, and devices.
  5. Alarm devices. Include electrical data.
  6. Fire department connections. Include type; number, size, and arrangement of inlets; caps and chains; size and direction of outlet; escutcheon and marking; and finish. Locate one at each standpipe.
  7. Hose stations. Include size, type, and finish of hose connections; type and length of fire hoses; finish of fire hose couplings; type, material, and finish of nozzles; and finish of rack.
  8. Sprinklers, escutcheons, and guards. Include sprinkler flow characteristics, mounting, finish, and other pertinent data.
- B. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction. Include hydraulic calculations, signed and stamped by a PR licensed Engineer.
- C. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13 and NFPA 14. Include "Contractor's Material and Test Certificate for Aboveground Piping" and "Contractor's Material and Test Certificate for Underground Piping."
- D. Maintenance Data: For each type of standpipe and sprinkler specialty to include in maintenance manuals specified in Division 1.
- 1.6 QUALITY ASSURANCE
- A. Installer Qualifications: An experienced installer who has designed and installed fire-suppression piping similar to that indicated for this Project and obtained design approval and inspection approval from authorities having jurisdiction.
- B. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer. Base calculations on a 1500 GPM pump @ 160 PSIG.
- C. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of fire-suppression piping that are similar to those indicated for this Project in material, design, and extent.
- D. Manufacturer Qualifications: Firms whose equipment, specialties, and accessories are listed by product name and manufacturer in UL's "Fire Protection Equipment Directory" and FM's "Fire Protection Approval Guide" and that comply with other requirements indicated.
- E. Standpipe and Sprinkler Components: Listing/approval stamp, label, or other marking by a testing agency acceptable to authorities having jurisdiction.
- F. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.
- G. NFPA Standards: Equipment, specialties, accessories, installation, and testing complying with the following:
1. NFPA 13, "Installation of Sprinkler Systems."

2. NFPA 14, "Standpipe and Hose Systems."
3. NFPA 20, "Installation of Stationary Pumps for Fire Protection"

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.
  1. Sprinkler Cabinets: Finished, wall-mounting steel cabinet and hinged cover, with space for a minimum of six spare sprinklers plus sprinkler wrench. Include the number of sprinklers required by NFPA 13 and wrench for sprinklers. Include separate cabinet with sprinklers and wrench for each type of sprinkler on Project.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Specialty Valves and Devices:
    - a. Badger Fire Protection, Inc.
    - b. Central Sprinkler Corp.
    - c. Firematic Sprinkler Devices, Inc.
    - d. Globe Fire Sprinkler Corp.
    - e. Grinnell Corp.
    - f. Reliable Automatic Sprinkler Co., Inc.
    - g. Star Sprinkler Corp.
    - h. Viking Corp.
  2. Water-Flow Indicators and Supervisory Switches:
    - a. Gamewell Co.
    - b. Grinnell Corp.
    - c. Pittway Corp.; System Sensor Div.
    - d. Potter Electric Signal Co.
    - e. Reliable Automatic Sprinkler Co., Inc.
    - f. Viking Corp.
    - g. Watts Industries, Inc.; Water Products Div.
  3. Sprinkler, Drain and Alarm Test Fittings:
    - a. Central Sprinkler Corp.
    - b. Fire-End and Croker Corp.
    - c. Grinnell Corp.
    - d. Victaulic Co. of America.
  4. Sprinkler, Branch-Line Test Fittings:
    - a. Elkhart Brass Mfg. Co., Inc.
    - b. Fire-End and Croker Corp.
    - c. Smith Industries, Inc.; Potter-Roemer Div.



5. Sprinkler, Inspector's Test Fittings:
  - a. Fire-End and Croker Corp.
  - b. G/J Innovations, Inc.
  - c. Triple R Specialty of Ajax, Inc.
  
6. Fire Department Connections:
  - a. Badger Fire Protection, Inc.
  - b. Elkhart Brass Mfg. Co., Inc.
  - c. Fire-End and Croker Corp.
  - d. Firematic Sprinkler Devices, Inc.
  - e. Grinnell Corp.
  - f. Guardian Fire Equipment, Inc.
  - g. Reliable Automatic Sprinkler Co., Inc.
  - h. Smith Industries, Inc.; Potter-Roemer Div.
  
7. Sprinklers:
  - a. Badger Fire Protection, Inc.
  - b. Central Sprinkler Corp.
  - c. Fire-matic Sprinkler Devices, Inc.
  - d. Globe Fire Sprinkler Corp.
  - e. Grinnell Corp.
  - f. Reliable Automatic Sprinkler Co., Inc.
  - g. Star Sprinkler Corp.
  - h. Viking Corp.

2.2 PIPING MATERIALS

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

2.3 PIPES AND TUBES

- A. Standard-Weight Steel Pipe: ASTM A 53, ASTM A 135, or ASTM A 795; Schedule 40 in NPS 6 and smaller, and Schedule 30 in NPS 8 and larger.

2.4 PIPE AND TUBE FITTINGS

- A. Cast-Iron Threaded Flanges: ASME B16.1.
- B. Cast-Iron Threaded Fittings: ASME B16.4.

2.5 PIPING MATERIALS

- A. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for pipe-flange gasket materials and welding filler metals.
- B. Ductile-Iron, Keyed Couplings: UL 213 and AWWA C606, for ductile-iron pipe dimensions. Include ASTM A 536, ductile-iron housing, rubber gaskets, and steel bolts and nuts.
- C. Ductile-Iron, Flanged Joints: AWWA C115, ductile-iron or gray-iron pipe flanges, rubber gaskets, and steel bolts and nuts.

- D. Steel, Keyed Couplings: UL 213 and AWWA C606, for steel-pipe dimensions. Include ASTM A 536, ductile-iron housing, rubber gaskets, and steel bolts and nuts. Include listing for dry-pipe service for couplings for dry piping.

## 2.6 FIRE-PROTECTION-SERVICE VALVES

- A. General: UL listed and FM approved, with minimum 175-psig non-shock working-pressure rating. Valves for grooved-end piping may be furnished with grooved ends instead of type of ends specified.

## 2.11 SPRINKLERS

- A. Automatic Sprinklers: With heat-responsive element complying with the following:
  1. UL 199, for applications.
- B. Sprinkler types, features, and options include the following:
  1. Concealed ceiling sprinklers, including cover plate. (Mall public corridors)
- C. Sprinkler Finishes: Chrome-plated, bronze, and painted.
- D. Special Coatings: Wax, lead, and corrosion-resistant paint.
- E. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.
  1. Ceiling Mounting: Chrome-plated steel, two piece, with 1-inch vertical adjustment.
  2. Sidewall Mounting: Chrome-plated steel, one piece, flat.

## 2.7 FIRE DEPARTMENT CONNECTIONS

- A. Wall, Fire Department Connections: UL 405; cast-brass body with brass, wall, escutcheon plate; brass, lugged caps with gaskets and brass chains; and brass, lugged swivel connections.

Include inlets with threads according to NFPA 1963 and matching local fire department sizes and threads, outlet with pipe threads, extension pipe nipples, check devices or clappers for inlets, and escutcheon plate with marking "AUTO SPKR & STANDPIPE."

1. Type: Exposed, projecting mounting.
2. Escutcheon Plate: Round.
3. Finish: Polished brass.

## 2.8 ALARM DEVICES

- A. General: Types matching piping and equipment connections.
- B. Water-Motor-Operated Alarms: UL 753, mechanical-operation type with pelton-wheel operator with shaft length, bearings, and sleeve to suit wall construction and 10-inch- diameter, cast-aluminum alarm gong with red-enamel factory finish. Include NPS 3/4 inlet and NPS 1 drain connections.
- C. Water-Flow Indicators: UL 346; electrical-supervision, vane-type water-flow detector; with 250-psig pressure rating; and designed for horizontal or vertical installation. Include two single-

pole, double-throw, circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.

- D. Pressure Switches: UL 753; electrical-supervision-type, water-flow switch with retard feature. Include single-pole, double-throw, normally closed contacts and design that operates on rising pressure and signals water flow.
- E. Valve Supervisory Switches: UL 753; electrical; single-pole, double throw; with normally closed contacts. Include design that signals controlled valve is in other than fully open position.
- F. Indicator-Post Supervisory Switches: UL 753; electrical; single-pole, double throw; with normally closed contacts. Include design that signals controlled indicator-post valve is in other than fully open position.

## 2.9 PRESSURE GAGES

- A. Pressure Gages: UL 393, 3-1/2- to 4-1/2-inch- diameter dial with dial range of 0 to 250 psig.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article in Part 1 of this Section.
- B. Report test results promptly and in writing.

### 3.2 EARTHWORK

- A. Refer to Division 2 Section "Earthwork" for excavating, trenching, and backfilling.

### 3.3 EXAMINATION

- A. Examine roughing-in for hose connections and stations to verify actual locations of piping connections before installation.
- B. Examine walls and partitions for suitable thickness, fire- and smoke-rated construction, framing for hose-station cabinets, and other conditions where hose connections and stations are to be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.4 PIPING APPLICATIONS

- A. Do not use welded joints with galvanized steel pipe.
- B. Flanges, unions, and transition and special fittings with pressure ratings the same as or higher than system's pressure rating may be used in aboveground applications, unless otherwise indicated.
- C. Piping between Fire Department Connections and Check Valves: Use galvanized, standard-weight steel pipe with threaded ends; cast- or malleable-iron threaded fittings; and threaded joints.

- D. Underground Service-Entrance Piping: Use ductile-iron, push-on-joint pipe and fittings and restrained joints.
- E. Standpipes: Use the following:
  - 1. NPS 4 and Smaller: Standard-weight steel pipe with threaded ends, cast- or malleable-iron threaded fittings, threaded joints or welded joints.
- F. Sprinklers:
- G. Wet-Pipe Sprinklers: Use the following:
  - 1. Standard-weight steel pipe with plain ends, locking-lug fittings, and twist-locked joints.

### 3.5 VALVE APPLICATIONS

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

### 3.6 JOINT CONSTRUCTION

- A. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for basic piping joint construction.

### 3.7 PIPING INSTALLATION

- A. Refer to Division 15 Section "Basic Mechanical 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. Use approved fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- D. Install unions adjacent to each valve in pipes NPS 2 and smaller. Unions are not required on flanged devices or in piping installations using grooved joints.
- E. Install flanges or flange adapters on valves, apparatus, and equipment having NPS 2-1/2 and larger connections.

- F. Install "Inspector's Test Connections" in sprinkler piping, complete with shutoff valve, sized and located according to NFPA 13.
  - G. Install sprinkler piping with drains for complete system drainage.
  - H. Install sprinkler zone control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.
  - I. Install drain valves on standpipes.
  - J. Install ball drip valves to drain piping between fire department connections and check valves. Drain to floor drain or outside building.
  - K. Install alarm devices in piping systems.
  - L. Hangers and Supports: Comply with NFPA 13 for hanger materials. Install according to NFPA 13 for sprinkler piping and to NFPA 14 for standpipes.
  - M. Earthquake Protection: Install piping according to NFPA 13 to protect from earthquake damage.
  - N. Install piping with grooved joints according to manufacturer's written instructions. Construct rigid piping joints, unless otherwise indicated.
  - O. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 and with soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they will not be subject to freezing.
- 3.8 SPECIALTY SPRINKLER FITTING INSTALLATION
- A. Install specialty sprinkler fittings according to manufacturer's written instructions.
- 3.9 VALVE INSTALLATION
- A. Refer to Division 15 Section "Valves" for installing general-duty valves. Install fire-protection specialty valves, trim, fittings, controls, and specialties according to NFPA 13 and NFPA 14, manufacturer's written instructions, and authorities having jurisdiction.
  - B. Gate Valves: Install fire-protection-service valves supervised-open, located to control sources of water supply except from fire department connections.  
  
Provide permanent identification signs indicating portion of system controlled by each valve.
  - C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water supply sources.
  - D. Alarm Check Valves: Install valves in vertical position for proper direction of flow, including bypass check valve and retard chamber drain-line connection.
- 3.10 SPRINKLER APPLICATIONS
- A. General: Use sprinklers according to the contract drawings indications.

3.11 SPRINKLER INSTALLATION

- A. Install sprinklers in patterns indicated.
- 3.12 CONNECTIONS
- A. Install ball drip valves at each check valve for fire department connection. Drain to floor drain or outside building.
  - B. Connect piping to specialty valves, hose valves, specialties, fire department connections, and accessories.
  - C. Electrical Connections: Power wiring is specified in Division 16.
  - D. Connect alarm devices to fire alarm.
- 3.13 LABELING AND IDENTIFICATION
- A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13 and NFPA 14 and in Division 15 Section "Basic Mechanical Materials and Methods."
  - B. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13 and NFPA 14 and in Division 15 Section "Mechanical Identification."
- 3.14 FIELD QUALITY CONTROL
- A. Flush, test, and inspect sprinkler piping according to NFPA 13, "System Acceptance" Chapter.
  - B. Flush, test, and inspect standpipes according to NFPA 14, "Tests and Inspection" Chapter.
  - C. Replace piping system components that do not pass test procedures and retest to demonstrate compliance. Repeat procedure until satisfactory results are obtained.
  - D. Report test results promptly and in writing to Architect and authorities having jurisdiction.
- 3.15 CLEANING
- A. Clean dirt and debris from sprinklers.
  - B. Remove and replace sprinklers having paint other than factory finish.
- 3.16 PROTECTION
- A. Protect sprinklers from damage until Substantial Completion.
- 3.17 COMMISSIONING
- A. Verify that specialty valves, trim, fittings, controls, and accessories are installed and operate correctly.
  - B. Verify that excess-pressure pumps and accessories are installed and operate correctly.
  - C. Verify that specified tests of piping are complete.
  - D. Verify that damaged sprinklers and sprinklers with paint or coating not specified are replaced with new, correct type.

- E. Verify that sprinklers are correct types, have correct finishes and temperature ratings, and have guards as required for each application.
  - F. Verify that hose connections and fire department connections have threads compatible with local fire department equipment.
  - G. Fill wet-pipe sprinkler piping with water.
  - H. Fill standpipes with water.
  - I. Verify that hose connections are correct type and size.
  - J. Verify that hose stations are correct type and size.
  - K. Energize circuits to electrical equipment and devices.
  - L. Adjust operating controls and pressure settings.
  - M. Coordinate with fire alarm tests. Operate as required.
  - N. Coordinate with fire-pump tests. Operate as required.
- 3.18 DEMONSTRATION
- A. Demonstrate equipment, specialties, and accessories. Review operating and maintenance information.
  - B. Schedule demonstration with Owner with at least seven days' advance notice.

END OF SECTION 13915

## SECTION 15050 – BASIC MECHANICAL MATERIALS AND METHODS (HVAC)

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

- A. This Section includes the following basic mechanical materials and methods to complement other Division 15 Sections.

1. Piping materials and installation instructions common to most piping systems.
2. Concrete base construction requirements.
3. Escutcheons.
4. Dielectric fittings.
5. Flexible connectors.
6. Mechanical sleeve seals.
7. Equipment nameplate data requirements.
8. Labeling and identifying mechanical systems and equipment.
9. Nonshrink grout for equipment installations.
10. Field-fabricated metal and wood equipment supports.
11. Installation requirements common to equipment specification sections.
12. Mechanical demolition.
13. Cutting and patching.
14. Touchup painting and finishing.

- B. Pipe and pipe fitting materials are specified in Division 15 piping system Sections.

## 1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawl spaces, 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 duct shafts.



- 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. ABS: Acrylonitrile-butadiene-styrene plastic.
  2. CPVC: Chlorinated polyvinyl chloride plastic.
  3. NP: Nylon plastic.
  4. PE: Polyethylene plastic.
  5. PVC: Polyvinyl chloride plastic.
- G. The following are industry abbreviations for rubber materials:
  1. CR: Chlorosulfonated polyethylene synthetic rubber.
  2. EPDM: Ethylene propylene diene terpolymer rubber.

#### 1.4 SUBMITTALS

- A. Product Data: For dielectric fittings, flexible connectors, mechanical sleeve seals, and identification materials and devices.
- B. Shop Drawings: Detail fabrication and installation for metal and wood supports and anchorage for mechanical materials and equipment.
- C. Coordination Drawings: Detail major elements, components, and systems of mechanical equipment and materials in relationship with other systems, installations, and building components. Show space requirements for installation and access. Indicate if sequence and coordination of installations are important to efficient flow of the Work. Include the following:
  1. Planned piping layout, including valve and specialty locations and valve-stem movement.
  2. Clearances for installing and maintaining insulation.
  3. Clearances for servicing and maintaining equipment, accessories, and specialties, including space for disassembly required for periodic maintenance.
  4. Equipment and accessory service connections and support details.
  5. Exterior wall and foundation penetrations.
  6. Fire-rated wall and floor penetrations.
  7. Sizes and location of required concrete pads and bases.
  8. Scheduling, sequencing, movement, and positioning of large equipment into building during construction.
  9. Floor plans, elevations, and details to indicate penetrations in floors, roofs, walls, and ceilings and their relationship to other penetrations, structural components, other trades and installations.
  10. Reflected ceiling plans to coordinate and integrate installation of air outlets and inlets, light fixtures, communication system components, sprinklers, and other ceiling-mounted items.
- D. Samples: Of color, lettering style, and other graphic representation required for each identification material and device.

## 1.5 QUALITY ASSURANCE

- A. Comply with ASME A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.
- B. Equipment Selection: Equipment of higher electrical characteristics, physical dimensions, capacities, and ratings may be furnished provided such proposed equipment is approved in writing and connecting mechanical and electrical services, circuit breakers, conduit, motors, bases, and equipment spaces are increased. Additional costs shall be approved in advance by appropriate Contract Modification for these increases. If minimum energy ratings or efficiencies of equipment are specified, equipment must meet design and commissioning requirements.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and prevent entrance of dirt, debris, and moisture.
- B. Protect stored pipes and tubes from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor, if stored inside.
- C. Protect flanges, fittings, and piping specialties from moisture and dirt.
- D. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.
- E. Protect air handling equipment and ductwork from moisture, construction dust and dirt.

## 1.7 SEQUENCING AND SCHEDULING

- A. Coordinate mechanical equipment installation with other building components.
- B. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction to allow for mechanical installations.
- C. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components, as they are constructed.
- D. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the Work. Coordinate installation of large equipment requiring positioning before closing in building.
- E. Coordinate connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies.
- F. Coordinate requirements for access panels and doors if mechanical items requiring access are concealed behind finished surfaces. Access panels and doors are specified in Division 8 Section "Access Doors."

- G. Coordinate installation of identifying devices after completing covering and painting, if devices are applied to surfaces. Install identifying devices before installing acoustical ceilings and similar concealment.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Dielectric Unions:
    - a. Capitol Manufacturing Co.
    - b. Central Plastics Co.
    - c. Eclipse, Inc.; Rockford-Eclipse Div.
    - d. Epcos Sales Inc.
    - e. Hart Industries International, Inc.
    - f. Watts Industries, Inc.; Water Products Div.
    - g. Zurn Industries, Inc.; Wilkins Div.
  - 2. Dielectric Flanges:
    - a. Capitol Manufacturing Co.
    - b. Central Plastics Co.
    - c. Epcos Sales Inc.
    - d. Watts Industries, Inc.; Water Products Div.
  - 3. Dielectric-Flange Insulating Kits:
    - a. Calpico, Inc.
    - b. Central Plastics Co.
  - 4. Dielectric Couplings:
    - a. Calpico, Inc.
    - b. Lochinvar Corp.
  - 5. Dielectric Nipples:
    - a. Grinnell Corp.; Grinnell Supply Sales Co.
    - b. Perfection Corp.
    - c. Victaulic Co. of America.
  - 6. Metal, Flexible Connectors:

- a. ANAMET Industrial, Inc.
- b. Central Sprink, Inc.
- c. Flexicraft Industries.
- d. Flex-Weld, Inc.
- e. Grinnell Corp.; Grinnell Supply Sales Co.
- f. Hyspan Precision Products, Inc.
- g. McWane, Inc.; Tyler Pipe; Gustin-Bacon Div.
- h. Mercer Rubber Co.
- i. Metraflex Co.
- j. Proco Products, Inc.
- k. Uniflex, Inc.

7. Rubber, Flexible Connectors:

- a. General Rubber Corp.
- b. Mercer Rubber Co.
- c. Metraflex Co.
- d. Proco Products, Inc.
- e. Red Valve Co., Inc.
- f. Uniflex, Inc.

8. Mechanical Sleeve Seals:

- a. Calpico, Inc.
- b. Metraflex Co.
- c. Thunderline/Link-Seal.

2.2 PIPE AND PIPE FITTINGS

- A. Refer to individual Division 15 piping Sections for pipe 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 15 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 (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; and 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.
  - 1. Alloy Sn95 or Alloy Sn94: Approximately 95 percent tin and 5 percent silver, with 0.10 percent lead content.
  - 2. Alloy E: Approximately 95 percent tin and 5 percent copper, with 0.10 percent maximum lead content.
  - 3. Alloy HA: Tin-antimony-silver-copper zinc, with 0.10 percent maximum lead content.
  - 4. Alloy HB: Tin-antimony-silver-copper nickel, with 0.10 percent maximum lead content.
  - 5. Alloy Sb5: 95 percent tin and 5 percent antimony, with 0.20 percent maximum lead content.
- F. Brazing Filler Metals: AWS A5.8.
  - 1. BCuP Series: Copper-phosphorus alloys.
  - 2. BAg1: Silver alloy.
- 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: Manufacturer's standard solvent cements for the following:
  - 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. Plastic Pipe Seals: ASTM F 477, elastomeric gasket.
- J. Flanged, Ductile-Iron Pipe Gasket, Bolts, and Nuts: AWWA C110, rubber gasket, carbon-steel bolts and nuts.
- K. Couplings: Iron-body sleeve assembly, fabricated to match OD of plain-end, pressure pipes.
  - 1. Sleeve: ASTM A 126, Class B, gray iron.
  - 2. Followers: ASTM A 47 (ASTM A 47M) malleable iron or ASTM A 536 ductile iron.
  - 3. Gaskets: Rubber.
  - 4. Bolts and Nuts: AWWA C111.
  - 5. Finish: Enamel paint.

#### 2.4 DIELECTRIC FITTINGS

- A. General: Assembly or fitting with insulating material isolating joined dissimilar metals, to prevent galvanic action and stop corrosion.

- B. Description: Combination of copper alloy and ferrous; threaded, solder, plain, and weld-neck end types and matching piping system materials.
- C. Insulating Material: Suitable for system fluid, pressure, and temperature.
- D. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig (1725-kPa) minimum working pressure at 180 deg F (82 deg C).
- E. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig (1035- or 2070-kPa) minimum working pressure as required to suit system pressures.
- F. Dielectric-Flange Insulation Kits: Field-assembled, companion-flange assembly, full-face or ring type. Components include neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
  - 1. Provide separate companion flanges and steel bolts and nuts for 150- or 300-psig (1035- or 2070-kPa) minimum working pressure as required to suit system pressures.
- G. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).
- H. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).

## 2.5 FLEXIBLE CONNECTORS

- A. General: Fabricated from materials suitable for system fluid and that will provide flexible pipe connections. Include 125-psig (860-kPa) minimum working-pressure rating, unless higher working pressure is indicated, and ends according to the following:
  - 1. 2-Inch NPS (DN50) and Smaller: Threaded.
  - 2. 2-1/2-Inch NPS (DN65) and Larger: Flanged.
  - 3. Option for 2-1/2-Inch NPS (DN65) and Larger: Grooved for use with keyed couplings.
- B. Bronze-Hose, Flexible Connectors: Corrugated, bronze, inner tubing covered with bronze wire braid. Include copper-tube ends or bronze flanged ends, braze welded to hose.
- C. Stainless-Steel-Hose/Steel Pipe, Flexible Connectors: Corrugated, stainless-steel, inner tubing covered with stainless-steel wire braid. Include steel nipples or flanges, welded to hose.
- D. Stainless-Steel-Hose/Stainless-Steel Pipe, Flexible Connectors: Corrugated, stainless-steel, inner tubing covered with stainless-steel wire braid. Include stainless-steel nipples or flanges, welded to hose.
- E. Rubber, Flexible Connectors: CR or EPDM elastomer rubber construction, with multiple plies of NP fabric, molded and cured in hydraulic presses. Include 125-psig (860-kPa) minimum working-pressure rating at 220 deg F (104 deg C). Units may be straight or elbow type, unless otherwise indicated.

## 2.6 MECHANICAL SLEEVE SEALS

- A. Description: Modular design, with interlocking rubber links shaped to continuously fill annular space between pipe and sleeve. Include connecting bolts and pressure plates.

## 2.7 PIPING SPECIALTIES

- A. Sleeves: The following materials are for wall, floor, slab, and roof penetrations:

1. Steel Sheet Metal: 0.0239-inch (0.6-mm) minimum thickness, galvanized, round tube closed with welded longitudinal joint.
2. Steel Pipe: ASTM A 53, Type E, Grade A, Schedule 40, galvanized, plain ends.
3. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
4. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
  - a. Underdeck Clamp: Clamping ring with set screws.
5. PVC: Manufactured, permanent, with nailing flange for attaching to wooden forms.
6. PVC Pipe: ASTM D 1785, Schedule 40.
7. PE: Manufactured, reusable, tapered, cup shaped, smooth outer surface, with nailing flange for attaching to wooden forms.

- B. Escutcheons: Manufactured wall, ceiling, and floor plates; deep-pattern type if required to conceal protruding fittings and sleeves.

1. ID: Closely fit around pipe, tube, and insulation of insulated piping.
2. OD: Completely cover opening.
3. Cast Brass: One piece, with set screw.
  - a. Finish: Rough brass.
  - b. Finish: Polished chrome-plate.
4. Cast Brass: Split casting, with concealed hinge and set screw.
  - a. Finish: Rough brass.
  - b. Finish: Polished chrome-plate.
5. Stamped Steel: One piece, with set screw and chrome-plated finish.
6. Stamped Steel: One piece, with spring clips and chrome-plated finish.
7. Stamped Steel: Split plate, with concealed hinge, set screw, and chrome-plated finish.
8. Stamped Steel: Split plate, with concealed hinge, spring clips, and chrome-plated finish.
9. Stamped Steel: Split plate, with exposed-rivet hinge, set screw, and chrome-plated finish.
10. Stamped Steel: Split plate, with exposed-rivet hinge, spring clips, and chrome-plated finish.
11. Cast-Iron Floor Plate: One-piece casting.

## 2.8 IDENTIFYING DEVICES AND LABELS

- A. General: Manufacturer's standard products of categories and types required for each application as referenced in other Division 15 Sections. If more than one type is specified for application, selection is Installer's option, but provide one selection for each product category.
- B. Equipment Nameplates: Metal nameplate with operational data engraved or stamped; permanently fastened to equipment.
  - 1. Data: Manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances, and similar essential data.
  - 2. Location: Accessible and visible location.
- C. Stencils: Standard stencils, prepared for required applications with letter sizes complying with recommendations of ASME A13.1 for piping and similar applications, but not less than 1-1/4-inch- (30-mm-) high letters for ductwork and not less than 3/4-inch- (19-mm-) high letters for access door signs and similar operational instructions.
  - 1. Material: Fiberboard.
  - 2. Material: Brass.
  - 3. Stencil Paint: Standard exterior-type stenciling enamel; black, unless otherwise indicated; either brushing grade or pressurized spray-can form and grade.
  - 4. Identification Paint: Standard identification enamel of colors indicated or, if not otherwise indicated for piping systems, comply with ASME A13.1 for colors.
- D. Snap-on Plastic Pipe Markers: Manufacturer's standard preprinted, semirigid, snap on, color-coded, complying with ASME A13.1.
- E. Pressure-Sensitive Pipe Markers: Manufacturer's standard preprinted, permanent adhesive, color-coded, pressure-sensitive vinyl, complying with ASME A13.1.
- F. Plastic Duct Markers: Manufacturer's standard color-coded, laminated plastic. Comply with the following color code:
  - 1. Green: Cold air.
  - 2. Yellow: Hot air.
  - 3. Yellow/Green or Green: Supply air.
  - 4. Blue: Exhaust, outside, return, and mixed air.
  - 5. For hazardous exhausts, use colors and designs recommended by ASME A13.1.
  - 6. Nomenclature: Include the following:
    - a. Direction of airflow.
    - b. Duct service.
    - c. Duct origin.
    - d. Duct destination.
    - e. Design cubic feet per minute (liters per second).
- G. Engraved Plastic-Laminate Signs: ASTM D 709, Type I, cellulose, paper-base, phenolic-resin-laminate engraving stock; Grade ES-2, black surface, black phenolic core, with white melamine subcore, unless otherwise indicated.



1. Fabricate in sizes required for message.
  2. Engraved with engraver's standard letter style, of sizes and with wording to match equipment identification.
  3. Punch for mechanical fastening.
  4. Thickness: 1/16 inch (1.6 mm), for units up to 20 sq. in. (130 sq. cm) or 8 inches (200 mm) long; 1/8 inch (3.2 mm) for larger units.
  5. Fasteners: Self-tapping stainless-steel screws or contact-type permanent adhesive.
- H. Plastic Equipment Markers: Color-coded, laminated plastic. Comply with the following color code:
1. Green: Cooling equipment and components.
  2. Yellow: Heating equipment and components.
  3. Yellow/Green: Combination cooling and heating equipment and components.
  4. Brown: Energy reclamation equipment and components.
  5. Blue: Equipment and components that do not meet any criteria above.
  6. For hazardous equipment, use colors and designs recommended by ASME A13.1.
  7. Nomenclature: Include the following, matching terminology on schedules as closely as possible:
    - a. Name and plan number.
    - b. Equipment service.
    - c. Design capacity.
    - d. Other design parameters such as pressure drop, entering and leaving conditions, and rpm.
  8. Size: Approximate 2-1/2 by 4 inches (65 by 100 mm) for control devices, dampers, and valves; and 4-1/2 by 6 inches (115 by 150 mm) for equipment.
- I. Lettering and Graphics: Coordinate names, abbreviations, and other designations used in mechanical identification, with corresponding designations indicated. Use numbers, lettering, and wording indicated for proper identification and operation/maintenance of mechanical systems and equipment.
1. Multiple Systems: If multiple systems of same generic name are indicated, provide identification that indicates individual system number and service such as "Boiler No. 3," "Air Supply No. 1H," or "Standpipe F12."

## 2.9 GROUT

- A. Nonshrink, Nonmetallic Grout: ASTM C 1107, Grade B.
1. Characteristics: Post-hardening, volume-adjusting, dry, hydraulic-cement grout, non-staining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
  2. Design Mix: 5000-psig (34.5-MPa), 28-day compressive strength.
  3. Packaging: Premixed and factory packaged.

## PART 3 - EXECUTION

## 3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. General: Install piping as described below, unless piping Sections specify otherwise. Individual Division 15 piping Sections specify unique piping installation requirements.
- B. General Locations and Arrangements: 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 at indicated slope.
- D. Install components with pressure rating equal to or greater than system operating pressure.
- E. Install piping in concealed interior and exterior locations, except in equipment rooms and service areas.
- F. Install piping free of sags and bends.
- G. Install exposed interior and exterior piping at right angles or parallel to building walls. Diagonal runs are prohibited, unless otherwise indicated.
- H. Install piping tight to slabs, beams, joists, columns, walls, and other building elements. Allow sufficient space above removable ceiling panels to allow for ceiling panel removal.
- I. Install piping to allow application of insulation plus 1-inch (25-mm) clearance around insulation.
- J. Locate groups of pipes parallel to each other, spaced to permit valve servicing.
- K. Install fittings for changes in direction and branch connections.
- L. Install couplings according to manufacturer's written instructions.
- M. Install pipe escutcheons for pipe penetrations of concrete and masonry walls, wall board partitions, and suspended ceilings according to the following:
  - 1. Chrome-Plated Piping: Cast brass, one piece, with set screw, and polished chrome-plated finish. Use split-casting escutcheons if required, for existing piping.
  - 2. Uninsulated Piping Wall Escutcheons: Cast brass or stamped steel, with set screw.
  - 3. Uninsulated Piping Floor Plates in Utility Areas: Cast-iron floor plates.
  - 4. Insulated Piping: Cast brass or stamped steel; with concealed hinge, spring clips, and chrome-plated finish.
  - 5. Piping in Utility Areas: Cast brass or stamped steel, with set-screw or spring clips.
- N. Sleeves are not required for core drilled holes.
- O. Permanent sleeves are not required for holes formed by PE removable sleeves.

- P. Install sleeves for pipes passing through concrete and masonry walls, and concrete floor and roof slabs.
- Q. 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 2 inches (50 mm) above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
  2. Build sleeves into new walls and slabs as work progresses.
  3. Install sleeves large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
    - a. Steel Pipe Sleeves: For pipes smaller than 6-inch NPS (DN150).
    - b. Steel, Sheet-Metal Sleeves: For pipes 6-inch NPS (DN150) and larger, penetrating gypsum-board partitions.
    - c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches (50 mm) above finished floor level. Refer to Division 7 Section "Sheet Metal Flashing and Trim" for flashing.
      - 1) Seal space outside of sleeve fittings with nonshrink, nonmetallic grout.
  4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using elastomeric joint sealants. Refer to Division 7 Section "Joint Sealants" for materials.
  5. Use Type S, Grade NS, Class 25, Use O, neutral-curing silicone sealant, unless otherwise indicated.
- R. Aboveground, Exterior-Wall, Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Size sleeve for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
1. Install steel pipe for sleeves smaller than 6 inches (150 mm) in diameter.
  2. Install cast-iron "wall pipes" for sleeves 6 inches (150 mm) in diameter and larger.
  3. Assemble and install mechanical sleeve seals according to manufacturer's written instructions. Tighten bolts that cause rubber sealing elements to expand and make watertight seal.
- S. Underground, Exterior-Wall, Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Size sleeve for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
1. Assemble and install mechanical sleeve seals according to manufacturer's written instructions. Tighten bolts that cause rubber sealing elements to expand and make watertight seal.

- T. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestopping materials. Refer to Division 7 Section "Firestopping" for materials.
- U. Verify final equipment locations for roughing-in.
- V. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.
- W. Piping Joint Construction: Join pipe and fittings as follows and as specifically required in individual piping specification Sections:
1. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
  2. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
  3. Soldered Joints: Construct joints according to AWS's "Soldering Manual," Chapter "The Soldering of Pipe and Tube"; or CDA's "Copper Tube Handbook."
  4. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."
  5. 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:
    - a. Note internal length of threads in fittings or valve ends, and proximity of internal seat or wall, to determine how far pipe should be threaded into joint.
    - b. Apply appropriate tape or thread compound to external pipe threads, unless dry seal threading is specified.
    - c. Align threads at point of assembly.
    - d. Tighten joint with wrench. Apply wrench to valve end into which pipe is being threaded.
    - e. 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.
  6. Welded Joints: Construct joints according to AWS D10.12, "Recommended Practices and Procedures for Welding Low Carbon Steel Pipe," using qualified processes and welding operators according to "Quality Assurance" Article.
  7. Flanged Joints: Align flange surfaces parallel. Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly using torque wrench.
  8. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join pipe and fittings according to the following:
    - a. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
    - b. ABS Piping: ASTM D 2235 and ASTM D 2661.
    - c. CPVC Piping: ASTM D 2846 and ASTM F 493.
    - d. PVC Pressure Piping: ASTM D 2672.
    - e. PVC Nonpressure Piping: ASTM D 2855.

- f. PVC to ABS Nonpressure Transition Fittings: Procedure and solvent cement according to ASTM D 3138.
- 9. Plastic Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657 procedures and manufacturer's written instructions.
  - a. Plain-End Pipe and Fittings: Use butt fusion.
  - b. Plain-End Pipe and Socket Fittings: Use socket fusion.
- X. Piping Connections: Make connections according to the following, unless otherwise indicated:
  - 1. Install unions, in piping 2-inch NPS (DN50) and smaller, adjacent to each valve and at final connection to each piece of equipment with 2-inch NPS (DN50) or smaller threaded pipe connection.
  - 2. Install flanges, in piping 2-1/2-inch NPS (DN65) and larger, adjacent to flanged valves and at final connection to each piece of equipment with flanged pipe connection.
  - 3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
  - 4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

### 3.2 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to provide maximum possible headroom, if mounting heights are not indicated.
- B. Install equipment according to approved submittal data. Portions of the Work are shown only in diagrammatic form. Refer conflicts to Engineer.
- C. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- D. Install mechanical 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.
- E. Install equipment giving right of way to piping installed at required slope.
- F. Install flexible connectors on equipment side of shutoff valves, horizontally and parallel to equipment shafts if possible.

### 3.3 LABELING AND IDENTIFYING

- A. Piping Systems: Install pipe markers on each system. Include arrows showing normal direction of flow.

1. Stenciled Markers: According to ASME A13.1.
  2. Plastic markers, with application systems. Install on insulation segment if required for hot, uninsulated piping.
  3. Locate pipe markers as follows if piping is exposed in finished spaces, machine rooms, and accessible maintenance spaces, such as shafts, tunnels, plenums, and exterior non-concealed locations:
    - a. Near each valve and control device.
    - b. Near each branch, excluding short takeoffs for fixtures and terminal units. Mark each pipe at branch, if flow pattern is not obvious.
    - c. Near locations if pipes pass through walls, floors, ceilings, or enter nonaccessible enclosures.
    - d. At access doors, manholes, and similar access points that permit view of concealed piping.
    - e. Near major equipment items and other points of origination and termination.
    - f. Spaced at maximum of 50-foot (15-m) intervals along each run. Reduce intervals to 25 feet (7.5 m) in congested areas of piping and equipment.
    - g. On piping above removable acoustical ceilings, except omit intermediately spaced markers.
- B. Equipment: Install engraved plastic-laminate sign or equipment marker on or near each major item of mechanical equipment.
1. Lettering Size: Minimum 1/4-inch- (6.4-mm-) high lettering for name of unit if viewing distance is less than 24 inches (610 mm), 1/2-inch- (12.7-mm-) high lettering for distances up to 72 inches (1800 mm), and proportionately larger lettering for greater distances. Provide secondary lettering two-thirds to three-fourths of size of principal lettering.
  2. Text of Signs: Provide name of identified unit. Include text to distinguish between multiple units, inform user of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.
- C. Duct Systems: Identify air supply, return, exhaust, intake, and relief ducts with duct markers; or provide stenciled signs and arrows, showing duct system service and direction of flow.
1. Location: In each space, if ducts are exposed or concealed by removable ceiling system, locate signs near points where ducts enter into space and at maximum intervals of 50 feet (15 m).
- D. Adjusting: Relocate identifying devices as necessary for unobstructed view in finished construction.
- 3.4 PAINTING AND FINISHING
- A. Refer to Division 9 Section "Painting" for paint materials, surface preparation, and application of paint.
  - B. Apply paint to exposed piping according to the following, unless otherwise indicated:

1. Interior, Ferrous Piping: Use semigloss, acrylic-enamel finish. Include finish coat over enamel undercoat and primer.
2. Interior, Galvanized-Steel Piping: Use semigloss, acrylic-enamel finish. Include two finish coats over galvanized metal primer.
3. Interior, Ferrous Supports: Use semigloss, acrylic-enamel finish. Include finish coat over enamel undercoat and primer.
4. Exterior, Ferrous Piping: Use semigloss, acrylic-enamel finish. Include two finish coats over rust-inhibitive metal primer.
5. Exterior, Galvanized-Steel Piping: Use semigloss, acrylic-enamel finish. Include two finish coats over galvanized metal primer.
6. Exterior, Ferrous Supports: Use semigloss, acrylic-enamel finish. Include two finish coats over rust-inhibitive metal primer.

C. Do not paint piping specialties with factory-applied finish.

D. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

### 3.5 CONCRETE BASES

A. Construct concrete bases of dimensions indicated, but not less than 4 inches (100 mm) larger in both directions than supported unit. Follow supported equipment manufacturer's setting templates for anchor bolt and tie locations. Use 3000-psig (20.7-MPa), 28-day compressive-strength concrete and reinforcement as specified in Division 3 Section "Cast-in-Place Concrete."

### 3.6 ERECTION OF METAL SUPPORTS AND ANCHORAGE

A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.

B. Field Welding: Comply with AWS D1.1, "Structural Welding Code--Steel."

### 3.7 ERECTION OF WOOD SUPPORTS AND ANCHORAGE

A. Cut, fit, and place wood grounds, nailers, blocking, and anchorage to support and anchor mechanical 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.

### 3.8 DEMOLITION

A. Disconnect, demolish, and remove Work specified in Division 15 Sections.

- B. If pipe, ductwork, insulation, or equipment to remain is damaged or disturbed, remove damaged portions and install new products of equal capacity and quality.
- C. Accessible Work: Remove indicated exposed pipe and ductwork in its entirety.
- D. Work Abandoned in Place: Cut and remove underground pipe a minimum of 2 inches (50 mm) beyond face of adjacent construction. Cap and patch surface to match existing finish.
- E. Removal: Remove indicated equipment from Project site.
- F. Temporary Disconnection: Remove, store, clean, reinstall, reconnect, and make operational equipment indicated for relocation.

### 3.9 CUTTING AND PATCHING

- A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces necessary for mechanical installations. Perform cutting by skilled mechanics of trades involved.
- B. Repair cut surfaces to match adjacent surfaces.

### 3.10 GROUTING

- A. Install nonmetallic, nonshrink, grout for mechanical equipment base bearing surfaces, pump and other equipment base plates, and anchors. Mix grout according to manufacturer's written instructions.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placing of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases to provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout according to manufacturer's written instructions.

END OF SECTION 15050





## SECTION 15060 - HANGERS AND SUPPORTS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes hangers and supports for mechanical system piping and equipment.
- B. Related Sections include the following:
  - 1. Division 5 Section "Metal Fabrications" for materials for attaching hangers and supports to building structure.
  - 2. Division 13 Sections on fire-suppression piping for fire-suppression pipe hangers.
  - 3. Division 15 Section "Mechanical Vibration Controls and Seismic Restraints" for vibration isolation and seismic restraint devices.

#### 1.3 DEFINITIONS

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

#### 1.4 PERFORMANCE REQUIREMENTS

- A. Design channel support systems for piping to support multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.
- B. Design heavy-duty steel trapezes for piping to support multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.
- C. Design seismic restraint hangers and supports for piping and equipment.
- D. Design and obtain approval from Authorities Having Jurisdiction for seismic restraint hangers and supports for piping and equipment.

#### 1.5 SUBMITTALS

- A. Product Data: For each type of pipe hanger, channel support system component, and thermal-hanger shield insert indicated.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer for multiple piping supports and trapeze hangers. Include design calculations and indicate size and characteristics of components and fabrication details.

- C. Welding Certificates: Copies of certificates for welding procedures and operators.

## 1.6 QUALITY ASSURANCE

- A. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
- B. Engineering Responsibility: Design and preparation of Shop Drawings and calculations for each multiple pipe support and trapeze by a qualified professional engineer.
- C. Engineering Responsibility: Design and preparation of Shop Drawings and calculations for each multiple pipe support, trapeze, and seismic restraint by a qualified professional engineer.
  - 1. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of hangers and supports that are similar to those indicated for this Project in material, design, and extent.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Pipe Hangers:
    - a. AAA Technology and Specialties Co., Inc.
    - b. B-Line Systems, Inc.
    - c. Carpenter & Patterson, Inc.
    - d. Empire Tool & Manufacturing Co., Inc.
    - e. Globe Pipe Hanger Products, Inc.
    - f. Grinnell Corp.
    - g. GS Metals Corp.
    - h. Michigan Hanger Co., Inc.
    - i. National Pipe Hanger Corp.
    - j. PHD Manufacturing, Inc.
    - k. PHS Industries, Inc.
    - l. Piping Technology & Products, Inc.
  - 2. Channel Support Systems:
    - a. B-Line Systems, Inc.

- b. Grinnell Corp.; Power-Strut Unit.
  - c. GS Metals Corp.
  - d. Michigan Hanger Co., Inc.; O-Strut Div.
  - e. National Pipe Hanger Corp.
  - f. Thomas & Betts Corp.
  - g. Unistrut Corp.
  - h. Wesanco, Inc.
3. Thermal-Hanger Shield Inserts:
- a. Carpenter & Patterson, Inc.
  - b. Michigan Hanger Co., Inc.
  - c. PHS Industries, Inc.
  - d. Pipe Shields, Inc.
  - e. Rilco Manufacturing Co., Inc.
  - f. Value Engineered Products, Inc.
4. Powder-Actuated Fastener Systems:
- a. Gunnebo Fastening Corp.
  - b. Hilti, Inc.
  - c. ITW Ramset/Red Head.
  - d. Masterset Fastening Systems, Inc.

## 2.2 MANUFACTURED UNITS

- A. Pipe Hangers, Supports, and Components: MSS SP-58, factory-fabricated components. Refer to "Hanger and Support Applications" Article in Part 3 for where to use specific hanger and support types.
- 1. Galvanized, Metallic Coatings: For piping and equipment that will not have field-applied finish.
  - 2. Nonmetallic Coatings: On attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- B. Channel Support Systems: MFMA-2, factory-fabricated components for field assembly.
- 1. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated.
  - 2. Nonmetallic Coatings: On attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- C. Thermal-Hanger Shield Inserts: 100-psi (690-kPa) minimum compressive-strength insulation, encased in sheet metal shield.
- 1. Material for Cold Piping: ASTM C 552, Type I cellular glass or water-repellent-treated, ASTM C 533, Type I calcium silicate with vapor barrier.
  - 2. Material for Cold Piping: ASTM C 552, Type I cellular glass with vapor barrier.
  - 3. Material for Cold Piping: Water-repellent-treated, ASTM C 533, Type I calcium silicate with vapor barrier.
  - 4. Material for Hot Piping: ASTM C 552, Type I cellular glass or water-repellent-treated, ASTM C 533, Type I calcium silicate.

5. Material for Hot Piping: ASTM C 552, Type I cellular glass.
6. Material for Hot Piping: Water-repellent-treated, ASTM C 533, Type I calcium silicate.
7. For Trapeze or Clamped System: Insert and shield cover entire circumference of pipe.
8. For Clevis or Band Hanger: Insert and shield cover lower 180 degrees of pipe.
9. Insert Length: Extend 2 inches (50 mm) beyond sheet metal shield for piping operating below ambient air temperature.

## 2.3 MISCELLANEOUS MATERIALS

- A. Powder-Actuated Drive-Pin Fasteners: Powder-actuated-type, drive-pin attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.
- B. Mechanical-Anchor Fasteners: Insert-type attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.
- C. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars, black and galvanized.
- D. Grout: ASTM C 1107, Grade B, factory-mixed and -packaged, nonshrink and nonmetallic, dry, hydraulic-cement grout.
  1. Characteristics: Post hardening and volume adjusting; recommended for both interior and exterior applications.
  2. Properties: Nonstaining, noncorrosive, and nongaseous.
  3. Design Mix: 0500-psi, 28-day compressive strength.

## PART 3 - EXECUTION

### 3.1 HANGER AND SUPPORT APPLICATIONS

- A. Specific hanger requirements are specified in Sections specifying equipment and systems.
- B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Specification Sections.
- C. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Specification 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 deg F (49 to 232 deg C) pipes, NPS 4 to NPS 16 (DN100 to DN400), requiring up to 4 inches (100 mm) 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.
  3. Steel Pipe Clamps MSS Type 4. For suspension of cold and hot pipes, NPS 1/2 to NPS 24, if little or no insulation is required.
  4. Pipe Hangers MSS Type 5. For suspension of pipes, NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.

5. Adjustable Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated stationary pipes, NPS 3/4 to NPS 8 (DN20 to DN200).
6. Adjustable Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8 (DN15 to DN200).
7. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8 (DN15 to DN200).
8. Adjustable Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 2 (DN15 to DN50).
9. Split Pipe-Ring with or without Turnbuckle-Adjustment Hangers (MSS Type 11): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 8 (DN10 to DN200).
10. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 3 (DN10 to DN80).
11. U-Bolts (MSS Type 24): For support of heavy pipe, NPS 1/2 to NPS 30 (DN15 to DN750).
12. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
13. Pipe Saddle Supports (MSS Type 36): For support of pipes, NPS 4 to NPS 36 (DN100 to DN900), with steel pipe base stanchion support and cast-iron floor flange.
14. Pipe Stanchion Saddles (MSS Type 37): For support of pipes, NPS 4 to NPS 36 (DN100 to DN900), with steel pipe base stanchion support and cast-iron floor flange and with U-bolt to retain pipe.
15. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes, NPS 2-1/2 to NPS 36 (DN65 to DN900), if vertical adjustment is required, with steel pipe base stanchion support and cast-iron floor flange.
16. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 30 (DN25 to DN750), from two rods if longitudinal movement caused by expansion and contraction might occur.
17. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes, NPS 2-1/2 to NPS 20 (DN65 to DN500), from single rod if horizontal movement caused by expansion and contraction might occur.
18. Complete Pipe Rolls (MSS Type 44): For support of pipes, NPS 2 to NPS 42 (DN50 to DN1050), if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
19. Pipe Roll and Plate Units (MSS Type 45): For support of pipes, NPS 2 to NPS 24 (DN50 to DN600), if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
20. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes, NPS 2 to NPS 30 (DN50 to DN750), if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

D. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Specification 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.

E. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:

1. Steel Turnbuckles MSS Type 13. For adjustment up to 6 inches for heavy loads.
2. Steel Clevises MSS Type 14. For 120 to 450 deg F piping installations.
3. Swivel Turnbuckles MSS Type 15. For use with MSS Type 11, split pipe rings.
4. Malleable-Iron Sockets MSS Type 16. For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts MSS Type 17. For 120 to 450 deg F piping installations.

F. Building Attachments: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joint construction to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
  - a. Light (MSS Type 31): 750 lb (340 kg).
  - b. Medium (MSS Type 32): 1500 lb (675 kg).
  - c. Heavy (MSS Type 33): 3000 lb (1350 kg).
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 head room is limited.

B. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Specification 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 by manufacturer to prevent crushing insulation.

3. Thermal-Hanger Shield Inserts: For supporting insulated pipe, 360-degree insert of high-density, 100-psi (690-kPa) minimum compressive-strength, water-repellent-treated calcium silicate or cellular-glass pipe insulation, same thickness as adjoining insulation with vapor barrier and encased in 360-degree sheet metal shield.
- C. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Specification 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 (32 mm).
  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.

### 3.2 HANGER AND SUPPORT INSTALLATION

- A. Pipe Hanger and Support 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. Channel Support System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled channel systems.
1. Field assemble and install according to manufacturer's written instructions.
- C. Heavy-Duty Steel Trapeze Installation: Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated, heavy-duty trapezes.
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 D-1.1.



- D. Install building attachments within concrete slabs. Space attachments within maximum piping span length indicated in MSS SP-69. Install additional attachments at concentrated loads, including valves, flanges, guides, strainers, and expansion joints, 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.
- E. Install powder-actuated drive-pin fasteners 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.
- F. Install mechanical-anchor fasteners in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- G. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- H. 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.
- I. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- J. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9, "Building Services Piping," is not exceeded.
- K. 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.
  - 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 (DN100) 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 arc of 180 degrees.
    - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN100) 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 (DN8 to DN90): 12 inches (305 mm) long and 0.048 inch (1.22 mm) thick.
  - b. NPS 4 (DN100): 12 inches (305 mm) long and 0.06 inch (1.52 mm) thick.
  - c. NPS 5 and NPS 6 (DN125 and DN150): 18 inches (457 mm) long and 0.06 inch (1.52 mm) thick.
  - d. NPS 8 to NPS 14 (DN200 to DN350): 24 inches (610 mm) long and 0.075 inch (1.91 mm) thick.
  - e. NPS 16 to NPS 24 (DN400 to DN600): 24 inches (610 mm) long and 0.105 inch (2.67 mm) thick.
5. Pipes NPS 8 (DN200) 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 above or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make smooth bearing surface.

### 3.4 METAL FABRICATION

- A. Cut, drill, and fit miscellaneous metal fabrications for heavy-duty steel trapezes 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 Adjustment: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

### 3.6 PAINTING

- A. Touching 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 a minimum dry film thickness of 2.0 mils.
- B. Touching Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 9 Section "Painting."
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 15060

## SECTION 15071 – MECHANICAL VIBRATION AND SEISMIC CONTROLS

## PART 1 – GENERAL

## 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Elastomeric isolation pads and mounts.
  - 2. Restrained elastomeric isolation mounts.
  - 3. Freestanding and restrained spring isolators.
  - 4. Housed spring mounts.
  - 5. Elastomeric hangers.
  - 6. Spring hangers.
  - 7. Spring hangers with vertical-limit stops.
  - 8. Thrust limits.
  - 9. Pipe riser resilient supports.
  - 10. Resilient pipe guides.
  - 11. Freestanding and restrained air spring isolators.
  - 12. Restrained vibration isolation roof-curb rails.
  - 13. Seismic snubbers.
  - 14. Restraining cables.
  - 15. Steel and inertia, vibration isolation equipment bases.

## 1.3 DEFINITIONS

- A.  $A_v$ : Effective peak velocity related acceleration coefficient.
- B. OSHPD: Office of Statewide Health Planning & Development for the State of Puerto Rico. OSHPD assigns a unique anchorage pre-approval "R" number to each seismic restraint it tests. The number describes a specific device applied as tested.

## 1.4 PERFORMANCE REQUIREMENTS

- A.  $A_v$ : Comply with UBC-1997, Category II.
- B. Component Seismic Coefficient: Comply with UBC-1997.
- C. Performance Criteria Factor: Comply with UBC-1997.
- D. Attachment Amplification Factor: Comply with UBC-1997.

## 1.5 SUBMITTALS

- A. Product Data: Include load deflection curves for each vibration isolation device.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer. Include the following:
  - 1. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
  - 2. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification that riser system has been examined for excessive stress and that none will exist.
  - 3. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, base weights, equipment static loads, power transmission, component misalignment, and cantilever loads.
  - 4. Seismic-Restraint Details: Detail fabrication and attachment of seismic restraints and snubbers. Show anchorage details and indicate quantity, diameter, and depth of penetration of anchors.
  - 5. Submittals for Interlocking Snubbers: Include load deflection curves up to 1/2-inch deflection in x, y, and z planes.
- C. Welding certificates.
- D. Air-Mounting System Performance Certification: Include natural frequency, load, and damping tests performed by an independent laboratory or acoustician.
- E. Manufacturer Seismic Qualification Certification: Submit certification that all specified equipment will withstand seismic forces identified in "Performance Requirements" Article above. Include the following:
  - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculations.
    - a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
    - b. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
  - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
  - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

## 1.6 QUALITY ASSURANCE

- A. Seismic-restraint devices shall have horizontal and vertical load testing and analysis performed according to OSHPD and shall bear anchorage preapproval "R" number, from OSHPD or another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If pre-approved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer. Testing and calculations must include both shear and tensile loads and 1 test or analysis at 45 degrees to the weakest mode.

- B. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel."

1.7 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into base. Concrete, reinforcement, and formwork requirements are specified in Division 3.
- B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 7 Section "Roof Accessories."

1.8 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. Seismic Snubber Units: Furnish replacement neoprene inserts for all snubbers.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
  - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.
  - 2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 VIBRATION ISOLATORS

- A. Available Manufacturers:
- B. Manufacturers:
  - 1. Ace Mounting Co., Inc.
  - 2. Amber/Booth Company, Inc.
  - 3. B-Line Systems, Inc.
  - 4. California Dynamics Corp.
  - 5. Isolation Technology, Inc.
  - 6. Kinetics Noise Control, Inc.
  - 7. Mason Industries, Inc.
  - 8. Vibration Eliminator Co., Inc.
  - 9. Vibration Isolation Co., Inc.
  - 10. Vibration Mountings & Controls/Korfund.
- C. Elastomeric Isolator Pads: Oil- and water-resistant elastomer or natural rubber, arranged in single or multiple layers, molded with a nonslip pattern and galvanized steel baseplates of sufficient stiffness for uniform loading over pad area, and factory cut to sizes that match requirements of supported equipment.

1. Material: Bridge-bearing neoprene, complying with AASHTO M 251.
  2. Durometer Rating: 70.
  3. Number of Layers: 3.
- D. Elastomeric Mounts: Double-deflection type, with molded, oil-resistant rubber or neoprene isolator elements with factory-drilled, encapsulated top plate for bolting to equipment and with baseplate for bolting to structure. Color-code or otherwise identify to indicate capacity range.
1. Durometer Rating: 70.
- E. Restrained Elastomeric Mounts: All-directional elastomeric mountings with seismic restraint.
1. Materials: Cast-ductile-iron housing containing two separate and opposing, molded, bridge-bearing neoprene elements that prevent central threaded sleeve and attachment bolt from contacting the casting during normal operation.
  2. Neoprene: Shock-absorbing materials compounded according to, the standard for bridge-bearing neoprene as defined by AASHTO.
- F. Spring Isolators: Freestanding, laterally stable, open-spring isolators.
1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
  2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
  3. Lateral Stiffness: More than 80 percent of the rated vertical stiffness.
  4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
  5. Baseplates: Factory drilled for bolting to structure and bonded to 1/4-inch- thick, rubber isolator pad attached to baseplate underside. Baseplates shall limit floor load to 100 psig.
  6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.
- G. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic restraint.
1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to wind loads or if weight is removed; factory-drilled baseplate bonded to 1/4-inch- thick, elastomeric isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
  2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
  3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
  4. Lateral Stiffness: More than 80 percent of the rated vertical stiffness.
  5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
- H. Housed Spring Mounts: Housed spring isolator with integral seismic snubbers.
1. Housing: Ductile-iron or steel housing to provide all-directional seismic restraint.
  2. Base: Factory drilled for bolting to structure.
  3. Snubbers: Vertically adjustable to allow a maximum of 1/4-inch travel before contacting a resilient collar.
- I. Elastomeric Hangers: Double-deflection type, with molded, oil-resistant rubber or neoprene isolator elements bonded to steel housings with threaded connections for hanger rods. Color-code or otherwise identify to indicate capacity range.

- J. Spring Hangers: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression.
1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
  2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
  3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
  4. Lateral Stiffness: More than 80 percent of the rated vertical stiffness.
  5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
  6. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
- K. Spring Hangers with Vertical-Limit Stop: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression and with a vertical-limit stop.
1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
  2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
  3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
  4. Lateral Stiffness: More than 80 percent of the rated vertical stiffness.
  5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
  6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
  7. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
- L. Thrust Limits: Combination coil spring and elastomeric insert with spring and insert in compression and with a load stop. Include rod and angle-iron brackets for attaching to equipment.
1. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.
  2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
  3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
  4. Lateral Stiffness: More than 80 percent of the rated vertical stiffness.
  5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
  6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
  7. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch movement at start and stop.
- M. Pipe Riser Resilient Support: All-directional, acoustical pipe anchor consisting of 2 steel tubes separated by a minimum of 1/2-inch-thick, 60-durometer neoprene. Include steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions. Design support for a maximum load on the isolation material of 500 psig and for equal resistance in all directions.
- N. Resilient Pipe Guides: Telescopic arrangement of 2 steel tubes separated by a minimum of 1/2-inch-thick, 60-durometer neoprene. Factory set guide height with a shear pin to allow vertical motion due to pipe expansion and contraction. Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.



## 2.3 RESTRAINED VIBRATION ISOLATION ROOF-CURB RAILS

- A. Available Manufacturers:
- B. Manufacturers:
  - 1. Amber/Booth Company, Inc.
  - 2. California Dynamics Corp.
  - 3. Isolation Technology, Inc.
  - 4. Kinetics Noise Control, Inc.
  - 5. Mason Industries, Inc.
  - 6. Vibration Eliminator Co., Inc.
  - 7. Vibration Isolation Co., Inc.
  - 8. Vibration Mountings & Controls/Korfund.
- C. Description: Factory-assembled, fully enclosed, insulated, air- and watertight curb rail designed to resiliently support equipment and to withstand 125-mph wind impinging laterally against side of equipment.
- D. Lower Support Assembly: Sheet-metal "Z" section containing adjustable and removable steel springs that support upper floating frame. Upper frame shall provide continuous support for equipment and shall be captive to resiliently resist wind and seismic forces. Lower support assembly shall have a means for attaching to building structure and a wood nailer for attaching roof materials, and shall be insulated with a minimum of 2 inches of rigid, glass-fiber insulation on inside of assembly.
- E. Spring Isolators: Adjustable, restrained spring isolators shall be mounted on 1/4-inch- thick, elastomeric vibration isolation pads and shall have access ports, for level adjustment, with removable waterproof covers at all isolator locations. Isolators shall be located so they are accessible for adjustment at any time during the life of the installation without interfering with the integrity of the roof.
  - 1. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic restraint.
    - a. Housing: Steel with resilient vertical-limit stops and adjustable equipment mounting and leveling bolt.
    - b. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
    - c. Minimum Additional Travel: 50 percent of the required deflection at rated load.
    - d. Lateral Stiffness: More than 80 percent of the rated vertical stiffness.
    - e. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
  - 2. Elastomeric Isolator Pads: Oil- and water-resistant elastomer or natural rubber, arranged in single or multiple layers, molded with a nonslip pattern and galvanized steel baseplates of sufficient stiffness for uniform loading over pad area, and factory cut to sizes that match requirements of supported equipment.
    - a. Material: Bridge-bearing neoprene, complying with AASHTO M 251.
    - b. Durometer Rating: 70.
    - c. Number of Layers: 4.
- F. Snubber Bushings: All-directional, elastomeric snubber bushings at least 1/4 inch thick.
- G. Water Seal: Galvanized sheet metal with EPDM seals at corners, attached to upper support frame, extending down past wood nailer of lower support assembly, and counterflashed over roof materials.

- A. Available Manufacturers:
  - B. Manufacturers:
    - 1. Amber/Booth Company, Inc.
    - 2. B-Line Systems, Inc.
    - 3. California Dynamics Corp.
    - 4. Kinetics Noise Control, Inc.
    - 5. Loos & Co., Inc.; Cableware Technology Division.
    - 6. Mason Industries, Inc.
    - 7. TOLCO Incorporated.
    - 8. Unistrut Diversified Products Co.; Wayne Manufacturing Division.
    - 9. Vibration Eliminator Co., Inc.
    - 10. Vibration Isolation Co., Inc.
    - 11. Vibration Mountings & Controls/Korfund.
  - C. Resilient Isolation Washers and Bushings: 1-piece, molded, bridge-bearing neoprene complying with AASHTO M 251 and having a durometer of 60, plus or minus 5, with a flat washer face.
  - D. Seismic Snubbers: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.
    - 1. Anchor bolts for attaching to concrete shall be seismic-rated, drill-in, and stud-wedge or female-wedge type.
    - 2. Resilient Isolation Washers and Bushings: 1-piece, molded, bridge-bearing neoprene complying with AASHTO M 251 and having a durometer of 60, plus or minus 5.
  - E. Restraining Cables: Galvanized steel aircraft cables with end connections made of steel assemblies that swivel to final installation angle and utilize two clamping bolts for cable engagement.
  - F. Anchor Bolts: Seismic-rated, drill-in, and stud-wedge or female-wedge type. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488/E 488M.
- 2.5 VIBRATION ISOLATION EQUIPMENT BASES
- A. Available Manufacturers:
  - B. Manufacturers:
    - 1. Amber/Booth Company, Inc.
    - 2. California Dynamics Corp.
    - 3. Isolation Technology, Inc.
    - 4. Kinetics Noise Control, Inc.
    - 5. Mason Industries, Inc.
    - 6. Vibration Eliminator Co., Inc.
    - 7. Vibration Isolation Co., Inc.
    - 8. Vibration Mountings & Controls/Korfund.
  - C. Steel Base: Factory-fabricated, welded, structural-steel bases and rails.
    - 1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails. Include supports for suction and discharge elbows for pumps.
    - 2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.

3. Support Brackets: Factory-welded steel angles on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
- D. Inertia Base: Factory-fabricated, welded, structural-steel bases and rails ready for field-applied, cast-in-place concrete.
1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails. Include supports for suction and discharge elbows for pumps.
  2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
  3. Support Brackets: Factory-welded steel angles on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
  4. Fabrication: Fabricate steel templates to hold equipment anchor-bolt sleeves and anchors in place during placement of concrete. Obtain anchor-bolt templates from supported equipment manufacturer.

## 2.6 FACTORY FINISHES

- A. Manufacturer's standard prime-coat finish ready for field painting.
- B. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.
1. Powder coating on springs and housings.
  2. All hardware shall be electrogalvanized. Hot-dip galvanize metal components for exterior use.
  3. Baked enamel for metal components on isolators for interior use.
  4. Color-code or otherwise mark vibration isolation and seismic-control devices to indicate capacity range.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements, installation tolerances, and other conditions affecting performance.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Install roof curbs, equipment supports, and roof penetrations as specified in Division 7 Section "Roof Accessories."
- B. Install thrust limits at centerline of thrust, symmetrical on either side of equipment.

- C. Install seismic snubbers on isolated equipment. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
- D. Install restraining cables at each trapeze and individual pipe hanger. At trapeze anchor locations, shackle piping to trapeze. Install cables so they do not bend across sharp edges of adjacent equipment or building structure.
- E. Install steel angles or channel, sized to prevent buckling, clamped with ductile-iron clamps to hanger rods for trapeze and individual pipe hangers. At trapeze anchor locations, shackle piping to trapeze. Requirements apply equally to hanging equipment. Do not weld angles to rods.
- F. Install resilient bolt isolation washers on equipment anchor bolts.

### 3.3 EQUIPMENT BASES

- A. Fill concrete inertia bases, after installing base frame, with 3000-psi concrete; trowel to a smooth finish.
  - 1. Cast-in-place concrete materials and placement requirements are specified in Division 3.
- B. Concrete Bases: Anchor equipment to concrete base according to supported equipment manufacturer's written instructions for seismic codes at Project site.
  - 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
  - 2. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base and anchor into structural concrete floor.
  - 3. Place and secure anchorage devices. Use Setting Drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 4. Install anchor bolts to elevations required for proper attachment to supported equipment.
  - 5. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
  - 6. Cast-in-place concrete materials and placement requirements are specified in Division 3.

### 3.4 FIELD QUALITY CONTROL

- A. Testing: Owner will engage a qualified testing agency to perform the following field quality-control testing:
- B. Testing: Engage a qualified testing agency to perform the following field quality-control testing:
- C. Testing: Perform the following field quality-control testing:
  - 1. Isolator seismic-restraint clearance.
  - 2. Isolator deflection.
  - 3. Snubber minimum clearances.
  - 4. Air-Mounting System Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
  - 5. Air-Mounting System Operational Test: Test the compressed-air leveling system. Remove malfunctioning units, replace with new units, and retest.
  - 6. Test and adjust air-mounting system controls and safeties. Replace damaged and malfunctioning controls and equipment.

- D. Air-Mounting System Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including piping connections. Report results in writing.
1. Isolator seismic-restraint clearance.
  2. Isolator deflection.
  3. Snubber minimum clearances.
  4. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
  5. Operational Test: Test the compressed-air leveling system. Remove malfunctioning units, replace with new units, and retest.
  6. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

### 3.5 ADJUSTING

- A. Adjust isolators after piping systems have been filled and equipment is at operating weight.
- B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.
- C. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch movement during start and stop.
- D. Adjust air spring leveling mechanism.
- E. Adjust active height of spring isolators.
- F. Adjust snubbers according to manufacturer's written recommendations.
- G. Adjust seismic restraints to permit free movement of equipment within normal mode of operation.
- H. Torque anchor bolts according to equipment manufacturer's written recommendations to resist seismic forces.

### 3.6 CLEANING

- A. After completing equipment installation, inspect vibration isolation and seismic-control devices. Remove paint splatters and other spots, dirt, and debris.

### 3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air-mounting systems. Refer to Division 1 Section "Closeout Procedures Demonstration and Training."

### 3.8 VIBRATION ISOLATOR AND SEISMIC-RESTRAINT SCHEDULE

- A. Supported or Suspended Equipment:
  1. Equipment Location:

2. Isolator Type:
3. Base Type:
4. Minimum Deflection:
5. Component Seismic Coefficient:
6. Performance Criteria Factor:
7. Attachment Amplification Factor:

END OF SECTION 15071



## SECTION 15075 - MECHANICAL 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.

## 1.2 SUMMARY

- A. This Section includes the following mechanical identification materials and their installation:
  - 1. Equipment nameplates.
  - 2. Equipment markers.
  - 3. Equipment signs.
  - 4. Access panel and door markers.
  - 5. Pipe markers.
  - 6. Duct markers.
  - 7. Stencils.
  - 8. Valve tags.
  - 9. Valve schedules.
  - 10. Warning tags.

## 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Valve numbering scheme.
- D. Valve Schedules: For each piping system. Furnish extra copies (in addition to mounted copies) to include in maintenance manuals.

## 1.4 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.

## 1.5 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 EQUIPMENT IDENTIFICATION DEVICES

- A. Equipment Nameplates: Metal, with data engraved or stamped, for permanent attachment on equipment.
1. Data:
    - a. Manufacturer, product name, model number, and serial number.
    - b. Capacity, operating and power characteristics, and essential data.
    - c. Labels of tested compliances.
  2. Location: Accessible and visible.
  3. Fasteners: As required to mount on equipment.
- B. Equipment Markers: Engraved, color-coded laminated plastic. Include contact-type, permanent adhesive.
1. Terminology: Match schedules as closely as possible.
  2. Data:
    - a. Name and plan number.
    - b. Equipment service.
    - c. Design capacity.
    - d. Other design parameters such as pressure drop, entering and leaving conditions, and speed.
  3. Size: 2-1/2 by 4 inches for control devices, dampers, and valves; 4-1/2 by 6 inches for equipment.
- C. Equipment Signs: ASTM D 709, Type I, cellulose, paper-base, phenolic-resin-laminate engraving stock; Grade ES-2, black surface, black phenolic core, with white melamine subcore, unless otherwise indicated. Fabricate in sizes required for message. Provide holes for mechanical fastening.
1. Data: Instructions for operation of equipment and for safety procedures.
  2. Engraving: Manufacturer's standard letter style, of sizes and with terms to match equipment identification.
  3. Thickness: 1/16 inch for units up to 20 sq. in. or 8 inches in length, and 1/8 inch for larger units.
  4. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive.
- D. Access Panel and Door Markers: 1/16-inch- thick, engraved laminated plastic, with abbreviated terms and numbers corresponding to identification. Provide 1/8-inch center hole for attachment.
1. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive.

## 2.2 PIPING IDENTIFICATION DEVICES

- A. Manufactured Pipe Markers, 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 Full-band pipe markers extending 360 degrees around pipe at each location.
  4. Pipes with OD, Including Insulation, 6 Inches 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.

## 2.3 DUCT IDENTIFICATION DEVICES

- A. Duct Markers: Engraved, color-coded laminated plastic. Include direction and quantity of airflow and duct service (such as supply, return, and exhaust). Include contact-type, permanent adhesive.

## 2.4 STENCILS

- A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; minimum letter height of 1-1/4 inches for ducts; and minimum letter height of 3/4 inch for access panel and door markers, equipment markers, equipment signs, and similar operational instructions.

1. Stencil Material: Aluminum.
2. Stencil Paint: Exterior, gloss, acrylic enamel black, unless otherwise indicated. Paint may be in pressurized spray-can form.
3. Identification Paint: Exterior, acrylic enamel in colors according to ASME A13.1, unless otherwise indicated.

## 2.5 VALVE TAGS

- A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers, with numbering scheme approved by Architect. Provide 5/32-inch hole for fastener.

1. Material: 0.032-inch- thick aluminum.
2. Valve-Tag Fasteners: Brass or S-hook.

## 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.

## 2.7 WARNING TAGS

- A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags; of plasticized card stock with matte finish suitable for writing.

1. Size: 3 by 5-1/4 inches minimum. Approximately 4 by 7 inches .
2. Fasteners: Reinforced grommet and wire or string.
3. Nomenclature: Large-size primary caption such as DANGER, CAUTION, or DO NOT OPERATE.
4. Color: Yellow background with black lettering.

## PART 3 - EXECUTION

## 3.1 APPLICATIONS, GENERAL

- A. Products specified are for applications referenced in other Division 15 Sections. If more than single-type material, device, or label is specified for listed applications, selection is Installer's option.

### 3.2 EQUIPMENT IDENTIFICATION

- A. Install and permanently fasten equipment nameplates on each major item of mechanical equipment that does not have nameplate or has nameplate that is damaged or located where not easily visible. Locate nameplates where accessible and visible. Include nameplates for the following general categories of equipment:
  - 1. Pumps and similar motor-driven units.
  - 2. Fans, blowers, primary balancing dampers, and mixing boxes.
- 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.
  - 1. Letter Size: Minimum 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
  - 2. Data: Distinguish among multiple units, indicate operational requirements, indicate safety and emergency precautions, warn of hazards and improper operations, and identify units.
  - 3. Locate markers where accessible and visible. Include markers for the following general categories of equipment:
    - a. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
    - b. Fire department hose valves and hose stations.
    - c. Meters, gages, thermometers, and similar units.
    - d. Pumps and similar motor-driven units.
    - e. Fans, blowers, primary balancing dampers, and mixing boxes.
    - f. Tanks and pressure vessels.
- 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.
- D. Install equipment signs with screws or permanent adhesive on or near each major item of mechanical equipment. Locate signs where accessible and visible.
  - 1. Letter Size: Minimum 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
  - 2. Data: Distinguish among multiple units, indicate operational requirements, indicate safety and emergency precautions, warn of hazards and improper operations, and identify units.
  - 3. Include signs for the following general categories of equipment:
    - a. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
    - b. Pumps, compressors and similar motor-driven units.
    - c. Fans, blowers, primary balancing dampers, and mixing boxes.
    - d. Tanks and pressure vessels.
    - e. Strainers, filters, humidifiers, water-treatment systems, and similar equipment.
- E. Install access panel markers with screws on equipment access panels.

## 3.3 PIPING IDENTIFICATION

- A. Install manufactured pipe markers indicating service on each piping system. Install with flow indication arrows showing direction of flow.
- B. Locate pipe markers and color bands where piping is exposed in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior nonconcealed locations as follows:
  - 1. Near each valve and control device.
  - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
  - 3. Near penetrations through walls, floors, ceilings, and nonaccessible enclosures.
  - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
  - 5. Near major equipment items and other points of origination and termination.
  - 6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
  - 7. On piping above removable acoustical ceilings. Omit intermediately spaced markers.

## 3.4 DUCT IDENTIFICATION

- A. Install duct markers with permanent adhesive on air ducts in the following color codes:
  - 1. Blue for exhaust-, outside-, relief-, return-, and mixed-air ducts.
  - 2. ASME A13.1 Colors and Designs: For hazardous material exhaust.
  - 3. Letter Size: Minimum 1/4 inch for name of units if viewing distance is less than 24 inches 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- B. Locate markers near points where ducts enter into concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

## 3.5 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; plumbing fixture supply stops; shutoff valves; faucets; convenience and lawn-watering hose connections; and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following:
  - 1. Valve-Tag Size and Shape:
    - a. Cold Water: 2 inches, square.
    - b. Hot Water: 2 inches, square.
    - c. Fire Protection: 2 inches, square.
    - d. Gas: 2 inches, square.
  - 2. Valve-Tag Color:
    - a. Cold Water: Blue .
    - b. Hot Water: Green .
    - c. Fire Protection: Red.
    - d. Gas: Yellow.

3. Letter Color:
  - a. Cold Water: White.
  - b. Hot Water: White.
  - c. Fire Protection: White.
  - d. Gas: Black .

3.6 VALVE-SCHEDULE INSTALLATION

- A. Mount valve schedule on wall in accessible location in each major equipment room.

3.7 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

3.8 ADJUSTING

- A. Relocate mechanical identification materials and devices that have become visually blocked by other work.

3.9 CLEANING

- A. Clean faces of mechanical identification devices and glass frames of valve schedules.

END OF SECTION 15075

## SECTION 15081 - DUCT 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.

## 1.2 SUMMARY

- A. This Section includes semirigid and flexible duct, plenum, and breeching insulation; insulating cements; field-applied jackets; accessories and attachments; and sealing compounds.
- B. Related Sections include the following:
  - 1. Division 7 Section "Firestopping" for firestopping materials and requirements for penetrations through fire and smoke barriers.
  - 2. Division 15 Section "Equipment Insulation" for insulation materials and application for pumps, tanks, hydronic specialties, and other equipment.
  - 3. Division 15 Section "Pipe Insulation" for insulation for piping systems.
  - 4. Division 15 Section "Metal Ducts" for duct liner.

## 1.3 SUBMITTALS

- A. Product Data: Identify thermal conductivity, thickness, and jackets (both factory and field applied, if any), for each type of product indicated.
- B. Shop Drawings: Show fabrication and installation details for the following:
  - 1. Removable insulation sections at access panels.
  - 2. Application of field-applied jackets.
  - 3. Applications at linkages for control devices.
- C. Samples: For each type of insulation and field-applied jacket. Identify each Sample, describing product and intended use. Submit 12-inch- (300-mm-) square sections of each sample material.
  - 1. Manufacturer's Color Charts: Show the full range of colors available for each type of field-applied finish material indicated.
- D. 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.
- E. Installer Certificates: Signed by the Contractor certifying that installers comply with requirements.

## 1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the U.S. Department of Labor, Bureau of Apprenticeship and Training.
- B. Fire-Test-Response Characteristics: As determined by testing materials identical to those specified in this Section according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and sealer and cement material containers with appropriate markings of applicable testing and inspecting agency.
  - 1. Insulation Installed Indoors: Flame-spread rating of 25 or less, and smoke-developed rating of 50 or less.
  - 2. Insulation Installed Outdoors: Flame-spread rating of 75 or less, and smoke-developed rating of 150 or less.
- C. Mockups: Before installing insulation, build mockups for each type of insulation and finish listed below to demonstrate quality of insulation application and finishes. Build mockups according to the following requirements, using materials indicated for the completed Work:
  - 1. Include the following mockups:
    - a. One 10-foot (3-m) section of rectangular straight duct.
    - b. One 90-degree square elbow and one 90-degree radius elbow.
    - c. One branch takeoff.
    - d. One transition fitting.
    - e. Four support hangers.
  - 2. Build mockups with cutaway sections to allow observation of application details for insulation materials, mastics, attachments, and jackets.
  - 3. Build mockups in the location indicated or, if not indicated, as directed by Engineer.
  - 4. Notify Engineer seven days in advance of dates and times when mockups will be constructed.
  - 5. Obtain Engineer's approval of mockups before starting insulation application.
  - 6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
  - 7. Demolish and remove mockups when directed.
  - 8. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

## 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Ship insulation materials in containers marked by manufacturer with appropriate ASTM specification designation, type and grade, and maximum use temperature.

## 1.6 COORDINATION

- A. Coordinate clearance requirements with duct Installer for insulation application.

1.7 SCHEDULING

- A. Schedule insulation application after testing duct systems. Insulation application may begin on segments of ducts that have satisfactory test results.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Mineral-Fiber Insulation:
    - a. CertainTeed Manson.
    - b. Knauf FiberGlass GmbH.
    - c. Owens-Corning Fiberglas Corp.
    - d. Schuller International, Inc.
  - 2. Flexible Elastomeric Thermal Insulation:
    - a. Armstrong World Industries, Inc.
    - b. Rubatex Corp.
  - 3. Closed-Cell Phenolic-Foam Insulation:
    - a. Kooltherm Insulation Products, Ltd.
  - 4. Calcium Silicate Insulation:
    - a. Owens-Corning Fiberglas Corp.
    - b. Pabco.
    - c. Schuller International, Inc.

2.2 INSULATION MATERIALS

- A. Mineral-Fiber Board Thermal Insulation: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IB, 6.0 Lb/Cubic Ft., without facing and with all-service jacket manufactured from kraft paper, reinforcing scrim, aluminum foil, and vinyl film.
- B. Mineral-Fiber Blanket Thermal Insulation: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II, 1.5 lb/ Cubic Ft., without facing and with all-service jacket manufactured from kraft paper, reinforcing scrim, aluminum foil, and vinyl film.
- C. Flexible Elastomeric Thermal Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type II for sheet materials.



1. Adhesive: As recommended by insulation material manufacturer.
2. Ultraviolet-Protective Coating: As recommended by insulation manufacturer.

D. Closed-Cell Phenolic-Foam Insulation: Block insulation of rigid, expanded, closed-cell structure. Comply with ASTM C 1126, Type II, Grade 1.

E. Calcium Silicate Insulation: Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a nonasbestos fibrous reinforcement. Comply with ASTM C 533, Type I.

### 2.3 FIELD-APPLIED JACKETS

A. General: ASTM C 921, Type 1, unless otherwise indicated.

B. Foil and Paper Jacket: Laminated, glass-fiber-reinforced, flame-retardant kraft paper and aluminum foil.

C. PVC Jacket: High-impact, ultraviolet-resistant PVC; 20 mils (0.5 mm) thick; roll stock ready for shop or field cutting and forming.

1. Adhesive: As recommended by insulation material manufacturer.
2. PVC Jacket Color: White or gray.
3. PVC Jacket Color: Custom color selected by the Engineer.

D. Aluminum Jacket: Deep corrugated sheets manufactured from aluminum alloy complying with ASTM B 209 (ASTM B 209M), and having an integrally bonded moisture barrier over entire surface in contact with insulation. Metal thickness and corrugation dimensions are scheduled at the end of this Section.

1. Finish: Smooth finish.
2. Finish: Cross-crimp corrugated finish.
3. Finish: Stucco-embossed finish.
4. Finish: Factory-painted finish.
5. Moisture Barrier: 1-mil- (0.025-mm-) thick, heat-bonded polyethylene and kraft paper.

E. Stainless-Steel Jacket: Deep corrugated sheets of stainless steel complying with ASTM A 666, Type 304 or 316; 0.10 inch (2.5 mm) thick; and roll stock ready for shop or field cutting and forming to indicated sizes.

1. Moisture Barrier: 1-mil- (0.025-mm-) thick, heat-bonded polyethylene and kraft paper.
2. Moisture Barrier: 3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper.
3. Jacket Bands: Stainless steel, Type 304, 3/4 inch (19 mm) wide.

### 2.4 ACCESSORIES AND ATTACHMENTS

A. Glass Cloth and Tape: Comply with MIL-C-20079H, Type I for cloth and Type II for tape. Woven glass-fiber fabrics, plain weave, presized a minimum of 8 oz./sq. yd. (270 g/sq. m).

1. Tape Width: 4 inches (100 mm).

- B. Bands: 3/4 inch (19 mm) wide, in one of the following materials compatible with jacket:
  - 1. Stainless Steel: ASTM A 666, Type 304; 0.020 inch (0.5 mm) thick.
  - 2. Galvanized Steel: 0.005 inch (0.13 mm) thick.
  - 3. Aluminum: 0.007 inch (0.18 mm) thick.
  - 4. Brass: 0.010 inch (0.25 mm) thick.
  - 5. Nickel-Copper Alloy: 0.005 inch (0.13 mm) thick.
- C. Wire: 0.080-inch (2.0-mm), nickel-copper alloy; 0.062-inch (1.6-mm), soft-annealed, stainless steel; or 0.062-inch (1.6-mm), soft-annealed, galvanized steel.
- D. Weld-Attached Anchor Pins and Washers: Copper-coated steel pin for capacitor-discharge welding and galvanized speed washer. Pin length sufficient for insulation thickness indicated.
  - 1. Welded Pin Holding Capacity: 100 lb (45 kg) for direct pull perpendicular to the attached surface.
- E. Adhesive-Attached Anchor Pins and Speed Washers: Galvanized steel plate, pin, and washer manufactured for attachment to duct and plenum with adhesive. Pin length sufficient for insulation thickness indicated.
  - 1. Adhesive: Recommended by the anchor pin manufacturer as appropriate for surface temperatures of ducts, plenums, and breechings; and to achieve a holding capacity of 100 lb (45 kg) for direct pull perpendicular to the adhered surface.
- F. Self-Adhesive Anchor Pins and Speed Washers: Galvanized steel plate, pin, and washer manufactured for attachment to duct and plenum with adhesive. Pin length sufficient for insulation thickness indicated.

## 2.5 VAPOR RETARDERS

- A. Mastics: Materials recommended by insulation material manufacturer that are compatible with insulation materials, jackets, and substrates.

## 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.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

## 3.3 GENERAL APPLICATION REQUIREMENTS

- A. Apply insulation materials, accessories, and finishes according to the manufacturer's written instructions; with smooth, straight, and even surfaces; and free of voids throughout the length of ducts and fittings.
- B. Refer to schedules at the end of this Section for materials, forms, jackets, and thicknesses required for each duct system.
- C. Use accessories compatible with insulation materials and suitable for the service. Use accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Apply multiple layers of insulation with longitudinal and end seams staggered.
- E. Seal joints and seams with vapor-retarder mastic on insulation indicated to receive a vapor retarder.
- F. Keep insulation materials dry during application and finishing.
- G. Apply insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by the insulation material manufacturer.
- H. Apply insulation with the least number of joints practical.
- I. Apply insulation over fittings and specialties, with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
- J. Hangers and Anchors: Where vapor retarder is indicated, seal penetrations in insulation at hangers, supports, anchors, and other projections with vapor-retarder mastic. Apply insulation continuously through hangers and around anchor attachments.
- K. Insulation Terminations: For insulation application where vapor retarders are indicated, seal ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.
- L. Apply insulation with integral jackets as follows:
  - 1. Pull jacket tight and smooth.
  - 2. Joints and Seams: Cover with tape and vapor retarder as recommended by insulation material manufacturer to maintain vapor seal.
  - 3. Vapor-Retarder Mastics: Where vapor retarders are indicated, apply mastic on seams and joints and at ends adjacent to duct flanges and fittings.
- M. Cut insulation according to manufacturer's written instructions to prevent compressing insulation to less than 75 percent of its nominal thickness.
- N. Install vapor-retarder mastic on ducts and plenums scheduled to receive vapor retarders.
  - 1. Ducts with Vapor Retarders: Overlap insulation facing at seams and seal with vapor-retarder mastic and pressure-sensitive tape having same facing as insulation. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-retarder seal.

2. Ducts without Vapor Retarders: Overlap insulation facing at seams and secure with outward clinching staples and pressure-sensitive tape having same facing as insulation.
- O. Roof Penetrations: Apply insulation for interior applications to a point even with top of roof flashing.
1. Seal penetrations with vapor-retarder mastic.
  2. Apply insulation for exterior applications tightly joined to interior insulation ends.
  3. Seal insulation to roof flashing with vapor-retarder mastic.
- P. Interior Wall and Partition Penetrations: Apply insulation continuously through walls and partitions, except fire-rated walls and partitions.
- Q. Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire/smoke damper sleeves for fire-rated wall and partition penetrations.
- R. Floor Penetrations: Terminate insulation at underside of floor assembly and at floor support at top of floor.
1. For insulation indicated to have vapor retarders, taper termination and seal insulation ends with vapor-retarder mastic.

### 3.4 MINERAL-FIBER INSULATION APPLICATION

- A. Blanket Applications for Ducts and Plenums: Secure blanket insulation with adhesive and anchor pins and speed washers.
1. Apply adhesives according to manufacturer's recommended coverage rates per square foot, 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 anchor pins and speed washers 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, 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 16 inches (400 mm) o.c. each way, and 3 inches (75 mm) maximum from insulation joints. Apply additional pins and clips to hold insulation tightly against surface at cross bracing.
    - c. Anchor pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
    - d. Do not overcompress insulation during installation.
  4. Impale insulation over anchors and attach speed washers.
  5. 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.
  6. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches (50 mm) from one edge and one end of insulation segment. Secure laps to adja-

- cent insulation segment with 1/2-inch (13-mm) staples, 1 inch (25 mm) o.c., and cover with pressure-sensitive tape having same facing as insulation.
7. Overlap unfaced blankets a minimum of 2 inches (50 mm) on longitudinal seams and end joints. Secure with steel band at end joints and spaced a maximum of 18 inches (450 mm) o.c.
  8. Apply insulation on rectangular duct elbows and transitions with a full insulation segment for each surface. Apply insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
  9. Insulate duct stiffeners, hangers, and flanges that protrude beyond the insulation surface with 6-inch- (150-mm-) wide strips of the same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with anchor pins spaced 6 inches (150 mm) o.c.
  10. Apply vapor-retarder mastic to open joints, breaks, and punctures for insulation indicated to receive vapor retarder.
- B. Board Applications for Ducts and Plenums: Secure board insulation with adhesive and anchor pins and speed washers.
1. Apply adhesives according to manufacturer's recommended coverage rates per square foot, 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. Space anchor pins as follows:
    - a. On duct sides with dimensions 18 inches (450 mm) and smaller, 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 16 inches (400 mm) o.c. each way, and 3 inches (75 mm) maximum from insulation joints. Apply additional pins and clips to hold insulation tightly against surface at cross bracing.
    - c. Anchor pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
    - d. Do not overcompress insulation during installation.
  4. 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. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches (50 mm) from one edge and one end of insulation segment. Secure laps to adjacent insulation segment with 1/2-inch (13-mm) staples, 1 inch (25 mm) o.c., and cover with pressure-sensitive tape having same facing as insulation.
  6. Apply insulation on rectangular duct elbows and transitions with a full insulation segment for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Apply insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
  7. Insulate duct stiffeners, hangers, and flanges that protrude beyond the insulation surface with 6-inch- (150-mm-) wide strips of the same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with anchor pins spaced 6 inches (150 mm) o.c.
  8. Apply vapor-retarder mastic to open joints, breaks, and punctures for insulation indicated to receive vapor retarder.

### 3.5 FLEXIBLE ELASTOMERIC THERMAL INSULATION APPLICATION

- A. Apply insulation to ducts and plenums as follows:
1. Follow the manufacturer's written instructions for applying insulation.
  2. Seal longitudinal seams and end joints with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the duct and plenum surface.

### 3.6 CLOSED-CELL PHENOLIC-FOAM INSULATION APPLICATION

- A. Apply insulation as follows:
1. Secure each layer of insulation to duct with stainless-steel bands at 12-inch (300-mm) intervals and tighten without deforming the insulation materials.
  2. Apply two-layer insulation with joints tightly butted and staggered at least 3 inches (75 mm). Secure inner layer with 0.062-inch (1.6-mm), soft-annealed, stainless-steel wire spaced at 12-inch (300-mm) intervals. Secure outer layer with stainless-steel bands at 12-inch (300-mm) intervals.
  3. On exposed applications, finish insulation with a skim coat of mineral-fiber, hydraulic-setting cement to surface of installed insulation. When dry, apply flood coat of lagging adhesive and press on one layer of glass cloth or tape. Overlap edges at least 1 inch (25 mm). Apply finish coat of lagging adhesive over glass cloth or tape. Thin the finish coat to achieve smooth finish.

### 3.7 CALCIUM SILICATE INSULATION APPLICATION

- A. Apply insulation according to the manufacturer's written instructions and as follows:
1. Secure single layer of insulation to duct with stainless-steel bands. Tighten bands without deforming the insulation material.
  2. Apply two-layer insulation with joints tightly butted and staggered at least 3 inches (75 mm). Secure inner layer with 0.062-inch (1.6-mm), soft-annealed, stainless-steel wire. Secure outer layer with stainless-steel bands.
  3. On exposed applications, without metal jacket, finish insulation with a skim coat of mineral-fiber, hydraulic-setting cement to surface of installed insulation. When dry, apply flood coat of lagging adhesive and press on one layer of glass cloth or tape. Overlap edges at least 1 inch (25 mm). Apply finish coat of lagging adhesive over glass cloth or tape. Thin the finish coat to achieve smooth finish.

### 3.8 FIELD-APPLIED JACKET APPLICATION

- A. Apply glass-cloth jacket, where indicated, directly over bare insulation or insulation with factory-applied jackets.
1. Apply jacket smooth and tight to surface with 2-inch (50-mm) overlap at seams and joints.

2. Embed glass cloth between two 0.062-inch- (1.6-mm-) thick coats of jacket manufacturer's recommended adhesive.
3. Completely encapsulate insulation with jacket, leaving no exposed raw insulation.

### 3.9 FINISHES

- A. Glass-Cloth Jacketed Insulation: Paint insulation finished with glass-cloth jacket as specified in Division 9 Section "Painting."
- 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 Engineer. Vary first and second coats to allow visual inspection of the completed Work.

### 3.10 DUCT SYSTEM APPLICATIONS

- A. Insulation materials and thicknesses are specified in schedules at the end of this Section.
- B. Materials and thicknesses for systems listed below are specified in schedules at the end of this Section.
- C. Insulate the following plenums and duct systems:
  1. Indoor concealed supply-, return-, and outside-air ductwork.
  2. Indoor exposed supply-, return-, and outside-air ductwork.
  3. Outdoor exposed supply and return ductwork.
  4. Indoor exposed range-hood exhaust ductwork.
  5. Indoor concealed range-hood exhaust ductwork.
  6. Indoor exposed oven and dishwasher exhaust ductwork.
  7. Indoor concealed oven and dishwasher ductwork.
  8. Indoor concealed dust collection ductwork.
  9. Indoor exposed dust collection ductwork in non-air conditioned areas.
- D. Items Not Insulated: Unless otherwise indicated, do not apply insulation to the following systems, materials, and equipment:
  1. Fibrous-glass ducts.
  2. Metal ducts with duct liner.
  3. Factory-insulated flexible ducts.
  4. Factory-insulated plenums, casings, terminal boxes, and filter boxes and sections.
  5. Flexible connectors.
  6. Vibration-control devices.
  7. Testing agency labels and stamps.
  8. Nameplates and data plates.
  9. Access panels and doors in air-distribution systems.

### 3.11 INDOOR DUCT AND PLENUM APPLICATION SCHEDULE

- A. Service: Round, supply-air ducts, concealed.
  - 1. Material: Mineral-fiber blanket.
  - 2. Thickness: 1-1/2 inches (38 mm).
  - 3. Number of Layers: One.
  - 4. Field-Applied Jacket: Foil and paper.
  - 5. Vapor Retarder Required: Yes.
  
- B. Service: Round, return-air ducts, concealed.
  - 1. Material: Mineral-fiber blanket.
  - 2. Thickness: 1-1/2 inches (38 mm).
  - 3. Number of Layers: One.
  - 4. Field-Applied Jacket: Foil and paper.
  - 5. Vapor Retarder Required: Yes.
  
- C. Service: Round, outside-air ducts, concealed.
  - 1. Material: Mineral-fiber blanket.
  - 2. Thickness: 1-1/2 inches (38 mm).
  - 3. Number of Layers: One.
  - 4. Field-Applied Jacket: Foil and paper.
  - 5. Vapor Retarder Required: Yes.
  
- D. Service: Rectangular, supply-air ducts, concealed.
  - 1. Material: Mineral-fiber blanket.
  - 2. Thickness: 1-1/2 inches (38 mm).
  - 3. Field-Applied Jacket: Foil and paper.
  - 4. Vapor Retarder Required: Yes.
  
- E. Service: Rectangular, return-air and exhaust air ducts, concealed.
  - 1. Material: Mineral-fiber blanket.
  - 2. Thickness: 1-1/2 inches (38 mm).
  - 3. Number of Layers: One.
  - 4. Field-Applied Jacket: Foil and paper.
  - 5. Vapor Retarder Required: Yes.
  
- F. Service: Rectangular, outside-air ducts, concealed.
  - 1. Material: Mineral-fiber blanket.
  - 2. Thickness: 1-1/2 inches (38 mm).
  - 3. Number of Layers: One.
  - 4. Field-Applied Jacket: Foil and paper.
  - 5. Vapor Retarder Required: Yes.
  
- G. Service: Rectangular, supply-air ducts, exposed.
  - 1. Material: Mineral-fiber board.
  - 2. Thickness: 1-1/2 inches (38 mm).



3. Number of Layers: One.
  4. Field-Applied Jacket: Glass cloth.
  5. Vapor Retarder Required: Yes.
- H. Service: Rectangular, return-air ducts, exposed.
1. Material: Mineral-fiber board.
  2. Thickness: 1-1/2 inches (38 mm).
  3. Number of Layers: One.
  4. Field-Applied Jacket: Glass cloth.
  5. Vapor Retarder Required: Yes.
- I. Service: Rectangular, outside-air ducts, exposed.
1. Material: Mineral-fiber board.
  2. Thickness: 1-1/2 inches (38 mm).
  3. Number of Layers: One.
  4. Field-Applied Jacket: Glass cloth.
  5. Vapor Retarder Required: Yes.
- J. Service: Rectangular, range-hood exhaust ducts, concealed.
1. Material: Calcium silicate.
  2. Thickness: 2 inches (50 mm).
  3. Number of Layers: One.
  4. Field-Applied Jacket: Glass cloth.
  5. Vapor Retarder Required: No.
- K. Service: Rectangular, range-hood exhaust ducts, exposed.
1. Material: Calcium silicate.
  2. Thickness: 2 inches (50 mm).
  3. Number of Layers: One.
  4. Field-Applied Jacket: Glass cloth.
  5. Vapor Retarder Required: No.
- L. Service: Rectangular, dishwasher exhaust ducts, concealed.
1. Material: Mineral-fiber blanket.
  2. Thickness: 1-1/2 inches (38 mm).
  3. Number of Layers: One.
  4. Field-Applied Jacket: Foil and paper.
  5. Vapor Retarder Required: Yes.
- M. Service: Rectangular, dishwasher exhaust ducts, exposed.
1. Material: Mineral-fiber board.
  2. Thickness: 1-1/2 inches (38 mm).
  3. Number of Layers: One.
  4. Field-Applied Jacket: Glass cloth.
  5. Vapor Retarder Required: Yes.

3.12 OUTDOOR DUCT AND PLENUM APPLICATION SCHEDULE

- A. Service: Round, supply-air ducts.
  - 1. Material: Closed-cell phenolic foam.
  - 2. Thickness: 1-1/2 inches (38 mm).
  - 3. Number of Layers: One.
  - 4. Field-Applied Jacket: Glass cloth.
  - 5. Vapor Retarder Required: Yes.
  
- B. Service: Round, return-air ducts.
  - 1. Material: Closed-cell phenolic foam.
  - 2. Thickness: 1-1/2 inches (38 mm).
  - 3. Number of Layers: One.
  - 4. Field-Applied Jacket: Glass cloth.
  - 5. Vapor Retarder Required: Yes.
  
- C. Service: Rectangular, supply-air ducts.
  - 1. Material: Closed-cell phenolic foam.
  - 2. Thickness: 1-1/2 inches (38 mm).
  - 3. Field-Applied Jacket: Glass cloth.
  - 4. Vapor Retarder Required: Yes.
  
- D. Service: Rectangular, return air and exhaust air ducts.
  - 1. Material: Closed-cell phenolic foam.
  - 2. Thickness: 1-1/2 inches (38 mm).
  - 3. Field-Applied Jacket: Glass cloth.
  - 4. Vapor Retarder Required: Yes.

END OF SECTION 15081



## SECTION 15083 - PIPE INSULATION (HVAC)

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

- A. This Section includes preformed, rigid and flexible pipe insulation; insulating cements; field-applied jackets; accessories and attachments; and sealing compounds.
- B. Related Sections include the following:
  - 1. Division 2 Section "Hydronic Distribution" for loose-fill pipe insulation in underground piping outside the building.
  - 2. Division 7 Section "Firestopping" for firestopping materials and requirements for penetrations through fire and smoke barriers
  - 3. Division 15 Section "Duct Insulation" for insulation for ducts and plenums.
  - 4. Division 15 Section "Equipment Insulation" for insulation materials and application for pumps, tanks, hydronic specialties, and other equipment.
  - 5. Division 15 Section "Hangers and Supports" for pipe insulation shields and protection saddles.

## 1.3 SUBMITTALS

- A. Product Data: Identify thermal conductivity, thickness, and jackets (both factory and field applied, if any), for each type of product indicated.
- B. Shop Drawings: Show fabrication and installation details for the following:
  - 1. Application of protective shields, saddles, and inserts at pipe hangers for each type of insulation and hanger.
  - 2. Attachment and covering of heat trace inside insulation.
  - 3. Insulation application at pipe expansion joints for each type of insulation.
  - 4. Insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
  - 5. Removable insulation at piping specialties and equipment connections.
  - 6. Application of field-applied jackets.
- C. Samples: For each type of insulation and jacket. Identify each Sample, describing product and intended use. Submit Samples in the following sizes:
  - 1. Preformed Pipe Insulation Materials: 12 inches (300 mm) long by NPS 2 (DN50).
  - 2. Sheet Form Insulation Materials: 12 inches (300 mm) square.

3. Jacket Materials: 12 inches (300 mm) long by NPS 2 (DN50).
  4. Manufacturer's Color Charts: Show the full range of colors available for each type of field-applied finish material indicated.
- D. 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.
- E. Installer Certificates: Signed by the Contractor certifying that installers comply with requirements.

#### 1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the U.S. Department of Labor, Bureau of Apprenticeship and Training.
- B. Fire-Test-Response Characteristics: As determined by testing materials identical to those specified in this Section according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and sealer and cement material containers with appropriate markings of applicable testing and inspecting agency.
1. Insulation Installed Indoors: Flame-spread rating of 25 or less, and smoke-developed rating of 50 or less.
  2. Insulation Installed Outdoors: Flame-spread rating of 75 or less, and smoke-developed rating of 150 or less.
- C. Mockups: Before installing insulation, build mockups for each type of insulation and finish listed below to demonstrate quality of insulation application and finishes. Build mockups according to the following requirements, using materials indicated for the completed Work:
1. Include the following mockups:
    - a. One 10-foot (3-m) section of NPS 2 (DN50) straight pipe.
    - b. One 90-degree elbow.
    - c. One tee fitting.
    - d. One NPS 2 (DN50) valve.
    - e. Four support hangers, including hanger shield and insert.
    - f. One strainer with removable portion of insulation.
    - g. One reducer.
  2. Build mockups with cutaway sections to allow observation of application details for insulation materials, mastics, attachments, and jackets.
  3. Build mockups in the location indicated or, if not indicated, as directed by Engineer.
  4. Notify Engineer seven days in advance of dates and times when mockups will be constructed.
  5. Obtain Engineer's approval of mockups before starting insulation application.
  6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
  7. Demolish and remove mockups when directed.

8. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Ship insulation materials in containers marked by manufacturer with appropriate ASTM specification 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 15 Section "Hangers and Supports."
- B. Coordinate clearance requirements with piping Installer for insulation application.
- C. Coordinate installation and testing of steam or electric heat tracing.

#### 1.7 SCHEDULING

- A. Schedule insulation application after testing piping systems and, where required, after installing and testing heat-trace tape. Insulation application may begin on segments of piping that have satisfactory test results.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Mineral-Fiber Insulation:
    - a. CertainTeed Manson.
    - b. Knauf FiberGlass GmbH.
    - c. Owens-Corning Fiberglas Corp.
    - d. Schuller International, Inc.
  2. Cellular-Glass Insulation:
    - a. Pittsburgh-Corning Corp.
  3. Flexible Elastomeric Thermal Insulation:
    - a. Armstrong World Industries, Inc.

- b. Rubatex Corp.
- 4. Polyolefin Insulation:
  - a. Armstrong World Industries, Inc.
  - b. IMCOA.
- 5. Closed-Cell Phenolic-Foam Insulation:
  - a. Kooltherm Insulation Products, Ltd.
- 6. Calcium Silicate Insulation:
  - a. Owens-Corning Fiberglas Corp.
  - b. Pabco.
  - c. Schuller International, Inc.

## 2.2 INSULATION MATERIALS

- A. Mineral-Fiber Insulation: Glass fibers bonded with a thermosetting resin complying with the following:
  - 1. Preformed Pipe Insulation: Comply with ASTM C 547, Type 1, with factory-applied, all-purpose, vapor-retarder jacket.
  - 2. Blanket Insulation: Comply with ASTM C 553, Type II, without facing.
  - 3. Fire-Resistant Adhesive: Comply with MIL-A-3316C in the following classes and grades:
    - a. Class 1, Grade A for bonding glass cloth and tape to unfaced glass-fiber insulation, for sealing edges of glass-fiber insulation, and for bonding lagging cloth to unfaced glass-fiber insulation.
    - b. Class 2, Grade A for bonding glass-fiber insulation to metal surfaces.
  - 4. Vapor-Retarder Mastics: Fire- and water-resistant, vapor-retarder mastic for indoor applications. Comply with MIL-C-19565C, Type II.
  - 5. Mineral-Fiber Insulating Cements: Comply with ASTM C 195.
  - 6. Expanded or Exfoliated Vermiculite Insulating Cements: Comply with ASTM C 196.
  - 7. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.
- B. Cellular-Glass Insulation: Inorganic, foamed or cellulated glass, annealed, rigid, hermetically sealed cells, incombustible.
  - 1. Preformed Pipe Insulation, without Jacket: Comply with ASTM C 552, Type II, Class 1.
  - 2. Preformed Pipe Insulation, with Jacket: Comply with ASTM C 552, Type II, Class 2.
- C. Flexible Elastomeric Thermal Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
  - 1. Adhesive: As recommended by insulation material manufacturer.
  - 2. Ultraviolet-Protective Coating: As recommended by insulation manufacturer.

- D. Polyolefin Insulation: Unicellular polyethylene thermal plastic, preformed pipe insulation. Comply with ASTM C 534, Type I, except for density.
  - 1. Adhesive: As recommended by insulation material manufacturer.
- E. Closed-Cell Phenolic-Foam Insulation: Preformed pipe insulation of rigid, expanded, closed-cell structure. Comply with ASTM C 1126, Type III, Grade 1.
- F. Calcium Silicate Insulation: Preformed pipe sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C 533, Type I.
- G. Prefabricated Thermal Insulating Fitting Covers: Comply with ASTM C 450 for dimensions used in preforming insulation to cover valves, elbows, tees, and flanges.

### 2.3 FIELD-APPLIED JACKETS

- A. General: ASTM C 921, Type 1, unless otherwise indicated.
- B. Foil and Paper Jacket: Laminated, glass-fiber-reinforced, flame-retardant kraft paper and aluminum foil.
- C. PVC Jacket: High-impact, ultraviolet-resistant PVC; 20 mils (0.5 mm) thick; roll stock ready for shop or field cutting and forming.
  - 1. Adhesive: As recommended by insulation material manufacturer.
  - 2. PVC Jacket Color: White or gray.
  - 3. PVC Jacket Color: Color-code piping jackets based on materials contained within the piping system.
- D. PVC Fitting Covers: Factory-fabricated fitting covers manufactured from 20-mil- (0.5-mm-) thick, high-impact, ultraviolet-resistant PVC.
  - 1. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories for the disabled.
  - 2. Adhesive: As recommended by insulation material manufacturer.
- E. Aluminum Jacket: Aluminum roll stock, ready for shop or field cutting and forming to indicated sizes. Comply with ASTM B 209 (ASTM B 209M), 3003 alloy, H-14 temper.
  - 1. Finish and Thickness: Smooth finish, 0.010 inch (0.25 mm) thick.
  - 2. Moisture Barrier: 1-mil- (0.025-mm-) thick, heat-bonded polyethylene and kraft paper.
  - 3. Elbows: Preformed, 45- and 90-degree, short- and long-radius elbows; same material, finish, and thickness as jacket.
- F. Stainless-Steel Jacket: ASTM A 666, Type 304 or 316; 0.10 inch (2.5 mm) thick; and roll stock ready for shop or field cutting and forming to indicated sizes.
  - 1. Moisture Barrier: 1-mil- (0.025-mm-) thick, heat-bonded polyethylene and kraft paper.



2. Elbows: Gore type, for 45- and 90-degree elbows in same material, finish, and thickness as jacket.
3. Jacket Bands: Stainless steel, Type 304, 3/4 inch (19 mm) wide.

#### 2.4 ACCESSORIES AND ATTACHMENTS

- A. Glass Cloth and Tape: Comply with MIL-C-20079H, Type I for cloth and Type II for tape. Woven glass-fiber fabrics, plain weave, presized a minimum of 8-oz./sq. yd. (270 g/sq. m).
  1. Tape Width: 4 inches (100 mm).
- B. Bands: 3/4 inch (19 mm) wide, in one of the following materials compatible with jacket
  1. Aluminum: 0.007 inch (0.18 mm) thick.
- C. Wire: 0.080-inch (2.0-mm), nickel-copper alloy; 0.062-inch (1.6-mm), soft-annealed, stainless steel; or 0.062-inch (1.6-mm), soft-annealed, galvanized steel.

#### 2.5 VAPOR RETARDERS

- A. Mastics: Materials recommended by insulation material manufacturers that are compatible with insulation materials, jackets, and substrates.

### 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.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 PREPARATION

- A. Surface Preparation: Clean and dry pipe and fitting surfaces. Remove materials that will adversely affect insulation application.

#### 3.3 GENERAL APPLICATION REQUIREMENTS

- A. Apply insulation materials, accessories, and finishes according to the manufacturer's written instructions; with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.
- B. Refer to schedules at the end of this Section for materials, forms, jackets, and thickness required for each piping system.

- C. Use accessories compatible with insulation materials and suitable for the service. Use accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Apply insulation with longitudinal seams at top and bottom of horizontal pipe runs.
- E. Apply multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Seal joints and seams with vapor-retarder mastic on insulation indicated to receive a vapor retarder.
- H. Keep insulation materials dry during application and finishing.
- I. Apply insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by the insulation material manufacturer.
- J. Apply insulation with the least number of joints practical.
- K. Apply insulation over fittings, valves, and specialties, with continuous thermal and vapor-retarder integrity, unless otherwise indicated. Refer to special instructions for applying insulation over fittings, valves, and specialties.
- L. Hangers and Anchors: Where vapor retarder is indicated, seal penetrations in insulation at hangers, supports, anchors, and other projections with vapor-retarder mastic.
  - 1. Apply insulation continuously through hangers and around anchor attachments.
  - 2. For insulation application where vapor retarders are indicated, extend insulation on anchor legs at least 12 inches (300 mm) from point of attachment to pipe and taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.
  - 3. Install insert materials and apply insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by the insulation material manufacturer.
  - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect the jacket from tear or puncture by the hanger, support, and shield.
- M. Insulation Terminations: For insulation application where vapor retarders are indicated, taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.
- N. Apply adhesives and mastics at the manufacturer's recommended coverage rate.
- O. Apply insulation with integral jackets as follows:
  - 1. Pull jacket tight and smooth.
  - 2. Circumferential Joints: Cover with 3-inch- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip and spaced 4 inches (100 mm) o.c.

3. Longitudinal Seams: Overlap jacket seams at least 1-1/2 inches (40 mm). Apply insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches (100 mm) o.c.
    - a. Exception: Do not staple longitudinal laps on insulation having a vapor retarder.
  4. Vapor-Retarder Mastics: Where vapor retarders are indicated, apply mastic on seams and joints and at ends adjacent to flanges, unions, valves, and fittings.
  5. At penetrations in jackets for thermometers and pressure gages, fill and seal voids with vapor-retarder mastic.
- P. Roof Penetrations: Apply insulation for interior applications to a point even with top of roof flashing.
1. Seal penetrations with vapor-retarder mastic.
  2. Apply insulation for exterior applications tightly joined to interior insulation ends.
  3. Extend metal jacket of exterior insulation outside roof flashing at least 2 inches (50 mm) below top of roof flashing.
  4. Seal metal jacket to roof flashing with vapor-retarder mastic.
- Q. Exterior Wall Penetrations: For penetrations of below-grade exterior walls, terminate insulation flush with mechanical sleeve seal. Seal terminations with vapor-retarder mastic.
- R. Interior Wall and Partition Penetrations: Apply insulation continuously through walls and floors.
- S. Fire-Rated Wall and Partition Penetrations: Apply insulation continuously through penetrations of fire-rated walls and partitions.
1. Firestopping and fire-resistive joint sealers are specified in Division 7 Section "Firestopping."
- T. Floor Penetrations: Apply insulation continuously through floor assembly.
1. For insulation with vapor retarders, seal insulation with vapor-retarder mastic where floor supports penetrate vapor retarder.
- 3.4 MINERAL-FIBER INSULATION APPLICATION
- A. Apply insulation to straight pipes and tubes as follows:
1. Secure each layer of preformed pipe insulation to pipe with wire, tape, or bands without deforming insulation materials.
  2. Where vapor retarders are indicated, seal longitudinal seams and end joints with vapor-retarder mastic. Apply vapor retarder to ends of insulation at intervals of 15 to 20 feet (4.5 to 6 m) to form a vapor retarder between pipe insulation segments.
  3. For insulation with factory-applied jackets, secure laps with outward clinched staples at 6 inches (150 mm) o.c.

4. For insulation with factory-applied jackets with vapor retarders, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by the insulation material manufacturer and seal with vapor-retarder mastic.

B. Apply insulation to flanges as follows:

1. Apply preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation segment the same as overall width of the flange and bolts, plus twice the thickness of the pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Apply canvas jacket material with manufacturer's recommended adhesive, overlapping seams at least 1 inch (25 mm), and seal joints with vapor-retarder mastic.

C. Apply insulation to fittings and elbows as follows:

1. Apply pre-molded insulation sections of the same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When pre-molded insulation elbows and fittings are not available, apply mitered sections of pipe insulation, or glass-fiber blanket insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire, tape, or bands.
3. Cover fittings with standard PVC fitting covers.
4. Cover fittings with heavy PVC fitting covers. Overlap PVC covers on pipe insulation jackets at least 1 inch (25 mm) at each end. Secure fitting covers with manufacturer's attachments and accessories. Seal seams with tape and vapor-retarder mastic.

D. Apply insulation to valves and specialties as follows:

1. Apply pre-molded insulation sections of the same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When pre-molded insulation sections are not available, apply glass-fiber blanket insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation. For check valves, arrange insulation for access to strainer basket without disturbing insulation.
3. Apply insulation to flanges as specified for flange insulation application.
4. Use preformed standard PVC fitting covers for valve sizes where available. Secure fitting covers with manufacturer's attachments and accessories. Seal seams with tape and vapor-retarder mastic.
5. Use preformed heavy PVC fitting covers for valve sizes where available. Secure fitting covers with manufacturer's attachments and accessories. Seal seams with tape and vapor-retarder mastic.
6. For larger sizes where PVC fitting covers are not available, seal insulation with canvas jacket and sealing compound recommended by the insulation material manufacturer.

### 3.5 CELLULAR-GLASS INSULATION APPLICATION

A. Apply insulation to straight pipes and tubes as follows:

1. Secure each layer of insulation to pipe with wire, tape, or bands without deforming insulation materials.

2. Where vapor retarders are indicated, seal longitudinal seams and end joints with vapor-retarder mastic.
3. For insulation with factory-applied jackets, secure laps with outward clinched staples at 6 inches (150 mm) o.c.
4. For insulation with factory-applied jackets with vapor retarders, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by the insulation material manufacturer and seal with vapor-retarder mastic.

B. Apply insulation to flanges as follows:

1. Apply preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation segments the same as overall width of the flange and bolts, plus twice the thickness of the pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of the same thickness as pipe insulation.
4. Apply canvas jacket material with manufacturer's recommended adhesive, overlapping seams at least 1 inch (25 mm), and seal joints with vapor-retarder mastic.

C. Apply insulation to fittings and elbows as follows:

1. Apply pre-molded insulation sections of the same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When pre-molded sections of insulation are not available, apply mitered sections of cellular-glass insulation. Secure insulation materials with wire, tape, or bands.
3. Cover fittings with standard PVC fitting covers.
4. Cover fittings with heavy PVC fitting covers. Overlap PVC covers on pipe insulation jackets at least 1 inch (25 mm) at each end. Secure fitting covers with manufacturer's attachments and accessories. Seal seams with tape and vapor-retarder mastic.

D. Apply insulation to valves and specialties as follows:

1. Apply pre-molded segments of cellular-glass insulation or glass-fiber blanket insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation. For check valves, arrange insulation for access to strainer basket without disturbing insulation.
2. Apply insulation to flanges as specified for flange insulation application.
3. Use preformed standard PVC fitting covers for valve sizes where available. Secure fitting covers with manufacturer's attachments and accessories. Seal seams with tape and vapor-retarder mastic.
4. Use preformed heavy PVC fitting covers for valve sizes where available. Secure fitting covers with manufacturer's attachments and accessories. Seal seams with tape and vapor-retarder mastic.
5. For larger sizes where PVC fitting covers are not available, seal insulation with canvas jacket and sealing compound recommended by the insulation material manufacturer.

### 3.6 FLEXIBLE ELASTOMERIC THERMAL INSULATION APPLICATION

A. Apply insulation to straight pipes and tubes as follows:

1. Follow manufacturer's written instructions for applying insulation.
  2. Seal longitudinal seams and end joints with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.
- B. Apply insulation to flanges as follows:
1. Apply pipe insulation to outer diameter of pipe flange.
  2. Make width of insulation segments the same as overall width of the flange and bolts, plus twice the thickness of the pipe insulation.
  3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of the same thickness as pipe insulation.
  4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.
- C. Apply insulation to fittings and elbows as follows:
1. Apply mitered sections of pipe insulation.
  2. Secure insulation materials and seal seams with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.
- D. Apply insulation to valves and specialties as follows:
1. Apply preformed valve covers manufactured of the same material as pipe insulation and attached according to the manufacturer's written instructions.
  2. Apply cut segments of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation. For check valves, fabricate removable sections of insulation arranged to allow access to strainer basket.
  3. Apply insulation to flanges as specified for flange insulation application.
  4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.

### 3.7 POLYOLEFIN INSULATION APPLICATION

- A. Apply insulation to straight pipes and tubes as follows:
1. Follow manufacturer's written instructions for applying insulation.
  2. For split tubes, seal longitudinal seams and end joints with manufacturer's recommended adhesive.
  3. For self-adhesive insulation, staple longitudinal seams after sealing. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.
- B. Apply insulation to flanges as follows:
1. Apply pipe insulation to outer diameter of pipe flange.
  2. Make width of insulation segments the same as overall width of the flange and bolts, plus twice the thickness of the pipe insulation.

3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of polyolefin sheet insulation of the same thickness as pipe insulation.
  4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.
- C. Apply insulation to fittings and elbows as follows:
1. Apply mitered sections of polyolefin pipe insulation.
  2. Secure insulation materials and seal seams with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.
- D. Apply insulation to valves and specialties as follows:
1. Apply preformed valve covers manufactured of the same material as pipe insulation and attached according to the manufacturer's written instructions.
  2. Apply cut segments of polyolefin pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation. For check valves, fabricate removable sections of insulation arranged to allow access to strainer basket.
  3. Apply insulation to flanges as specified for flange insulation application.
  4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.

### 3.8 CLOSED-CELL PHENOLIC-FOAM INSULATION APPLICATION

- A. Apply insulation to straight pipes and tubes as follows:
1. Secure each layer of insulation to pipe with wire, tape, or bands without deforming insulation materials.
  2. Where vapor retarders are indicated, seal longitudinal seams and end joints with vapor-retarder mastic.
  3. For insulation with factory-applied jackets, secure laps with outward clinched staples at 6 inches (150 mm) o.c.
  4. For insulation with factory-applied jackets with vapor retarders, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by the insulation material manufacturer and seal with vapor-retarder mastic.
- B. Apply insulation to flanges as follows:
1. Apply preformed pipe insulation to outer diameter of pipe flange.
  2. Make width of insulation segments the same as overall width of the flange and bolts, plus twice the thickness of the pipe insulation.
  3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of block insulation of the same material and thickness as pipe insulation.
  4. Apply canvas jacket material with manufacturer's recommended adhesive, overlapping seams at least 1 inch (25 mm), and seal joints with vapor-retarder mastic.

## C. Apply insulation to fittings and elbows as follows:

1. Apply pre-molded insulation sections of the same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When pre-molded sections of insulation are not available, apply mitered sections of phenolic-foam insulation. Secure insulation materials with wire, tape, or bands.
3. Cover fittings with standard PVC fitting covers.
4. Cover fittings with heavy PVC fitting covers. Overlap PVC covers on pipe insulation jackets at least 1 inch (25 mm) at each end. Secure fitting covers with manufacturer's attachments and accessories. Seal seams with tape and vapor-retarder mastic.

## D. Apply insulation to valves and specialties as follows:

1. Apply pre-molded insulation sections of the same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When pre-molded sections of insulation are not available, apply mitered segments of phenolic-foam insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation. For check valves, arrange insulation for access to strainer basket without disturbing insulation.
3. Apply insulation to flanges as specified for flange insulation application.
4. Use preformed standard PVC fitting covers for valve sizes where available. Secure fitting covers with manufacturer's attachments and accessories. Seal seams with tape and vapor-retarder mastic.
5. Use preformed heavy PVC fitting covers for valve sizes where available. Secure fitting covers with manufacturer's attachments and accessories. Seal seams with tape and vapor-retarder mastic.
6. For larger sizes where PVC fitting covers are not available, seal insulation with canvas jacket and sealing compound recommended by the insulation material manufacturer.

## 3.9 CALCIUM SILICATE INSULATION APPLICATION

## A. Apply insulation to straight pipes and tubes as follows:

1. Secure each layer of insulation to pipe with stainless-steel bands at 12-inch (300-mm) intervals and tighten without deforming insulation materials.
2. Apply two-layer insulation with joints tightly butted and staggered at least 3 inches (75 mm). Secure inner layer with 0.062-inch (1.6-mm), soft-annealed, stainless-steel wire spaced at 12-inch (300-mm) intervals. Secure outer layer with stainless-steel bands at 12-inch (300-mm) intervals.
3. Apply a skim coat of mineral-fiber, hydraulic-setting cement to surface of installed insulation. When dry, apply flood coat of lagging adhesive and press on one layer of glass cloth or tape. Overlap edges at least 1 inch (25 mm). Apply finish coat of lagging adhesive over glass cloth or tape. Thin the finish coat to achieve smooth finish.

## B. Apply insulation to flanges as follows:

1. Apply preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation segments the same as overall width of the flange and bolts, plus twice the thickness of the pipe insulation.



3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of block insulation of the same material and thickness as pipe insulation.
4. Finish flange insulation the same as pipe insulation.

C. Apply insulation to fittings and elbows as follows:

1. Apply pre-molded insulation sections of the same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When pre-molded sections of insulation are not available, apply mitered sections of calcium silicate insulation. Secure insulation materials with stainless-steel wire.
3. Finish insulation of fittings the same as pipe insulation.

D. Apply insulation to valves and specialties as follows:

1. Apply mitered segments of calcium silicate insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation. For check valves, arrange insulation for access to strainer basket without disturbing insulation.
2. Apply insulation to flanges as specified for flange insulation application.
3. Finish valve and specialty insulation the same as pipe insulation.

### 3.10 FIELD-APPLIED JACKET APPLICATION

A. Apply glass-cloth jacket, where indicated, directly over bare insulation or insulation with factory-applied jackets.

1. Apply jacket smooth and tight to surface with 2-inch (50-mm) overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch- (1.6-mm-) thick coats of jacket manufacturer's recommended adhesive.
3. Completely encapsulate insulation with jacket, leaving no exposed raw insulation.

B. Foil and Paper Jackets: Apply foil and paper jackets where indicated.

1. Draw jacket material smooth and tight.
2. Apply lap or joint strips with the same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Apply jackets with 1-1/2-inch (40-mm) laps at longitudinal seams and 3-inch- (75-mm-) wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-retarder mastic.

C. Apply PVC jacket where indicated, with 1-inch (25-mm) overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.

D. Apply metal jacket where indicated, 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.

## 3.11 FINISHES

- A. Glass-Cloth Jacketed Insulation: Paint insulation finished with glass-cloth jacket as specified in Division 9 Section "Painting."
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of the insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Engineer. Vary first and second coats to allow visual inspection of the completed Work.

## 3.12 PIPING SYSTEM APPLICATIONS

- A. Insulation materials and thickness are specified in schedules at the end of this Section.
- B. Items Not Insulated: Unless otherwise indicated, do not apply insulation to the following systems, materials, and equipment:
  - 1. Flexible connectors.
  - 2. Vibration-control devices.

## 3.13 FIELD QUALITY CONTROL

- A. Inspection: Perform the following field quality-control inspections, after installing insulation materials, jackets, and finishes, to determine compliance with requirements:
  - 1. Inspect fittings and valves randomly selected by Engineer.
  - 2. Remove fitting covers from 20 elbows or 1 percent of elbows, whichever is less, for various pipe sizes.
  - 3. Remove fitting covers from 20 valves or 1 percent of valves, whichever is less, for various pipe sizes.
- B. Insulation applications will be considered defective if sample inspection reveals noncompliance with requirements. Remove defective Work and replace with new materials according to these Specifications.
- C. Reinstall insulation and covers on fittings and valves uncovered for inspection according to these Specifications.

## 3.14 INSULATION APPLICATION SCHEDULE, GENERAL

- A. Refer to insulation application schedules for required insulation materials, vapor retarders, and field-applied jackets.
- B. Application schedules identify piping system and indicate pipe size ranges and material, thickness, and jacket requirements.

## 3.15 INTERIOR INSULATION APPLICATION SCHEDULE

- A. Service: Condensate drain piping.
1. Operating Temperature: 35 to 75 deg F (2 to 24 deg C).
  2. Insulation Material: Flexible elastomeric
  3. Insulation Thickness: 1 ½”.
  4. Vapor Retarder Required: Yes.
  5. Finish: Painted when exposed to view.
- B. Service: Chilled-water supply and return.
1. Operating Temperature: 35 to 75 deg F (2 to 24 deg C).
  2. Insulation Material: Closed-cell phenolic foam.
  3. Insulation Thickness: Apply the following insulation thickness:
    - a. Steel, Copper, PVC Pipe, Up to 2”: 1 ½”
    - b. Steel, Copper, PVC Pipe, 2 ½” and above: 2”
  4. Field-Applied Jacket: Foil and paper.
  5. Vapor Retarder Required: Yes.
  6. Finish: Painted when exposed to view.
- C. Service: Refrigerant suction and hot-gas piping.
1. Operating Temperature: 35 to 50 deg F (2 to 10 deg C).
  2. Insulation Material: Flexible elastomeric.
  3. Insulation Thickness: Apply the following insulation thickness:
    - a. Copper Pipe, Up to 1 1/8”: 1”.
    - b. Copper Pipe, Above 1 1/8”: 1 ½”.
  4. Field-Applied Jacket: None.
  5. Vapor Retarder Required: Yes.
  6. Finish: None
- D. Service: Heating (reheat) hot-water supply and return.
1. Operating Temperature: 60 to 200 deg F (38 to 93 deg C).
  2. Insulation Material: Closed-cell phenolic foam.
  3. Insulation Thickness: Apply the following insulation thickness:
    - a. Steel and Copper Pipe, All sizes: 1 1/2”.
  4. Field-Applied Jacket: Foil and paper.
  5. Finish none.
- E. Service: Steam and condensate.
1. Operating Temperature: 450 deg F (232 deg C) and lower.
  2. Insulation Material: Calcium silicate.
  3. Insulation Thickness: Apply the following insulation thickness:

- a. Steel Pipe, Up to 3": 2".
  - b. Steel Pipe, Above 3": 2 ½".
- 4. Field-Applied Jacket: None.
  - 5. Vapor Retarder Required: No.
  - 6. Finish: Painted when exposed to view.

### 3.16 EXTERIOR INSULATION APPLICATION SCHEDULE

- A. This application schedule is for aboveground insulation outside the building. Loose-fill insulation, for below ground piping, is specified in Division 2 piping distribution Sections.
- B. Service: Refrigerant suction.
  - 1. Operating Temperature: 35 to 50 deg F (2 to 10 deg C).
  - 2. Insulation Material: Flexible elastomeric.
  - 3. Insulation Thickness: Apply the following insulation thickness:
    - a. Copper Pipe, Up to 1 1/8": 1".
    - b. Copper Pipe, Above 1 1/8": 1 ½".
  - 4. Field-Applied Jacket: Aluminum.
  - 5. Vapor Retarder Required: Yes.
  - 6. Finish none.
- C. Service: Chilled-water supply and return.
  - 1. Operating Temperature: 35 to 75 deg F (2 to 24 deg C).
  - 2. Insulation Material: Closed-cell phenolic foam.
  - 3. Insulation Thickness: Apply the following insulation thickness:
    - a. Steel and Copper Pipe, Up to 2": 1 1/2".
    - b. Steel and Copper Pipe, 2-1/2" and above: 2".
  - 4. Field-Applied Jacket: Aluminum.
  - 5. Vapor Retarder Required: Yes.
  - 6. Finish none.
- D. Service: Heating (reheat) hot-water supply and return.
  - 1. Operating Temperature: 60 to 220 deg F (38 to 104 deg C).
  - 2. Insulation Material: Closed-cell phenolic foam.
  - 3. Insulation Thickness: Apply the following insulation thickness:
    - a. Steel and Copper Pipe, All sizes: 1 1/2".
  - 4. Field-Applied Jacket: Aluminum.
  - 5. Vapor Retarder Required: No.
  - 6. Finish: Painted.
- E. Service: Steam and condensate.

1. Operating Temperature: 450 deg F (232 deg C) and lower.
2. Insulation Material: Calcium Silicate.
3. Insulation Thickness: Apply the following insulation thickness:
  - a. Steel Pipe, Up to 3": 2"
  - b. Steel Pipe, 3" and above: 2 1/2".
4. Field-Applied Jacket: Aluminum.
5. Vapor Retarder Required: No.
6. Finish none.

END OF SECTION 15083

SECTION 15100 - VALVES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes general duty valves common to several mechanical piping systems.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
  - 1. Special purpose valves are specified in Division 15 piping system Sections.
  - 2. Valve tags and charts are specified in Division 15 Section "Mechanical Identification."

1.3 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product Data for each valve type. Include body material, valve design, pressure and temperature classification, end connection details, seating materials, trim material and arrangement, dimensions and required clearances, and installation instructions. Include list indicating valve and its application.
- C. Maintenance data for valves to include in the operation and maintenance manual specified in Division 1. Include detailed manufacturer's instructions on adjusting, servicing, disassembling, and repairing.

1.4 QUALITY ASSURANCE

- A. Single-Source Responsibility: Comply with the requirements specified in Division 1 Section "Materials and Equipment," under "Source Limitations" Paragraph.
- B. ASME Compliance: Comply with ASME B31.9 for building services piping and ASME B31.1 for power piping.
- C. MSS Compliance: Comply with the various MSS Standard Practice documents referenced.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
  - 1. Protect internal parts against rust and corrosion.
  - 2. Protect threads, flange faces, grooves, and weld ends.
  - 3. Set globe and gate 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 indoors and maintain valve temperature higher than ambient dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
  
- C. Use a sling to handle large valves. Rig to avoid damage to exposed parts. Do not use handwheels and stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:
  
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Gate Valves:
    - a. Crane Company; Valves and Fitting Division.
    - b. Hammond Valve Corporation.
    - c. Kitz Corp. of America.
    - d. Lunkenheimer/Cincinnati Valve Co.
    - e. Milwaukee Valve Company, Inc.
    - f. NIBCO Inc.
    - g. Powell: Wm. Powell Company (The).
    - h. Red-White Valve Corp.
    - i. Stockham Valves & Fittings, Inc.
  
  - 2. Ball Valves:
    - a. Conbraco Industries, Inc.; Apollo Division.
    - b. Hammond Valve Corporation.
    - c. Milwaukee Valve Company, Inc.

- d. NIBCO Inc.
  - e. Stockham Valves & Fittings, Inc.
  - f. Tyler Pipe.
  - g. Victaulic Company of America.
3. Plug Valves:
- a. Grinnell Corp.
  - b. Huber: J.M. Huber Corp.; Flow Control Division (Resun Valves).
  - c. NIBCO Inc.
  - d. Stockham Valves & Fittings, Inc.
  - e. Victaulic Company of America.
4. Globe Valves:
- a. Crane Company; Valves and Fitting Division.
  - b. Hammond Valve Corporation.
  - c. Kitz Corp. of America.
  - d. Lunkenheimer/Cincinnati Valve Co.
  - e. Milwaukee Valve Company, Inc.
  - f. NIBCO Inc.
  - g. Powell: Wm. Powell Company (The).
  - h. Red-White Valve Corp.
  - i. Stockham Valves & Fittings, Inc.
5. Butterfly Valves:
- a. Center Line, Mark Controls Corporation.
  - b. Crane Company; Valves and Fitting Division.
  - c. General Signal; DeZurik Unit.
  - d. Grinnell Corp.
  - e. Hammond Valve Corporation.
  - f. Keystone Valve USA, Inc.
  - g. Milwaukee Valve Company, Inc.
  - h. NIBCO Inc.
  - i. Red-White Valve Corp.
  - j. Stockham Valves & Fittings, Inc.
  - k. Tyler Pipe.
  - l. Ultraflo Corporation.
  - m. Victaulic Company of America.
6. Swing Check Valves:
- a. Cla-Val Co.
  - b. Crane Company; Valves and Fitting Division.
  - c. Hammond Valve Corporation.
  - d. Kitz Corp. of America.
  - e. Lunkenheimer/Cincinnati Valve Co.
  - f. Milwaukee Valve Company, Inc.
  - g. NIBCO Inc.
  - h. Powell: Wm. Powell Company (The).



- i. Red-White Valve Corp.
- j. Stockham Valves & Fittings, Inc.
- k. Victaulic Company of America.

7. Wafer Check Valves:

- a. Cla-Val Co.
- b. Conbraco Industries, Inc.; Apollo Division.
- c. Hammond Valve Corporation.
- d. Keystone Valve USA, Inc.
- e. Kitz Corp. of America.
- f. Metraflex Company.
- g. Milwaukee Valve Company, Inc.
- h. NIBCO Inc.
- i. Red-White Valve Corp.
- j. Stockham Valves & Fittings, Inc.
- k. Tyler Pipe.
- l. Val-Matic Valve & Mfg. Corp.
- m. Victaulic Company of America.

8. Lift Check Valves:

- a. Crane Company; Valves and Fitting Division.
- b. Kitz Corp. of America.
- c. Milwaukee Valve Company, Inc.
- d. NIBCO Inc.
- e. Powell: Wm. Powell Company (The).
- f. Red-White Valve Corp.
- g. Stockham Valves & Fittings, Inc.

2.2 BASIC, COMMON FEATURES

- A. Design: Rising stem or rising outside screw and yoke stems, except as specified below.
  - 1. Nonrising stem valves may be used only where headroom prevents full extension of rising stems.
- B. Pressure and Temperature Ratings: As indicated in the "Application Schedule" of Part 3 of this Section and as required to suit system pressures and temperatures.
- C. Sizes: Same size as upstream pipe, unless otherwise indicated.
- D. Operators: Use specified operators and handwheels, except provide the following special operator features:
  - 1. Handwheels: For valves other than quarter turn.
  - 2. Lever Handles: For quarter-turn valves 6 inches (DN150) and smaller, except for plug valves, which shall have square heads. Furnish Owner with 1 wrench for every 10 plug valves.

3. Chain-Wheel Operators: For valves 4 inches (DN100) and larger, installed 96 inches (2400 mm) or higher above finished floor elevation.
  4. Gear-Drive Operators: For quarter-turn valves 8 inches (DN200) and larger.
- E. Extended Stems: Where insulation is indicated or specified, provide extended stems arranged to receive insulation.
  - F. Bypass and Drain Connections: Comply with MSS SP-45 bypass and drain connections.
  - G. Threads: ASME B1.20.1.
  - H. Flanges: ASME B16.1 for cast iron, ASME B16.5 for steel, and ASME B16.24 for bronze valves.
  - I. Solder Joint: ASME B16.18.
    1. Caution: Where soldered end connections are used, use solder having a melting point below 840 deg F (450 deg C) for gate, globe, and check valves; below 421 deg F (216 deg C) for ball valves.

### 2.3 GATE VALVES

- A. Gate Valves, 2-1/2 Inches (DN65) and Smaller: MSS SP-80; Class 125, 200-psi (1380-kPa) cold working pressure (CWP), or Class 150, 300-psi (2070-kPa) CWP; ASTM B 62 cast-bronze body and bonnet, solid-bronze wedge, copper-silicon alloy rising stem, teflon-impregnated packing with bronze packing nut, threaded or soldered end connections; and with aluminum or malleable-iron handwheel.
- B. Gate Valves, 3 Inches (DN80) and Larger: MSS SP-70, Class 125, 200-psi (1380-kPa) CWP, ASTM A 126 cast-iron body and bonnet, solid cast-iron wedge, brass-alloy stem, outside screw and yoke, teflon-impregnated packing with 2-piece packing gland assembly, flanged end connections; and with cast-iron handwheel.

### 2.4 BALL VALVES

- A. Ball Valves, 4 Inches (DN100) and Smaller: MSS SP-110, Class 150, 600-psi (4140-kPa) CWP, ASTM B 584 bronze body and bonnet, 2-piece construction; chrome-plated brass ball, standard port for 1/2-inch (DN15) valves and smaller and conventional port for 3/4-inch (DN20) valves and larger; blowout proof; bronze or brass stem; teflon seats and seals; threaded or soldered end connections:
  1. Operator: Vinyl-covered steel lever handle.
  2. Stem Extension: For valves installed in insulated piping.

### 2.5 PLUG VALVES

- A. Plug Valves: MSS SP-78, 175-psi (1200-kPa) CWP, ASTM A 126 cast-iron body and bonnet, cast-iron plug, Buna N, Viton, or teflon packing, flanged or grooved end connections:
  - 1. Operator: Square head with 1 wrench for every 10 valves.

## 2.6 GLOBE VALVES

- A. Globe Valves, 2-1/2 Inches (DN65) and Smaller: MSS SP-80; Class 125, 200-psi (1380-kPa) CWP, or Class 150, 300-psi (2070-kPa) CWP; ASTM B 62 cast-bronze body and screwed bonnet, rubber, bronze, or teflon disc, silicon bronze-alloy stem, teflon-impregnated packing with bronze nut, threaded or soldered end connections; and with aluminum or malleable-iron handwheel.
- B. Globe Valves, 3 Inches (DN80) and Larger: MSS SP-85, Class 125, 200-psi (1380-kPa) CWP, ASTM A 126 cast-iron body and bolted bonnet with bronze fittings, renewable bronze seat and disc, brass-alloy stem, outside screw and yoke, teflon-impregnated packing with cast-iron follower, flanged end connections; and with cast-iron handwheel.

## 2.7 BUTTERFLY VALVES

- A. Butterfly Valves: MSS SP-67, 200-psi (1380-kPa) CWP, 150-psi (1035- kPa) maximum pressure differential, ASTM A 126 cast-iron body and bonnet, extended neck, stainless-steel stem, field-replaceable EPDM or Buna N sleeve and stem seals, wafer, lug, or grooved style:
  - 1. Disc Type: Aluminum bronze.
  - 2. Operator for Sizes 2 Inches (DN50) to 6 Inches (DN150): Lever handle with latch lock.
  - 3. Operator for Sizes 8 Inches (DN200) to 24 Inches (DN600): Gear operator with position indicator.
  - 4. Operator for Sizes 8 Inches (DN200) and Larger, 96 Inches (2400 mm) or Higher above Floor: Chain-wheel operator.

## 2.8 CHECK VALVES

- A. Swing Check Valves, 2-1/2 Inches (DN65) and Smaller: MSS SP-80; Class 125, 200-psi (1380-kPa) CWP, or Class 150, 300-psi (2070-kPa) CWP; horizontal swing, Y-pattern, ASTM B 62 cast-bronze body and cap, rotating bronze disc with rubber seat or composition seat, threaded or soldered end connections:
- B. Swing Check Valves, 3 Inches (DN80) and Larger: MSS SP-71, Class 125, 200-psi (1380-kPa) CWP, ASTM A 126 cast-iron body and bolted cap, horizontal-swing bronze disc, flanged or grooved end connections.

- C. Wafer Check Valves: Class 125, 200-psi (1380-kPa) CWP, ASTM A 126 cast-iron body, bronze disc/plates, stainless-steel pins and springs, Buna N seals, installed between flanges.
- D. Lift Check Valves: Class 125, ASTM B 62 bronze body and cap (main components), horizontal or vertical pattern, lift-type, bronze disc or Buna N rubber disc with stainless-steel holder threaded or soldered end connections.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance of valves. Do not proceed with installation until unsatisfactory conditions have been corrected.
- B. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- C. Operate valves from fully open to fully closed positions. Examine guides and seats made accessible by such operation.
- D. Examine threads on valve and mating pipe for form and cleanliness.
- E. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Check gasket material for proper size, material composition suitable for service, and freedom from defects and damage.
- F. Do not attempt to repair defective valves; replace with new valves.

#### 3.2 INSTALLATION

- A. Install valves as indicated, according to manufacturer's written instructions.
- B. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate the general arrangement of piping, fittings, and specialties.
- C. Install valves with unions or flanges at each piece of equipment arranged to allow servicing, maintenance, and equipment removal without system shutdown.
- D. Locate valves for easy access and provide separate support where necessary.
- E. Install valves in horizontal piping with stem at or above the center of the pipe.
- F. Install valves in a position to allow full stem movement.
- G. For chain-wheel operators, extend chains to 60 inches (1500 mm) above finished floor elevation.

H. Installation of Check Valves: Install for proper direction of flow as follows:

1. Swing Check Valves: Horizontal position with hinge pin level.
2. Wafer Check Valves: Horizontal or vertical position, between flanges.
3. Lift Check Valve: With stem upright and plumb.

### 3.3 SOLDERED CONNECTIONS

- A. Cut tube square and to exact lengths.
- B. Clean end of tube to depth of valve socket with steel wool, sand cloth, or a steel wire brush to a bright finish. Clean valve socket.
- C. Apply proper soldering flux in an even coat to inside of valve socket and outside of tube.
- D. Open gate and globe valves to fully open position.
- E. Remove the cap and disc holder of swing check valves having composition discs.
- F. Insert tube into valve socket, making sure the end rests against the shoulder inside valve. Rotate tube or valve slightly to ensure even distribution of the flux.
- G. Apply heat evenly to outside of valve around joint until solder melts on contact. Feed solder until it completely fills the joint around tube. Avoid hot spots or overheating valve. Once the solder starts cooling, remove excess amounts around the joint with a cloth or brush.

### 3.4 THREADED CONNECTIONS

- A. Note the internal length of threads in valve ends and proximity of valve internal seat or wall to determine how far pipe should be threaded into valve.
- B. Align threads at point of assembly.
- C. Apply appropriate tape or thread compound to the external pipe threads, except where dry seal threading is specified.
- D. Assemble joint, wrench tight. Wrench on valve shall be on the valve end into which the pipe is being threaded.

### 3.5 FLANGED CONNECTIONS

- A. Align flange surfaces parallel.
- B. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly with a torque wrench.

- C. For dead-end service, butterfly valves require flanges both upstream and downstream for proper shutoff and retention.

### 3.6 VALVE END SELECTION

- A. Select valves with the following ends or types of pipe/tube connections:
  1. Copper Tube Size, 2-1/2 Inches (DN65) and Smaller: Solder ends, except provide threaded ends for heating hot water and low-pressure steam service.
  2. Steel Pipe Sizes, 2-1/2 Inches (DN65) and Smaller: Threaded or grooved end.
  3. Steel Pipe Sizes, 3 Inches (DN80) and Larger: Grooved end or flanged.

### 3.7 APPLICATION SCHEDULE

- A. General Application: Use gate, ball, and butterfly valves for shutoff duty; globe, ball, and butterfly for throttling duty. Refer to piping system Specification Sections for specific valve applications and arrangements.
- B. Heating Water Systems: Use the following valve types:
  1. Gate Valves: Class 150, bronze or cast-iron body to suit piping system.
  2. Ball Valves: Class 150, 600-psi (4140-kPa) CWP, with stem extension and memory stop.
  3. Plug Valves: Viton or teflon packing.
  4. Globe Valves: Class 150, bronze or cast-iron body to suit piping system, and bronze disc.
  5. Butterfly Valves: Nickel-plated ductile iron, aluminum bronze, or epoxy-coated ductile iron disc; EPDM or Buna N sleeve and stem seals.
  6. Bronze Swing Check: Class 150, with composition seat.
  7. Check Valves: Iron swing, wafer, or lift type, as indicated. Swing check shall be Class 150 with bronze seat ring.
- C. Low-Pressure Steam and Condensate Return Systems: Use the following valve types:
  1. Gate Valves: Class 150, bronze body; or Class 125, cast-iron body.
  2. Ball Valves: Class 150, 600-psi (4140-kPa) CWP, with stem extension.
  3. Plug Valves: Viton or teflon packing.
  4. Globe Valves: Class 150, bronze body with teflon disc; or Class 125, cast-iron body.
  5. Check Valves: Class 150, bronze body swing check with composition seat; Class 150, cast-iron body swing check with bronze seat ring; or Class 125, cast-iron body wafer check.
- D. Chilled-Water Systems: Use the following valve types:
  1. Gate Valves: Class 150, bronze body; or Class 125, cast-iron body.
  2. Ball Valves: Class 150, 600-psi (4140-kPa) CWP, with stem extension and memory stop.
  3. Plug Valves: Buna N packing.

4. Globe Valves: Class 125, bronze body with bronze or teflon disc; or Class 125, cast-iron body.
  5. Butterfly Valves: Nickel-plated ductile iron, aluminum bronze, or elastomer-coated ductile iron disc; EPDM sleeve and stem seals.
  6. Check Valves: Class 125, bronze body swing check with rubber seat; Class 125, cast-iron body swing check; Class 125, cast-iron body wafer check; or Class 125, cast-iron body lift check.
- E. Condenser Water Systems: Use the following valve types:
1. Gate Valves: Class 125, bronze body; or Class 125, cast-iron body.
  2. Ball Valves: Class 150, 600-psi (4140-kPa) CWP, with memory stop.
  3. Plug Valves: Buna N packing.
  4. Globe Valves: Class 125, bronze body with bronze or teflon disc; or Class 125, cast-iron body.
  5. Butterfly Valves: Aluminum bronze, epoxy-coated ductile iron disc; EPDM sleeve and stem seals.
  6. Check Valves: Class 125, bronze body swing check with rubber seat; Class 125, cast-iron body swing check; Class 125, cast-iron body wafer check; or Class 125, cast-iron body lift check.

### 3.8 ADJUSTING

- A. Adjust or replace packing after piping systems have been tested and put into service, but before final adjusting and balancing. Replace valves if leak persists.

END OF SECTION 15100

## SECTION 15121 - PIPE EXPANSION FITTINGS AND LOOPS

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

- A. This Section includes pipe expansion fittings and loops for mechanical piping systems, and the following:
  - 1. Metal-bellows expansion joints.
  - 2. Expansion compensators.
  - 3. Rubber expansion joints.
  - 4. Flexible-hose expansion joints.
  - 5. Slip expansion joints.
  - 6. Flexible ball joints.
  - 7. Pipe bends and loops.
  - 8. Guides and anchors.

## 1.3 PERFORMANCE REQUIREMENTS

- A. Compatibility: Products suitable for piping system fluids, materials, working pressures, and temperatures.
- B. Capability: Absorb 200 percent of maximum piping expansion between anchors.

## 1.4 SUBMITTALS

- A. Product Data: For each type of expansion fitting indicated.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer.
  - 1. Design Calculations: For thermal expansion of piping systems and selection and design of expansion fittings and loops.
  - 2. Anchor Details: Detail fabrication of each indicated. Show dimensions and methods of assembly.
  - 3. Alignment Guide Details: Detail field assembly and anchorage.
- C. Welding Certificates: Copies of certificates for welding procedures and personnel.
- D. Schedule: Indicate manufacturer's number, size, location, and features for each expansion fitting and loop.



1.5 QUALITY ASSURANCE

- A. Engineering Responsibility: Design and preparation of Shop Drawings and calculations for expansion fittings and loops by a qualified professional engineer.
  - 1. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of expansion fittings and loops that are similar to those indicated for this Project in material, design, and extent.
- B. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Metal-Bellows Expansion Joints:
    - a. Adscos Manufacturing Corp.
    - b. Anamet, Inc.
    - c. Badger Industries, Inc.
    - d. Expansion Joint Systems, Inc.
    - e. Flexicraft Industries.
    - f. Flex-Weld, Inc.
    - g. Hyspan Precision Products, Inc.
    - h. Metraflex Co.
    - i. Pathway Bellows, Inc.
    - j. Piping Technology & Products, Inc.
    - k. Proco Products, Inc.
    - l. Senior Flexonics, Inc.; Expansion Joint Div.
    - m. Wahlco Engineered Products, Inc.
  - 2. Expansion Compensators:
    - a. Adscos Manufacturing Corp.
    - b. Flexicraft Industries.
    - c. Flex-Weld, Inc.
    - d. Hyspan Precision Products, Inc.
    - e. Metraflex Co.
    - f. Senior Flexonics, Inc.; Expansion Joint Div.

3. Rubber Expansion Joints:
  - a. Flexicraft Industries.
  - b. Flex-Weld, Inc.
  - c. Garlock, Inc.
  - d. General Rubber Corp.
  - e. Mercer Rubber Co.
  - f. Metraflex Co.
  - g. MG Piping Products Co.
  - h. Proco Products, Inc.
  - i. Senior Flexonics, Inc.; Expansion Joint Div.
  - j. Vibration Mountings & Controls, Inc.
  
4. Flexible-Hose Expansion Joints:
  - a. Flexicraft Industries.
  - b. Metraflex Co.
  
5. Slip Expansion Joints:
  - a. Adscos Manufacturing Corp.
  - b. Advanced Thermal Systems, Inc.
  - c. Hyspan Precision Products, Inc.
  
6. Flexible Ball Joints:
  - a. Advanced Thermal Systems, Inc.
  - b. Hyspan Precision Products, Inc.
  
7. Guides:
  - a. Adscos Manufacturing Corp.
  - b. Advanced Thermal Systems, Inc.
  - c. B-Line Systems, Inc.
  - d. Flex-Weld, Inc.
  - e. Grinnell Corp.
  - f. Hyspan Precision Products, Inc.
  - g. Metraflex Co.

## 2.2 PACKLESS EXPANSION JOINTS

- A. Metal-Bellows Expansion Joints: 175-psig (1200-kPa) minimum pressure rating, with end fittings and external tie rods for limiting maximum travel, and flanged-end connections, unless otherwise indicated.
  1. Configuration: Single- and double-bellows type, with base, unless otherwise indicated.
  2. Joints for Copper Piping: Single- and two-ply, phosphor-bronze bellows and brass shroud.
  3. Joints for Steel Piping: Single- and two-ply, stainless-steel bellows and carbon-steel shroud.

- B. Expansion Compensators: 175-psig (1200-kPa) minimum pressure rating, with internal guides, antitorque device, and removable end clip for positioning.
1. End Connections for NPS 2 (DN50) and Smaller: Threaded.
  2. End Connections for NPS 2-1/2 (DN65) and Larger: Flanged.
  3. Joints for Copper Piping: Two-ply, phosphor-bronze bellows and brass shroud.
  4. Joints for Steel Piping: Two-ply, stainless-steel bellows and carbon-steel shroud.
- C. Rubber Expansion Joints: ASTM F 1123, fabric-reinforced butyl rubber, and pressure rated for 175 psig at 240 deg F (1200 kPa at 116 deg C) minimum.
1. Configuration: Full-faced, integral, steel-flanged-end connections; external control rods; and steel retaining rings drilled to match flange bolt holes.
  2. Type: Single sphere.
- D. Flexible-Hose Expansion Joints: Manufactured assembly with two flexible-metal-hose legs joined by long-radius 180-degree return bend with inlet and outlet elbow fittings, corrugated-metal inner hoses, and braided outer sheaths.
1. Joints for Copper Piping: Copper fittings with solder-joint end connections.
    - a. NPS 2 (DN50) and Smaller: Bronze hoses and single-braid bronze sheaths with 450 psig at 70 deg F (3100 kPa at 21 deg C) and 340 psig at 450 deg F (2340 kPa at 232 deg C) minimum pressure ratings.
    - b. NPS 2-1/2 to NPS 4 (DN65 to DN100): Stainless-steel hoses and single-braid, stainless-steel sheaths with 300 psig at 70 deg F (2060 kPa at 21 deg C) and 225 psig at 450 deg F (1550 kPa at 232 deg C) minimum pressure ratings.
  2. Joints for Steel Piping: Carbon-steel fittings.
    - a. End Connections for NPS 2 (DN50) and Smaller: Threaded.
    - b. End Connections for NPS 2-1/2 (DN65) and Larger: Flanged.
    - c. Joints for NPS 2 (DN50) and Smaller: Stainless-steel hoses and single-braid, stainless-steel sheaths with 450 psig at 70 deg F (3100 kPa at 21 deg C) and 325 psig at 600 deg F (2250 kPa at 315 deg C) minimum pressure ratings.
    - d. Joints for NPS 2-1/2 to NPS 6 (DN65 to DN150): Stainless-steel hoses and single-braid, stainless-steel sheaths with 200 psig at 70 deg F (1380 kPa at 21 deg C) and 145 psig at 600 deg F (1000 kPa at 315 deg C) minimum pressure ratings.
    - e. Joints for NPS 8 to NPS 12 (DN200 to DN300): Stainless-steel hoses and single-braid, stainless-steel sheaths with 125 psig at 70 deg F (860 kPa at 21 deg C) and 90 psig at 600 deg F (625 kPa at 315 deg C) minimum pressure ratings.

### 2.3 PACKED EXPANSION JOINTS

- A. Slip Expansion Joints: Carbon-steel, packing-type pipe expansion joint designed for repacking under pressure and pressure rated for 250 psig at 400 deg F (1725 kPa at 204 deg C) minimum with compound limit stops, flanged or weld ends to match piping system, drip connection if used for steam piping systems, and flanged-end connections, unless otherwise indicated.
1. Packing: Asbestos-free polytetrafluoroethylene.

2. Double-Slip Type: With base.

- B. Flexible Ball Joints: Carbon-steel assembly with asbestos-free composition packing, designed for 360-degree rotation and angular deflection, and 250 psig at 400 deg F (1725 kPa at 204 deg C) minimum pressure rating; comply with ASME Boiler and Pressure Vessel Code: Section II, "Materials Specifications," and with ASME B31.9, "Building Services Piping," for materials and design of pressure-containing parts and bolting.
1. End Connections for NPS 2 (DN50) and Smaller: Threaded.
  2. End Connections for NPS 2-1/2 (DN65) and Larger: Flanged.
  3. Joints for NPS 6 (DN150) and Smaller: 30-degree angular deflection minimum.
  4. Joints for NPS 8 (DN200) and Larger: 15-degree angular deflection minimum.

## 2.4 GUIDES

- A. Steel, factory fabricated, with bolted two-section outer cylinder and base for alignment of piping and two-section guiding spider for bolting to pipe.

## 2.5 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M.
- B. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel, hex head.
- C. Washers: ASTM F 844, steel, plain, flat washers.
- D. Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened portland cement concrete, and tension and shear capacities appropriate for application.
1. Stud: Threaded, zinc-coated carbon steel.
  2. Expansion Plug: Zinc-coated steel.
  3. Washer and Nut: Zinc-coated steel.
- E. Chemical Fasteners: Insert-type-stud bonding system anchor for use with hardened portland cement concrete, and tension and shear capacities appropriate for application.
1. Bonding Material: ASTM C 881, Type IV, Grade 3, two-component epoxy resin suitable for surface temperature of hardened concrete where fastener is to be installed.
  2. Stud: ASTM A 307, zinc-coated carbon steel with continuous thread on stud, unless otherwise indicated.
  3. Washer and Nut: Zinc-coated steel.
- F. Concrete: Portland cement mix, 3000 psi (20.7 MPa) minimum. Refer to Division 3 Section "Cast-in-Place Concrete" for formwork, reinforcement, and concrete.
- G. Grout: ASTM C 1107, Grade B, factory-mixed and -packaged nonshrink and nonmetallic grout; suitable for interior and exterior applications.
1. Characteristics: Post-hardening, volume-adjusting, dry, hydraulic-cement grout.
  2. Properties: Nonstaining, noncorrosive, and nongaseous.

3. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

### PART 3 - EXECUTION

#### 3.1 EXPANSION FITTING INSTALLATION

- A. Install expansion fittings according to manufacturer's written instructions.
- B. Install expansion fittings in sizes matching pipe size in which they are installed.
- C. Align expansion fittings to avoid end-loading and torsional stress.

#### 3.2 PIPE BEND AND LOOP INSTALLATION

- A. Install pipe bends and loops cold-sprung in tension or compression as required to partly absorb tension or compression produced during anticipated change in temperature.
- B. Attach pipe bends and loops to anchors.
  1. Steel Anchors: Attach by welding. Comply with ASME B31.9 and ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
  2. Concrete Anchors: Attach by fasteners. Follow fastener manufacturer's written instructions.

#### 3.3 SWING CONNECTIONS

- A. Connect risers and branch connections to mains with at least five pipe fittings, including tee in main.
- B. Connect risers and branch connections to terminal units with at least four pipe fittings, including tee in riser.
- C. Connect mains and branch connections to terminal units with at least four pipe fittings, including tee in main.

#### 3.4 GUIDE INSTALLATION

- A. Install guides on piping adjoining expansion fittings and loops.
- B. Attach guides to pipe and secure to building structure.

#### 3.5 ANCHOR INSTALLATION

- A. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.

- B. Fabricate and install steel anchors by welding steel shapes, plates, and bars to piping and to structure. Comply with ASME B31.9 and AWS D1.1.
- C. Construct concrete anchors of poured-in-place concrete of dimensions indicated and include embedded fasteners.
- D. Install pipe anchors according to expansion fitting manufacturer's written instructions if expansion fittings are indicated.
- E. Use grout to form flat bearing surfaces for expansion fittings, guides, and anchors installed on or in concrete.

### 3.6 PAINTING

- A. Touching 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 a minimum dry film thickness of 2.0 mils (0.05 mm).
- B. Touching Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 9 Section "Painting."
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 15121



SECTION 15122 - METERS AND GAGES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes meters and gages for mechanical systems and water meters installed outside the building.
- B. Related Sections include the following:
  - 1. Mechanical equipment Sections that specify meters and gages as part of factory-fabricated equipment.
- C. Utility-Furnished Products: Water meters will be furnished to site, ready for installation.

1.3 SUBMITTALS

- A. Product Data: Include scale range, ratings, and calibrated performance curves for each meter, gage, fitting, specialty, and accessory specified.
- B. Shop Drawings: Include schedule indicating manufacturer's number, scale range, fittings, and location for each meter and gage.
- C. Product Certificates: Signed by manufacturers of meters and gages certifying accuracies under specified operating conditions and compliance with specified requirements.
- D. Shop Drawings: For brackets for duct-mounting thermometers.
- E. Maintenance Data: For meters and gages to include in maintenance manuals specified in Division 1. Include data for the following:
  - 1. Flow-measuring systems.
  - 2. Flowmeters.
  - 3. Thermal-energy flowmeters.
  - 4. Water meters.

PART 2 - PRODUCTS

2.1 MANUFACTURERS



- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Liquid-in-Glass Thermometers:
    - a. Dresser Industries, Inc.; Instrument Div.; Weksler Instruments Operating Unit.
    - b. Ernst Gage Co.
    - c. Marsh Bellofram.
    - d. Palmer Instruments, Inc.
    - e. Terice: H. O. Terice Co.
    - f. Weiss Instruments, Inc.
    - g. Winter's Thermogauges, Inc.
  - 2. Direct-Mounting, Filled-System Dial Thermometers:
    - a. Dresser Industries, Inc.; Instrument Div.; Ashcroft Commercial Sales Operation.
    - b. Dresser Industries, Inc.; Instrument Div.; Weksler Instruments Operating Unit.
    - c. Marsh Bellofram.
    - d. Terice: H. O. Terice Co.
    - e. Weiss Instruments, Inc.
  - 3. Remote-Reading, Filled-System Dial Thermometers:
    - a. AMETEK, Inc.; U.S. Gauge Div.
    - b. Dresser Industries, Inc.; Instrument Div.; Ashcroft Commercial Sales Operation.
    - c. Dresser Industries, Inc.; Instrument Div.; Weksler Instruments Operating Unit.
    - d. Marsh Bellofram.
    - e. Tel-Tru Manufacturing Co., Inc.
    - f. Terice: H. O. Terice Co.
    - g. Weiss Instruments, Inc.
    - h. Winter's Thermogauges, Inc.
  - 4. Bimetal Dial Thermometers:
    - a. Dresser Industries, Inc.; Instrument Div.; Ashcroft Commercial Sales Operation.
    - b. Dresser Industries, Inc.; Instrument Div.; Weksler Instruments Operating Unit.
    - c. Ernst Gage Co.
    - d. Marsh Bellofram.
    - e. Noshok, Inc.
    - f. Reotemp Instrument Corp.
    - g. Tel-Tru Manufacturing Co., Inc.
    - h. Terice: H. O. Terice Co.
    - i. Weiss Instruments, Inc.
    - j. Winter's Thermogauges, Inc.
  - 5. Insertion Dial Thermometers:
    - a. Dresser Industries, Inc.; Instrument Div.; Ashcroft Commercial Sales Operation.

- b. Dresser Industries, Inc.; Instrument Div.; Weksler Instruments Operating Unit.
  - c. Reotemp Instrument Corp.
  - d. Tel-Tru Manufacturing Co., Inc.
  - e. Trerice: H. O. Trerice Co.
  - f. Weiss Instruments, Inc.
6. Pressure Gages:
- a. AMETEK, Inc.; U.S. Gauge Div.
  - b. Dresser Industries, Inc.; Instrument Div.; Ashcroft Commercial Sales Operation.
  - c. Dresser Industries, Inc.; Instrument Div.; Weksler Instruments Operating Unit.
  - d. Ernst Gage Co.
  - e. Marsh Bellofram.
  - f. Noshok, Inc.
  - g. Trerice: H. O. Trerice Co.
  - h. Weiss Instruments, Inc.
  - i. WIKA Instruments Corp.
  - j. Winter's Thermogauges, Inc.
7. Test Plugs:
- a. Flow Design, Inc.
  - b. MG Piping Products Co.
  - c. National Meter.
  - d. Peterson Equipment Co., Inc.
  - e. Sisco Manufacturing Co.
  - f. Trerice: H. O. Trerice Co.
  - g. Watts Industries, Inc.; Water Products Div.
8. Wafer-Orifice-Type Flow Elements:
- a. ABB, Inc.; ABB Instrumentation.
  - b. Armstrong Pumps, Inc.
  - c. Badger Meter, Inc.; Industrial Div. (Tulsa, OK).
  - d. ITT Fluid Technology Corp.; ITT Bell & Gossett Div.
  - e. Scott Fetzer Co.; Meriam Instrument Div.
9. Venturi-Type Flow Elements:
- a. Armstrong Pumps, Inc.
  - b. Badger Meter, Inc.; Industrial Div. (Tulsa, OK).
  - c. Bailey-Fischer & Porter Co.
  - d. Flow Design, Inc.
  - e. Gerand Engineering Co.
  - f. Hyspan Precision Products, Inc.
  - g. Leeds & Northrup.
  - h. McCrometer, Inc.
  - i. Preso Meters Corp.
  - j. Victaulic Co. of America.
10. Pitot-Tube-Type Flow Elements:

- a. Dieterich Standard Co.
  - b. KOBOLD Instruments, Inc.
  - c. Preso Meters Corp.
  - d. Scott Fetzer Co.; Meriam Instrument Div.
  - e. Taco, Inc.
11. Turbine Flowmeters:
- a. Badger Meter, Inc.; Industrial Div. (Tulsa, OK).
  - b. Bailey-Fischer & Porter Co.
  - c. Baird Controls, Inc.
  - d. Data Industrial Corp.
  - e. Ecosol Corp.
  - f. Engineering Measurements Co.
  - g. Erdco Engineering Corp.
  - h. Flow Research Corp.
  - i. George Fischer Signet, Inc.
  - j. Hersey Measurement Co.
  - k. Hoffer Flow Controls, Inc.
  - l. ISTECH Corp.
  - m. Onicon, Inc.
  - n. SeaFlow, Inc.
12. Vortex-Shedding Flowmeters:
- a. Bailey-Fischer & Porter Co.
  - b. Engineering Measurements Co.
  - c. ISTECH Corp.
  - d. Johnson Yokogawa Corp.
  - e. MCO/Eastech, Inc.
  - f. Schlumberger Industries, Inc.; Measurement Div.
13. Flow Indicators:
- a. Dover Corp.; OPW Engineered Systems.
  - b. Dwyer Instruments, Inc.
  - c. Emerson Electric Co.; Brooks Instrument Div.
  - d. Ernst Gage Co.
  - e. Eugene Ernst Products Co.
  - f. McCrometer, Inc.
  - g. Penberthy, Inc.
14. Thermal-Energy Flowmeters:
- a. Data Industrial Corp.
  - b. Engineering Measurements Co.
  - c. Flow Research Corp.
  - d. Hersey Measurement Co.
  - e. ISTECH Corp.
  - f. Onicon, Inc.
  - g. Preso Meters Corp.

## 15. Water Meters:

- a. ABB Water Meters, Inc.
- b. Badger Meter, Inc.; Industrial Div. (Milwaukee, WI).
- c. Carlon Meter Co., Inc.
- d. Grinnell Corp.; Mueller Co.; Hersey Products Div.
- e. Hersey Measurement Co.
- f. ISTECH Corp.
- g. Lee Brass Co.; Hays Div.
- h. Master Meter, Inc.
- i. Schlumberger Industries, Inc.; Water Div.
- j. Sensus Technologies, Inc.
- k. Water Specialties Corp.

## 2.2 THERMOMETERS, GENERAL

## A. Scale Range: Temperature ranges for services listed are as follows:

- 1. Reheat and Condenser Water: 0 to 160 deg F, with 2-degree scale divisions (minus 18 to plus 70 deg C, with 1-degree scale divisions).
- 2. Chilled Water: 0 to 100 deg F, with 2-degree scale divisions (minus 18 to plus 38 deg C, with 1-degree scale divisions).
- 3. Steam and Condensate: 50 to 400 deg F, with 5-degree scale divisions (10 to 205 deg C, with 3-degree scale divisions).

## B. Accuracy: Plus or minus 1 percent of range span or plus or minus one scale division to maximum of 1.5 percent of range span.

## 2.3 LIQUID-IN-GLASS THERMOMETERS

## A. Description: ASTM E 1.

## B. Case: Die cast and aluminum finished in baked-epoxy enamel, glass front, spring secured, 9 inches (230 mm) long.

## C. Adjustable Joint: Finish to match case, 180-degree adjustment in vertical plane, 360-degree adjustment in horizontal plane, with locking device.

## D. Tube: Red or blue reading, organic-liquid filled with magnifying lens.

## E. Scale: Satin-faced nonreflective aluminum with permanently etched markings.

## F. Stem: Copper-plated steel, aluminum, or brass for separable socket; of length to suit installation.

## 2.4 DIRECT-MOUNTING, FILLED-SYSTEM DIAL THERMOMETERS

## A. Description: Vapor-actuated, universal-angle dial type.

- B. Case: Drawn steel or cast aluminum, with 4-1/2-inch- (115-mm-) diameter, glass lens.
- C. Adjustable Joint: Finish to match case, 180-degree adjustment in vertical plane, 360-degree adjustment in horizontal plane, with locking device.
- D. Thermal Bulb: Copper with phosphor-bronze bourdon pressure tube.
- E. Movement: Brass, precision geared.
- F. Scale: Progressive, satin-faced nonreflective aluminum with permanently etched markings.
- G. Stem: Copper-plated steel, aluminum, or brass for separable socket; of length to suit installation.

#### 2.5 REMOTE-READING, FILLED-SYSTEM DIAL THERMOMETERS

- A. Description: Vapor-actuated, remote-reading dial type.
- B. Case: Drawn steel or cast aluminum, with 4-1/2-inch- (115-mm-) diameter, glass lens.
- C. Movement: Brass, precision geared.
- D. Scale: Progressive, satin-faced nonreflective aluminum with permanently etched markings.
- E. Tubing: Bronze, double-braided, armor-over-copper capillary; of length to suit installation.
- F. Bulb: Copper with separable socket for liquids; averaging element for air.

#### 2.6 BIMETAL DIAL THERMOMETERS

- A. Description: ASME B40.3; direct-mounting, universal-angle dial type.
- B. Case: Stainless steel with 5-inch- (125-mm-) diameter, glass lens.
- C. Adjustable Joint: Finish to match case, 180-degree adjustment in vertical plane, 360-degree adjustment in horizontal plane, with locking device.
- D. Element: Bimetal coil.
- E. Scale: Satin-faced nonreflective aluminum with permanently etched markings.
- F. Stem: Stainless steel for separable socket, of length to suit installation.

#### 2.7 INSERTION DIAL THERMOMETERS

- A. Description: ASME B40.3, bimetal type.
- B. Dial: 1-inch (25-mm) diameter.

- C. Case: Stainless steel.
- D. Stem: Dustproof and leakproof 1/8-inch- (3-mm-) diameter, tapered-end stem with nominal length of 5 inches (125 mm).

## 2.8 SEPARABLE SOCKETS

- A. Description: Fitting with protective socket for installation in threaded pipe fitting to hold fixed thermometer stem.
  1. Material: Brass, for use in copper piping.
  2. Material: Stainless steel, for use in steel piping.
  3. Material: Steel, for use in steel piping.
  4. Extension-Neck Length: Nominal thickness of 2 inches (50 mm), but not less than thickness of insulation. Omit extension neck for sockets for piping not insulated.
  5. Insertion Length: To extend to one-third of diameter of pipe.
  6. Cap: Threaded, with chain permanently fastened to socket.
  7. Heat-Transfer Fluid: Oil or graphite.

## 2.9 THERMOMETER WELLS

- A. Description: Fitting with protective well for installation in threaded pipe fitting to hold test thermometer.
  1. Material: Brass, for use in copper piping.
  2. Material: Stainless steel, for use in steel piping.
  3. Material: Steel, for use in steel piping.
  4. Extension-Neck Length: Nominal thickness of 2 inches (50 mm), but not less than thickness of insulation. Omit extension neck for wells for piping not insulated.
  5. Insertion Length: To extend to one-third of diameter of pipe.
  6. Insertion Length: To extend to center of pipe.
  7. Cap: Threaded, with chain permanently fastened to socket.
  8. Heat-Transfer Fluid: Oil or graphite.

## 2.10 DUCT THERMOMETER SUPPORT FLANGES

- A. Description: Flanged-fitting bracket for mounting in hole of duct, with threaded end for attaching thermometer.
  1. Extension-Neck Length: Nominal thickness of 2 inches (50 mm), but not less than thickness of exterior insulation.
  2. Insertion-Neck Length: Nominal thickness of 2 inches (50 mm), but not less than thickness of insulation lining.

## 2.11 PRESSURE GAGES

- A. Description: ASME B40.1, phosphor-bronze bourdon-tube type with bottom connection; dry type, unless liquid-filled-case type is indicated.

- B. Case: Drawn steel, brass, or aluminum with 4-1/2-inch- (115-mm-) diameter, glass lens.
- C. Connector: Brass, NPS 1/4 (DN8).
- D. Scale: White-coated aluminum with permanently etched markings.
- E. Accuracy: Grade B, plus or minus 2 percent of middle 50 percent of scale.
- F. Range: Comply with the following:
  1. Vacuum: 30 inches Hg of vacuum to 15 psig of pressure (100 kPa of vacuum to 103 kPa of pressure).
  2. Fluids under Pressure: Two times the operating pressure.

#### 2.12 PRESSURE-GAGE FITTINGS

- A. Valves: NPS 1/4 (DN8) brass or stainless-steel needle type.
- B. Syphons: NPS 1/4 (DN8) coil of brass tubing with threaded ends.
- C. Snubbers: ASME B40.5, NPS 1/4 (DN8) brass bushing with corrosion-resistant porous-metal disc of material suitable for system fluid and working pressure.

#### 2.13 TEST PLUGS

- A. Description: Nickel-plated, brass-body test plug in NPS 1/2 (DN15) fitting.
- B. Body: Length as required to extend beyond insulation.
- C. Pressure Rating: 500 psig (3450 kPa) minimum.
- D. Core Insert: Self-sealing valve, suitable for inserting 1/8-inch (3-mm) OD probe from dial-type thermometer or pressure gage.
- E. Core Material for Air, Water, Oil, and Gas: 20 to 200 deg F (Minus 7 to plus 93 deg C), chloro-sulfonated polyethylene synthetic rubber.
- F. Core Material for Air and Water: Minus 30 to plus 275 deg F (Minus 35 to plus 136 deg C), ethylene-propylene-diene terpolymer rubber.
- G. Test-Plug Cap: Gasketed and threaded cap, with retention chain or strap.
- H. Test Kit: Pressure gage and adapter with probe, two bimetal dial thermometers, and carrying case.
  1. Pressure Gage and Thermometer Ranges: Approximately two times the system's operating conditions.

#### 2.14 FLOW-MEASURING SYSTEMS

- A. System includes calibrated flow element, separate meter, hoses or tubing, valves, fittings, and conversion chart compatible with flow element, meter, and system fluid.
  - 1. Flow range of flow-measuring element and meter covers operating range of equipment or system where used.
  - 2. Display: Visual instantaneous rate of flow.
- B. Permanent Meters: Suitable for wall or bracket mounting. Include 6-inch- (150-mm-) diameter, or equivalent, dial with fittings and copper tubing for connecting to flow element.
  - 1. Scale: Gallons per minute.
  - 2. Accuracy: Plus or minus 1 percent of center 60 percent of range.
- C. Portable Meters: Differential-pressure gage. Include two 12-foot (3.7-m) hoses in carrying case with handle.
  - 1. Scale: Inches of water, unless otherwise indicated.
  - 2. Accuracy: Plus or minus 2 percent between 20 and 80 percent of range.
- D. Include complete operating instructions with each meter.
- E. Wafer-Orifice Flow Elements: Differential-pressure-design, orifice-insert flow element made for installation between pipe flanges.
  - 1. Construction: Cast-iron body, brass valves with integral check valves and caps, and calibrated nameplate.
  - 2. Pressure Rating: 300 psig (2070 kPa).
  - 3. Temperature Rating: 250 deg F (121 deg C).
- F. Venturi Flow Elements: Differential-pressure-design, flow-element fitting made for installation in piping.
  - 1. Construction: Bronze, brass, or factory-primed steel; with brass fittings and attached tag with flow conversion data. Include ends threaded for NPS 2 (DN50) and smaller elements and flanged or welded for NPS 2-1/2 (DN65) and larger elements.
  - 2. Pressure Rating: 250 psig (1725 kPa).
  - 3. Temperature Rating: 250 deg F (121 deg C).
- G. Pitot-Tube Flow Elements: Differential-pressure design with probe made for insertion into piping.
  - 1. Construction: Stainless-steel probe of length to span inside of pipe, with brass fittings and attached tag with flow conversion data.
  - 2. Pressure Rating: 150 psig (1035 kPa).
  - 3. Temperature Rating: 250 deg F (121 deg C).

## 2.15 TURBINE FLOWMETERS

- A. Description: Insertion type; measures flow directly in gallons per minute (liters per second).



1. Construction: Bronze or stainless-steel body and plastic turbine or impeller, with integral direct-reading scale.
2. Pressure Rating: 150 psig (1035 kPa) minimum.
3. Temperature Rating: 180 deg F (82 deg C) minimum.
4. Display: Visual instantaneous rate of flow, with register to indicate total volume in gallons (liters).
5. Accuracy: Plus or minus 2-1/2 percent.

#### 2.16 VORTEX-SHEDDING FLOWMETERS

- A. In-Line Vortex-Shedding Flowmeter: Made for installation between pipe flanges; measures flow directly in gallons per minute (liters per second).
1. Construction: Stainless-steel body, with integral transmitter and direct-reading scale.
  2. Pressure Rating: 1000 psig (6900 kPa) minimum.
  3. Temperature Rating: 500 deg F (260 deg C) minimum.
  4. Display: Visual instantaneous rate of flow, with register to indicate total volume in gallons (liters).
  5. Integral Transformer: For low-voltage power operation.
  6. Accuracy: Plus or minus 7/10 percent for liquids and 1-1/4 percent for gases.
- B. Insertion Vortex-Shedding Flowmeter: Made for installation in pipe; measures flow directly in gallons per minute (liters per second).
1. Construction: Stainless-steel probe, with integral transmitter and direct-reading scale.
  2. Pressure Rating: 1000 psig (6900 kPa) minimum.
  3. Temperature Rating: 500 deg F (260 deg C) minimum.
  4. Display: Visual instantaneous rate of flow, with register to indicate total volume in gallons (liters).
  5. Integral Transformer: For low-voltage power connection.
  6. Accuracy: Plus or minus 1 percent for liquids and 1-1/2 percent for gases.

#### 2.17 FLOW INDICATORS

- A. Description: Instrument for visual verification of flow; made for installation in piping systems.
1. Construction: Bronze or stainless-steel body, with sight glass and plastic pelton-wheel indicator.
  2. Pressure Rating: 125 psig (860 kPa).
  3. Temperature Rating: 200 deg F (93 deg C).

#### 2.18 THERMAL-ENERGY FLOWMETERS

- A. Instruments include turbine-wheel flowmeter, two temperature sensors, transmitter, solid-state calculator with integral battery pack, integral stop valves, strainer, and magnetic trap.

- B. Instruments include turbine-wheel or flow-sensor element and meter, two temperature sensors, transmitter, solid-state calculator with integral battery pack, integral stop valves, strainer, and magnetic trap.
1. Construction: Bronze body.
  2. Pressure Rating: 125 psig (860 kPa).
  3. Temperature Range: 40 to 250 deg F (4.4 to 121 deg C).
  4. Data Output: Six-digit electromechanical counter with readout in British thermal units.
  5. Accuracy: Plus or minus 1 percent.
  6. Battery Pack: Five-year lithium battery.

## 2.19 WATER METERS

- A. Description: AWWA C700, displacement type, bronze case. Registers flow in gallons.
- B. Description: AWWA C701, turbine type. Registers flow in gallons.
- C. Description: AWWA C702, compound type, bronze case. Registers flow in gallons.
- D. Remote Registration System: Utility's standard; direct-reading type complying with AWWA C706; modified with signal transmitting assembly, low-voltage connecting wiring, and remote register assembly.

## PART 3 - EXECUTION

### 3.1 METER AND GAGE INSTALLATION, GENERAL

- A. Install meters, gages, and accessories according to manufacturer's written instructions for applications where used.

### 3.2 THERMOMETER INSTALLATION

- A. Install thermometers and adjust vertical and tilted positions.
- B. Install in the following locations:
  1. Inlet and outlet of each hydronic boiler and chiller.
  2. Inlet and outlet of each hydronic coil in air-handling units and built-up central systems.
  3. Inlet and outlet of each hydronic heat exchanger.
  4. Inlet and outlet of each hydronic heat-recovery unit.
  5. Inlet and outlet of each thermal storage tank.
- C. Install remote-reading dial thermometers in control panels with tubing connecting panel and thermometer bulb supported to prevent kinks. Use minimum tubing length.
- D. Install separable sockets in vertical position in piping tees where fixed thermometers are indicated.

1. Install with socket extending to one-third of diameter of pipe.
  2. Fill sockets with oil or graphite and secure caps.
- E. Install thermometer wells in vertical position in piping tees where test thermometers are indicated.
1. Install with stem extending to one-third of diameter of pipe.
  2. Fill wells with oil or graphite and secure caps.
- F. Duct Thermometer Support Flanges: Install in wall of duct where duct thermometers are indicated. Attach to duct with screws.

### 3.3 PRESSURE-GAGE INSTALLATION

- A. Install pressure gages in piping tees with pressure-gage valve located on pipe at most readable position.
- B. Install dry-type pressure gages in the following locations:
1. Discharge of each pressure-reducing valve.
  2. Chilled-water and condenser-water inlets and outlets of chillers.
  3. Cooling and reheat water coils inlets and outlets.
- C. Install liquid-filled-type pressure gages at suction and discharge of each pump.
- D. Install pressure-gage needle valve and snubber in piping to pressure gages.
1. Exception: Install syphon instead of snubber in piping to steam pressure gages.

### 3.4 FLOW-MEASURING SYSTEM INSTALLATION

- A. Install flowmeters in accessible and most readable positions in piping systems.
- B. Install flow-measuring elements at inlet of each hydronic coil and elsewhere as indicated.
- C. Install differential-pressure-type flow elements with minimum straight lengths of pipe upstream and downstream from element as prescribed by manufacturer's written instructions.
- D. Install connection fittings for attachment to portable flowmeters in accessible locations.
- E. Install permanently mounted meters for flow elements on walls or brackets in accessible locations.
- F. Install connections, tubing, and accessories between flow elements and meters as prescribed by manufacturer's written instructions.

### 3.5 FLOWMETER INSTALLATION

- A. Install flowmeters and components according to manufacturer's written instructions.

3.6 THERMAL-ENERGY FLOWMETER INSTALLATION

- A. Install meters in hydronic supply piping. Install thermal well in return line for remote sensor. Mount meter on wall if accessible; if not, provide bracket to support meter.

3.7 WATER METER INSTALLATION

- A. Install water meters, piping, and specialties according to AWWA M6 and utility's requirements.
  1. Install displacement-type water meters with shutoff valve on water meter inlet. Install valve on water meter outlet and valved bypass around meter, unless prohibited by authorities having jurisdiction.
  2. Install compound-type water meters with shutoff valves on water meter inlet and outlet and on valved bypass around meter. Support meters, valves, and piping on brick or concrete piers.
  3. Install detector-type water meters with shutoff valves on water meter inlet and outlet and on full-size valved bypass around meter. Support meter, valves, and piping on brick or concrete piers.

3.8 ROUGHING-IN FOR WATER METERS

- A. Install roughing-in piping and specialties for water meter installation according to utility's instructions and requirements.

3.9 CONNECTIONS

- A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping and specialties. The following are specific connection requirements:
  1. Install meters and gages adjacent to machines and equipment to allow service and maintenance.
  2. Connect flow-measuring-system elements to meters.
  3. Connect flowmeter transmitters to meters.
  4. Connect thermal-energy-flowmeter transmitters to meters.
- B. Make electrical connections to power supply and electrically operated meters and devices.
- C. Ground electrically operated meters.
  1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- D. Install electrical connections for power and devices.
- E. Electrical power, wiring, and connections are specified in Division 16 Sections.

3.10 ADJUSTING AND CLEANING

- A. Calibrate meters according to manufacturer's written instructions, after installation.
- B. Adjust faces of meters and gages to proper angle for best visibility.
- C. Clean windows of meters and gages and clean factory-finished surfaces. Replace cracked and broken windows, and repair scratched and marred surfaces with manufacturer's touchup paint.

END OF SECTION 15122

## SECTION 15140 - 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 1 Specification Sections, apply to this Section.

## 1.2 SUMMARY

- A. This Section includes domestic water piping and water meters inside the building.

## 1.3 DEFINITIONS

- A. CPVC: Chlorinated polyvinyl chloride plastic.
- B. PEX: Crosslinked polyethylene plastic.
- C. PVC: Polyvinyl chloride plastic.

## 1.4 PERFORMANCE REQUIREMENTS

- A. Provide components and installation capable of producing domestic water piping systems with 80 psig (550 kPa), unless otherwise indicated.

## 1.5 SUBMITTALS

- A. Product Data: For pipe, tube, fittings, and couplings and water meters.
- B. Water Samples: Specified in Part 3 "Cleaning" Article.
- C. Field quality-control test reports.

## 1.6 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9," for potable domestic water piping and components.

## PART 2 - PRODUCTS

## 2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

## 2.2 PIPING MATERIALS

- A. Refer to Part 3 "Pipe and Fitting Applications" Article for applications of pipe, tube, fitting, and joining materials.
- B. Transition Couplings for Aboveground Pressure Piping: Coupling or other manufactured fitting the same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

## 2.3 COPPER TUBE AND FITTINGS

- A. Soft Copper Tube: ASTM B 88, Types K and L (ASTM B 88M, Types A and B), water tube, annealed temper.
  1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
  2. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends. Furnish Class 300 flanges if required to match piping.
  3. 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.
- B. Hard Copper Tube: ASTM B 88, Types L and M (ASTM B 88M, Types B and C), water tube, drawn temper.
  1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
  2. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends. Furnish Class 300 flanges if required to match piping.
  3. 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.
  4. Copper, Grooved-End Fittings: ASTM B 75 (ASTM B 75M) copper tube or ASTM B 584 bronze castings.
    - a. Grooved-End-Tube Couplings: Copper-tube dimensions and design similar to AWWA C606. Include ferrous housing sections, gasket suitable for hot water, and bolts and nuts.

## 2.4 PEX PIPE AND FITTINGS

- A. PEX Distribution System: ASTM F 877, SDR 9 tubing.
  1. Fittings for PEX Tube: ASTM F 1807, metal-insert type with copper crimp rings and matching PEX tube dimensions.
  2. Manifold: Multiple-outlet, plastic or corrosion-resistant-metal assembly complying with ASTM F 877 and with plastic or corrosion-resistant-metal valve for each outlet.

## 2.5 VALVES

- A. Bronze and cast-iron, general-duty valves are specified in Division 15 Section "Valves."

## PART 3 - EXECUTION

## 3.1 EXCAVATION

- A. Excavating, trenching, and backfilling are specified in Division 2 Section "Earthwork."

## 3.2 PIPE AND FITTING APPLICATIONS

- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below, unless otherwise indicated.
- B. Flanges may be used on aboveground piping, unless otherwise indicated.
- C. Grooved joints may be used on aboveground grooved-end piping.
- D. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.
- E. Under-Building-Slab, Domestic Water Piping on House Side of Water Meter, NPS 4 and Smaller: Hard copper tube, Type L; copper pressure fittings; and soldered joints.
- F. Aboveground Domestic Water Piping: Use any of the following piping materials for each size range:
  - 1. Hard copper tube, Type L copper pressure fittings; and soldered joints.
- G. Non-Potable-Water Piping: Use any of the following piping materials for each size range:
  - 1. Hard copper tube, Type L copper pressure fittings; and soldered joints.

## 3.3 VALVE APPLICATIONS

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
  - 1. Shutoff Duty: Use bronze ball valves for piping NPS 2 (DN 50) and smaller.
  - 2. Drain Duty: Hose-end drain valves.
- 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 valves for piping NPS 2 (DN 50) and smaller. Use gate valves for piping NPS 2-1/2 (DN 65) and larger.

## 3.4 PIPING INSTALLATION

- A. Basic piping installation requirements are specified in Division 15 Section "Basic Mechanical Materials and Methods."
- B. Install under-building-slab copper tubing according to CDA's "Copper Tube Handbook."
- C. 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 Division 15 Section "Basic Mechanical Materials and Methods."
- D. Install wall penetration system at each service pipe penetration through foundation wall. Make installation watertight. Wall penetration systems are specified in Division 15 Section "Basic Mechanical Materials and Methods."



- 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. Pressure gages are specified in Division 15 Section "Meters and Gages," and drain valves and strainers are specified in Division 15 Section "Plumbing Specialties."
- F. Install water-pressure regulators downstream from shutoff valves. Water-pressure regulators are specified in Division 15 Section "Plumbing Specialties."
- G. Install domestic water piping level with 0.25 percent slope downward toward drain without pitch and plumb.
- H. Rough-in domestic water piping for water-meter installation according to utility company's requirements.

### 3.5 JOINT CONSTRUCTION

- A. Basic piping joint construction requirements are specified in Division 15 Section "Basic Mechanical Materials and Methods."
- B. 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.
- C. Grooved Joints: Assemble joints with grooved-end-pipe or grooved-end-tube coupling housing, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.
- D. Extruded-Tee Connections: Form tee in copper tube according to ASTM F 2014. Use tool designed for copper tube; drill pilot hole, form collar for outlet, dimple tube to form seating stop, and braze branch tube into collar.

### 3.4 HANGER AND SUPPORT INSTALLATION

- A. Seismic-restraint devices are specified in Division 15 Section "Mechanical Vibration and Seismic Controls."
- B. Pipe hanger and support devices are specified in Division 15 Section "Hangers and Supports." Install the following:
  - 1. Vertical Piping: MSS Type 8 or Type 42, clamps.
  - 2. Individual, Straight, Horizontal Piping Runs: According to the following:
    - a. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.
    - b. Longer Than 100 Feet (30 m): MSS Type 43, adjustable roller hangers.
    - c. Longer Than 100 Feet (30 m): MSS Type 49, spring cushion rolls, if indicated.
  - 3. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) 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 Division 15 Section "Hangers and Supports."
- D. Support vertical piping and tubing at base and at each floor.
- E. Rod diameter may be reduced 1 size for double-rod hangers, to a minimum of 3/8 inch (10 mm).
- F. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
  - 1. NPS 1-1/4 (DN 32) and Smaller: 84 inches (2100 mm) with 3/8-inch (10-mm) rod.
  - 2. NPS 1-1/2 (DN 40): 108 inches (2700 mm) with 3/8-inch (10-mm) rod.

3. NPS 2 (DN 50): 10 feet (3 m) with 3/8-inch (10-mm) rod.
  4. NPS 2-1/2 (DN 65): 11 feet (3.4 m) with 1/2-inch (13-mm) rod.
  5. NPS 3 and NPS 3-1/2 (DN 80 and DN 90): 12 feet (3.7 m) with 1/2-inch (13-mm) rod.
  6. NPS 4 and NPS 5 (DN 100 and DN 125): 12 feet (3.7 m) with 5/8-inch (16-mm) rod.
  7. NPS 6 (DN 150): 12 feet (3.7 m) with 3/4-inch (19-mm) rod.
  8. NPS 8 to NPS 12 (DN 200 to DN 300): 12 feet (3.7 m) with 7/8-inch (22-mm) rod.
- G. Install supports for vertical steel piping every 15 feet (4.5 m).
- H. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 3/4 (DN 20) and Smaller: 60 inches (1500 mm) with 3/8-inch (10-mm) rod.
  2. NPS 1 and NPS 1-1/4 (DN 25 and DN 32): 72 inches (1800 mm) with 3/8-inch (10-mm) rod.
  3. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 96 inches (2400 mm) with 3/8-inch (10-mm) rod.
  4. NPS 2-1/2 (DN 65): 108 inches (2700 mm) with 1/2-inch (13-mm) rod.
- I. Install supports for vertical copper tubing every 10 feet (3 m).
- J. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

### 3.5 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment and machines to allow service and maintenance.

### 3.6 FIELD QUALITY CONTROL

- A. Inspect domestic water piping as follows:
  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 24 hours 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 test or inspection, make required corrections and arrange for reinspection.
  4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- B. Test domestic water piping as follows:
  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 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 (345 kPa) 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 required corrective action.

### 3.7 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 plugs used 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.

### 3.8 CLEANING

#### A. Clean and disinfect potable[ and non-potable] domestic water piping as follows:

1. Purge new piping and parts of existing domestic water piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction or, if methods are not prescribed, procedures described in either AWWA C651 or AWWA C652 or as 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 (50 mg/L) 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 (200 mg/L) of chlorine. Isolate and allow to stand for three hours.
  - c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
  - d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

#### B. Prepare and submit reports of purging and disinfecting activities.

#### C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

END OF SECTION 15140

## SECTION 15150 - 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 1 Specification Sections, apply to this Section.

## 1.2 SUMMARY

- A. This Section includes soil and waste, sanitary drainage and vent piping inside the building and to locations indicated.

## 1.3 DEFINITIONS

- A. The following are industry abbreviations for piping materials:

1. CI: Cast iron pipe.
2. DI: Ductile Iron.
3. PVC: Polyvinyl chloride plastic.

## 1.4 PERFORMANCE REQUIREMENTS

- A. Provide components and installation capable of producing piping systems with the following minimum working-pressure ratings, unless otherwise indicated:
  1. Soil, Waste, and Vent Piping: 10-foot head of water.
  2. Sanitary Sewer, Force-Main Piping: 100 psig.

## 1.5 SUBMITTALS

- A. Product Data: For pipe, tube, fittings, and couplings.
- B. Shop Drawings: For sovent drainage system, include plans, elevations, sections, and details.
- C. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

## 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.

## PART 2 - PRODUCTS

## 2.1 PIPING MATERIALS

- A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.
- B. Flexible Transition Couplings for Underground Nonpressure Piping: ASTM C 1173 with elastomeric sleeve. Include ends of same sizes as piping to be joined and include corrosion-resistant metal band on each end.
- C. Transition Couplings for Underground Pressure Piping: AWWA C219 metal, sleeve-type coupling or other manufactured fitting same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

## 2.3 PVC PIPING

- A. PVC Pipe: ASTM D 2665, solid-wall drain, waste, and vent.
  - 1. PVC Socket Fittings: ASTM D 2665, socket type, made to ASTM D 3311, drain, waste, and vent patterns.

## PART 3 - EXECUTION

## 3.1 EXCAVATION

- A. Refer to Division 2 Section "Earthwork" for excavating, trenching, and backfilling.

## 3.2 PIPING APPLICATIONS

- A. Transition and special fittings with pressure ratings at least equal to piping pressure ratings may be used in applications below, unless otherwise indicated.
- B. Flanges may be used on aboveground pressure piping, unless otherwise indicated.
- C. Soil, Waste, and Vent Piping (at A/C plenum return spaces): Use the following piping materials for each size range:
  - 1. NPS 1-1/4 and NPS 8: Use NPS 1-1/2 hubless, cast-iron soil piping and one of the following for the building:
    - a. Couplings: Heavy-duty, Type 304, stainless steel.
  - 2. NPS 2 to NPS 10: Hubless, cast-iron soil piping and one of the following for the building:
    - a. Couplings: Heavy-duty, Type 304, stainless steel.
  - 3. NPS 2 to NPS 4: Steel pipe; cast-iron, threaded drainage fittings; and threaded joints.
- D. Soil, Waste, and Vent Piping: Use the following piping materials for each size range:

1. PVC pipe, PVC socket fittings, and solvent-cemented joints.
- E. Aboveground Sanitary-Sewage Force Mains: Use the following piping materials for each size range:
1. NPS 2 and NPS 6 (DN 125 and DN 150): Steel pipe; steel-piping, grooved-end fittings; steel-piping, keyed couplings; and grooved joints.

### 3.3 PIPING INSTALLATION

- A. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for basic piping installation.
- B. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.
- C. Install cleanout fitting with closure plug inside the building in sanitary force-main piping.
- D. 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. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for sleeves and mechanical sleeve seals.
- E. Install wall penetration system at each service pipe penetration through foundation wall. Make installation watertight. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for wall penetration systems.
- F. 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.
- G. 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.
- H. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:
1. Building Sanitary Drain: 2 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
  2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.
  3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.
- I. Install force mains at elevations indicated.
- J. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.
- K. Do not enclose, cover, or put piping into operation until it is inspected and approved by construction manager.

## 3.4 JOINT CONSTRUCTION

- A. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for basic piping joint construction.
- B. Cast-Iron, Soil-Piping Joints: Make joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
  - 1. Gasketed Joints: Make with rubber gasket matching class of pipe and fittings.
  - 2. Hubless Joints: Make with rubber gasket and sleeve or clamp.
- C. PVC Nonpressure Piping Joints: Join piping according to ASTM D 2665.
- D. Grooved Joints: Assemble joint with keyed coupling, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.

## 3.5 VALVE INSTALLATION

- A. Refer to Division 15 Section "Valves" for general-duty valves.
- B. Shutoff Valves: Install shutoff valve on each sewage pump discharge.
  - 1. Use gate or full-port ball valve for piping NPS 2 and smaller.
  - 2. Use gate valve for piping NPS 2-1/2 and larger.
- C. Check Valves: Install swing check valve, downstream from shutoff valve, on each sewage pump discharge.
- D. Backwater Valves: Install backwater valves in piping subject to sewage backflow.
  - 1. Horizontal Piping: Horizontal backwater valves.
  - 2. Floor Drains: Drain outlet backwater valves, unless drain has integral backwater valve.
  - 3. Install backwater valves in accessible locations.
  - 4. Refer to Division 15 Section "Plumbing Specialties" for backwater valves.

## 3.6 HANGER AND SUPPORT INSTALLATION

- A. Refer to Division 15 Section "Mechanical Vibration Controls and Seismic Restraints" for seismic-restraint devices.
- B. Refer to Division 15 Section "Hangers and Supports" for pipe hanger and support devices. Install the following:
  - 1. Vertical Piping: MSS Type 8 or Type 42, clamps.
  - 2. Individual, Straight, Horizontal Piping Runs: According to the following:
    - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
    - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
    - c. Longer Than 100 Feet, if Indicated: MSS Type 49, spring cushion rolls.
  - 3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.

- 4. Base of Vertical Piping: MSS Type 52, spring hangers.
  - C. Install supports according to Division 15 Section "Hangers and Supports."
  - 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 PVC piping with the following maximum horizontal spacing and minimum rod diameters:
    - 1. NPS 1½ and NPS 2: 48 inches with 3/8-inch rod.
    - 2. NPS 3: 48 inches with ½-inch rod.
    - 3. NPS 4 and NPS 5: 48 inches with 5/8-inch rod.
    - 4. NPS 6: 48 inches with ¾-inch rod.
    - 5. NPS 8 to NPS 12: 48 inches with 7/8-inch rod.
  - G. Install supports for vertical PVC piping every 48 inches.
- 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. Refer to Division 15 Section "Plumbing Fixtures."
    - 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. Refer to Division 15 Section "Plumbing Specialties."
    - 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.
- 3.8 FIELD QUALITY CONTROL
- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
    - 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
    - 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
  - B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
  - C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.



- D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
  2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
  3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
  4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight.  
  
Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
  5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
  6. Prepare reports for tests and required corrective action.
- 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.

END OF SECTION 15150



SECTION 15160 - STORM DRAINAGE PIPING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes underground storm-drainage piping inside the building and to locations indicated.

1.3 DEFINITIONS

- A. The following are industry abbreviations for plastic piping materials:
  - 1. PVC: Polyvinyl chloride plastic.

1.4 PERFORMANCE REQUIREMENTS

- A. Provide components and installation capable of producing piping systems with the following minimum working-pressure ratings, unless otherwise indicated:
  - 1. Storm Drainage Piping: 10-foot head of water.

1.5 SUBMITTALS

- A. Product Data: For pipe, tube, fittings, and couplings.
- B. Shop Drawings: For underground piping showing elevations and crossings.
- C. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

1.6 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

PART 2 – PRODUCTS

2.1 PIPING MATERIALS

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

- B. Flexible Transition Couplings for Underground Nonpressure Piping: ASTM C 1173 with elastomeric sleeve. Include ends of same sizes as piping to be joined and include corrosion-resistant metal band on each end.

### 2.3 PVC PIPING

- A. PVC Pipe: ASTM D 2665, solid-wall drain, waste, and vent.
  - 1. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns.

## PART 3 – EXECUTION

### 3.1 EXCAVATION

- A. Refer to Division 2 Section "Earthwork" for excavating, trenching, and backfilling.

### 3.2 PIPING APPLICATIONS

- A. Transition and special fittings with pressure ratings at least equal to piping pressure ratings may be used in applications below, unless otherwise indicated.
- C. Aboveground Storm Drainage Piping: Use the following piping materials for each size range:
  - 1. NPS 2 to NPS 15: PVC Pipe: ASTM D 2665, solid-wall drain, waste, and vent. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns.
- D. Underground Storm Drainage Piping: Use the following piping materials for each size range:
  - 1. NPS 3 and NPS 15: PVC pipe, PVC socket fittings, and solvent-cemented joints.
  - 2. NPS 3 and NPS 15: Cellular-core, Schedule, 40, PVC pipe; PVC socket fittings; and solvent-cemented joints.
  - 3. NPS 3 and NPS 15: Cellular-core, Sewer and Drain Series, PVC pipe; PVC socket fittings; and solvent-cemented joints.

### 3.3 PIPING INSTALLATION

- A. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for basic piping installation.
- B. Install cleanouts at grade and extend to where building storm drains connect to building storm sewers.
- C. Install cleanout fitting with closure plug inside the building in storm drainage force-main piping.
- D. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall and pits. Select number of interlocking rubber links required to make installation watertight. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for sleeves and mechanical sleeve seals.

- E. Install wall penetration system at each service pipe penetration through foundation wall. Make installation watertight. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for wall penetration systems.
- F. Make changes in direction for storm piping using appropriate branches, bends, and long-sweep bends. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- G. Lay buried building drain 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.
- H. Install storm drainage piping at the following minimum slopes, unless otherwise indicated:
  - 1. Building Storm Drain: 1 percent downward in direction of flow.
- I. Install force mains at elevations indicated.
- J. Do not enclose, cover, or put piping into operation until it is inspected and approved by construction manager.
- K. Install PVC storm drainage piping according to ASTM D 2665.

#### 3.4 JOINT CONSTRUCTION

- A. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for basic piping joint construction.
- B. Cast-Iron, Soil-Piping Joints: Make joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
  - 1. Gasketed Joints: Make with rubber gasket matching class of pipe and fittings.
- C. PVC Nonpressure Piping Joints: Join piping according to ASTM D 2665.
- D. Backwater Valves: Install backwater valves in piping subject to backlog.
  - 1. Horizontal Piping: Horizontal backwater valves.
  - 2. Install backwater valves in accessible locations.
  - 3. Refer to Division 15 Section "Plumbing Specialties" for backwater valves.

#### 3.6 HANGER AND SUPPORT INSTALLATION

- A. Refer to Division 15 Section "Mechanical Vibration Controls and Seismic Restraints" for seismic-restraint devices.
- B. Refer to Division 15 Section "Hangers and Supports" for pipe hanger and support devices. Install the following:

1. Vertical Piping: MSS Type 8 or Type 42, clamps.
  2. Individual, Straight, Horizontal Piping Runs: According to the following:
    - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
  3. Base of Vertical Piping: MSS Type 52, spring hangers.
- C. Install supports according to Division 15 Section "Hangers and Supports."
- 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 and for supports underground & above ground cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
  2. NPS 3: 60 inches with 1/2-inch rod.
  3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
  4. NPS 6: 60 inches with 3/4-inch rod.
  5. NPS 8 to NPS 12: 60 inches with 7/8-inch rod.
  6. NPS 15: 60 inches with 1-inch rod.
  7. Spacing for 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.
- G. Install supports for vertical cast-iron soil piping every 15 feet.
- H. 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 interior storm drainage piping to exterior storm drainage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect storm drainage piping to roof drains and storm drainage specialties.

### 3.8 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
  1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in.
  2. Final Inspection: Arrange for final construction manager to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If construction manager find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by construction manager.

- D. Test storm drainage piping according to procedures of construction manager or, in absence of published procedures, as follows:
1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
  2. Leave uncovered and unconcealed new, altered, extended, or replaced storm drainage piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
  3. Test Procedure: Test storm drainage piping on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
  4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
  5. Prepare reports for tests and required corrective action.
- E. Test force-main piping according to procedures of construction manager 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.

END OF SECTION 15160





SECTION 15181 - HYDRONIC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes piping, special-duty valves, and hydronic specialties for hot-water heating, chilled-water cooling, and condenser water systems; makeup water for these systems; blowdown drain lines; and condensate drain piping.
- B. Related Sections include the following:
  - 1. Division 7 Section "Through-Penetration Firestop Systems" for materials and methods for sealing pipe penetrations through fire and smoke barriers.
  - 2. Division 7 Section "Joint Sealants" for materials and methods for sealing pipe penetrations through exterior walls.
  - 3. Division 15 Section "Basic Mechanical Materials and Methods" for general piping materials and installation requirements.
  - 4. Division 15 Section "Hangers and Supports" for pipe supports, product descriptions, and installation requirements. Hanger and support spacing is specified in this Section.
  - 5. Division 15 Section "Valves" for general-duty gate, globe, ball, butterfly, and check valves.
  - 6. Division 15 Section "Meters and Gages" for thermometers, flow meters, and pressure gages.
  - 7. Division 15 Section "Mechanical Identification" for labeling and identifying hydronic piping.
  - 8. Division 15 Section "Hydronic Pumps" for pumps, motors, and accessories for hydronic piping.
  - 9. Division 15 Section "HVAC Instrumentation and Controls" for temperature-control valves and sensors.

1.3 DEFINITIONS

- A. CPVC: Chlorinated polyvinyl chloride.
- B. PVC: Polyvinyl chloride.

## 1.4 SUBMITTALS

- A. Product Data: For each type of special-duty valve indicated. Include flow and pressure drop curves based on manufacturer's testing for diverting fittings, calibrated balancing valves, and automatic flow-control valves.
- B. Shop Drawings: Detail fabrication of pipe anchors, hangers, special pipe support assemblies, alignment guides, expansion joints and loops, and their attachment to the building structure. Detail location of anchors, alignment guides, and expansion joints and loops.
- C. Welding Certificates: Copies of certificates for welding procedures and personnel.
- D. Field Test Reports: Written reports of tests specified in Part 3 of this Section. Include the following:
  - 1. Test procedures used.
  - 2. Test results that comply with requirements.
  - 3. Failed test results and corrective action taken to achieve requirements.
- E. Maintenance Data: For hydronic specialties and special-duty valves to include in maintenance manuals specified in Division 1.
- F. Water Analysis: Submit a copy of the water analysis to illustrate water quality available at Project site.

## 1.5 QUALITY ASSURANCE

- A. Welding: Qualify processes and operators according to the ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
- B. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1.

## 1.6 COORDINATION

- A. Coordinate layout and installation of hydronic piping and suspension system components with other construction, including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.
- B. Coordinate pipe sleeve installations for foundation wall penetrations.
- C. Coordinate piping installation with roof curbs, equipment supports, and roof penetrations. Roof specialties are specified in Division 7 Sections.
- D. Coordinate pipe fitting pressure classes with products specified in related Sections.
- E. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into base. Concrete, reinforcement, and formwork requirements are specified in Division 3 Sections.

- F. Coordinate installation of pipe sleeves for penetrations through exterior walls and floor assemblies. Coordinate with requirements for firestopping specified in Division 7 Section "Through-Penetration Firestop Systems" for fire and smoke wall and floor assemblies.

1.7 EXTRA MATERIALS

- A. Water Treatment Chemicals: Furnish sufficient chemicals for initial system startup and for preventive maintenance for one year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Grooved Mechanical-Joint Fittings and Couplings:
    - a. Central Sprinkler Company; Central Grooved Piping Products.
    - b. Grinnell Corporation.
    - c. Victaulic Company of America.
  - 2. Calibrated Balancing Valves:
    - a. Armstrong Pumps, Inc.
    - b. Flow Design, Inc.
    - c. Gerand Engineering Company.
    - d. Griswold Controls.
    - e. ITT Bell & Gossett; ITT Fluid Technology Corp.
    - f. Taco, Inc.
  - 3. Pressure-Reducing Valves:
    - a. Amtrol, Inc.
    - b. Armstrong Pumps, Inc.
    - c. Conbraco Industries, Inc.
    - d. ITT Bell & Gossett; ITT Fluid Technology Corp.
    - e. Spence Engineering Company, Inc.
    - f. Watts Industries, Inc.; Watts Regulators.
  - 4. Safety Valves:
    - a. Amtrol, Inc.
    - b. Armstrong Pumps, Inc.
    - c. Conbraco Industries, Inc.
    - d. ITT McDonnell & Miller Div.; ITT Fluid Technology Corp.

- e. Kunkle Valve Division.
  - f. Spence Engineering Company, Inc.
5. Automatic Flow-Control Valves:
- a. Flow Design, Inc.
  - b. Griswold Controls.
6. Expansion Tanks:
- a. Amtrol, Inc.
  - b. Armstrong Pumps, Inc.
  - c. ITT Bell & Gossett; ITT Fluid Technology Corp.
  - d. Taco, Inc.
7. Air Separators and Air Purgers:
- a. Amtrol, Inc.
  - b. Armstrong Pumps, Inc.
  - c. ITT Bell & Gossett; ITT Fluid Technology Corp.
  - d. Taco, Inc.

## 2.2 PIPING MATERIALS

- A. General: Refer to Part 3 "Piping Applications" Article for applications of pipe and fitting materials.

## 2.3 COPPER TUBE AND FITTINGS

- A. Drawn-Temper Copper Tubing: ASTM B 88, Type L.
- B. Annealed-Temper Copper Tubing: ASTM B 88, Type K (ASTM B 88M, Type A).
- C. DWV Copper Tubing: ASTM B 306, Type DWV.
- D. Wrought-Copper Fittings: ASME B16.22.
- E. Wrought-Copper Unions: ASME B16.22.
- F. Solder Filler Metals: ASTM B 32, 95-5 tin antimony.
- G. Brazing Filler Metals: AWS A5.8, Classification BAg-1 (silver).

## 2.4 STEEL PIPE AND FITTINGS

- A. Steel Pipe, NPS 2 (DN 50) and Smaller: ASTM A 53, Type S (seamless) or Type F (furnace-butt welded), Grade B, Schedule 40, black steel, plain ends.

- B. Steel Pipe, NPS 2-1/2 through NPS 12 (DN 65 through DN 300): ASTM A 53, Type E (electric-resistance welded), Grade B, Schedule 40, black steel, plain ends.
- C. Steel Pipe, NPS 14 through NPS 18 (DN 350 through DN 450): ASTM A 53, Type E (electric-resistance welded) or Type S (seamless), Grade B, Schedule 30, black steel, plain ends.
- D. Steel Pipe, NPS 20 (DN 500): ASTM A 53, Type E (electric-resistance welded) or Type S (seamless), Grade B, Schedule 20, black steel, plain ends.
  - 1. Steel Pipe Nipples: ASTM A 733, made of ASTM A 53, Schedule 40, black steel; seamless for NPS 2 (DN 50) and smaller and electric-resistance welded for NPS 2-1/2 (DN 65) and larger.
- E. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125 and 250.
- F. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300.
- G. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300.
- H. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 25, 125, and 250; raised ground face, and bolt holes spot faced.
- I. Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.
- J. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
  - 1. Material Group: 1.1.
  - 2. End Connections: Butt welding.
  - 3. Facings: Raised face.
- K. Grooved Mechanical-Joint Fittings: ASTM A 536, Grade 65-45-12 ductile iron; ASTM A 47 (ASTM A 47M), Grade 32510 malleable iron; ASTM A 53, Type F, E, or S, Grade B fabricated steel; or ASTM A 106, Grade B steel fittings with grooves or shoulders designed to accept grooved end couplings.
- L. Grooved Mechanical-Joint Couplings: Ductile- or malleable-iron housing and synthetic rubber gasket of central cavity pressure-responsive design; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe an
- M. d fittings.
- N. Flexible Connectors: Stainless-steel bellows with woven, flexible, bronze, wire-reinforcing protective jacket; 150-psig (1035-kPa) minimum working pressure and 250 deg F (121 deg C) maximum operating temperature. Connectors shall have flanged or threaded-end connections to match equipment connected and shall be capable of 3/4-inch (20-mm) misalignment.
- O. Spherical, Rubber, Flexible Connectors: Fiber-reinforced rubber body with steel flanges drilled to align with Classes 150 and 300 steel flanges; operating temperatures up to 250 deg F (121 deg C) and pressures up to 150 psig (1035 kPa).

- P. Packed, Slip, Expansion Joints: 150-psig (1035-kPa) minimum working pressure, steel pipe fitting consisting of telescoping body and slip-pipe sections, packing ring, packing, limit rods, flanged ends, and chrome-plated finish on slip-pipe telescoping section.
- Q. Welding Materials: Comply with Section II, Part C, of the ASME Boiler and Pressure Vessel Code for welding materials appropriate for wall thickness and for chemical analysis of pipe being welded.
- R. Gasket Material: Thickness, material, and type suitable for fluid to be handled; and design temperatures and pressures.

## 2.5 PLASTIC PIPE AND FITTINGS

- A. CPVC Plastic Pipe: ASTM F 441, Schedules 40 and 80, plain ends.
- B. PVC Plastic Pipe: ASTM D 1785, Schedules 40 and 80, plain ends.
- C. CPVC Plastic Pipe Fittings: Socket-type pipe fittings, ASTM F 438 for Schedule 40 pipe; ASTM F 439 for Schedule 80 pipe.
  - 1. CPVC Solvent Cement: ASTM F 493.
- D. PVC Plastic Pipe Fittings: Socket-type pipe fittings, ASTM D 2466 for Schedule 40 pipe; ASTM D 2467 for Schedule 80 pipe.
  - 1. PVC Solvent Cement: ASTM D 2564.

## 2.6 VALVES

- A. Gate, globe, check, ball, and butterfly valves are specified in Division 15 Section "Valves."
- B. Refer to Part 3 "Valve Applications" Article for applications of each valve.
- C. Calibrated Balancing Valves, NPS 2 (DN 50) and Smaller: Bronze body, ball type, 125-psig (860-kPa) working pressure, 250 deg F (121 deg C) maximum operating temperature, and having threaded ends. Valves shall have calibrated orifice or venturi, connections for portable differential pressure meter with integral seals, and be equipped with a memory stop to retain set position.
- D. Calibrated Balancing Valves, NPS 2-1/2 (DN 65) and Larger: Cast-iron or steel body, ball type, 125-psig (860-kPa) working pressure, 250 deg F (121 deg C) maximum operating temperature, and having flanged or grooved connections. Valves shall have calibrated orifice or venturi, connections for portable differential pressure meter with integral seals, and be equipped with a memory stop to retain set position.
- E. Pressure-Reducing Valves: Diaphragm-operated, bronze or brass body with low inlet pressure check valve, inlet strainer removable without system shutdown, and noncorrosive valve seat and stem. Select valve size, capacity, and operating pressure to suit system. Valve shall be factory set at operating pressure and have capability for field adjustment.

- F. Safety Valves: Diaphragm-operated, bronze or brass body with brass and rubber, wetted, internal working parts; shall suit system pressure and heat capacity and shall comply with the ASME Boiler and Pressure Vessel Code, Section IV.
- G. Automatic Flow-Control Valves: Gray-iron body, factory set to maintain constant flow with plus or minus 5 percent over system pressure fluctuations, and equipped with a readout kit including flow meter, probes, hoses, flow charts, and carrying case. Each valve shall have an identification tag attached by chain, and be factory marked with the zone identification, valve number, and flow rate. Valve shall be line size and one of the following designs:
  - 1. Gray-iron or brass body, designed for 175 psig (1206 kPa) at 200 deg F (93 deg C) with stainless-steel piston and spring.
  - 2. Brass or ferrous-metal body, designed for 300 psig (2068 kPa) at 250 deg F (121 deg C) with corrosion-resistant, tamperproof, self-cleaning, piston-spring assembly easily removable for inspection or replacement.
  - 3. Combination assemblies, including bronze ball valve and brass alloy control valve, with stainless-steel piston and spring, fitted with pressure and temperature test valves, and designed for 300 psig (2067 kPa) at 250 deg F (121 deg C).
- H. Plastic Ball Valves: 150-psig (1035-kPa) working pressure, 250 deg F (121 deg C) maximum operating temperature, full port design, 1- or 2-piece body design, CPVC body and ball, polytetrafluoroethylene seats, EPDM seals, and tee handle; with threaded, socket, union, or flanged connections.
- I. Plastic Butterfly Valves: 150-psig (1035-kPa) working pressure, 250 deg F (121 deg C) maximum operating temperature, PVC wafer body, polytetrafluoroethylene seats, lever lock handle, and wafer style for installation between flanges.

## 2.7 HYDRONIC SPECIALTIES

- A. Manual Air Vent: Bronze body and nonferrous internal parts; 150-psig (1035-kPa) working pressure; 225 deg F (107 deg C) operating temperature; manually operated with screwdriver or thumbscrew; with NPS 1/8 (DN 6) discharge connection and NPS 1/2 (DN 15) inlet connection.
- B. Automatic Air Vent: Designed to vent automatically with float principle; bronze body and nonferrous internal parts; 150-psig (1035-kPa) working pressure; 240 deg F (116 deg C) operating temperature; with NPS 1/4 (DN 8) discharge connection and NPS 1/2 (DN 15) inlet connection.
- C. Expansion Tanks: Welded carbon steel, rated for 125-psig (860-kPa) working pressure and 375 deg F (191 deg C) maximum operating temperature, with taps in bottom of tank for tank fitting and taps in end of tank for gage glass. Tanks shall be factory tested with taps fabricated and labeled according to the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1. Include the following fittings and accessories:
  - 1. Air-Control Tank Fitting: Cast-iron body, copper-plated tube, brass vent tube plug, and stainless-steel ball check, 100-gal. (379-L) unit only; sized for compression-tank diameter. Design tank fittings for 125-psig (860-kPa) working pressure and 250 deg F (121 deg C) maximum operating temperature.



2. Tank Drain Fitting: Brass body, nonferrous internal parts; 125-psig (860-kPa) working pressure and 240 deg F (116 deg C) maximum operating temperature; designed to admit air to compression tank, drain water, and close off system.
  3. Gage Glass: Full height with dual manual shutoff valves, 3/4-inch- (20-mm-) diameter gage glass, and slotted-metal glass guard.
- D. Expansion Tanks: Welded carbon steel, rated for 125-psig (860-kPa) working pressure and 375 deg F (191 deg C) maximum operating temperature. Separate air charge from system water to maintain design expansion capacity by a flexible bladder securely sealed into tank. Include drain fitting and taps for pressure gage and air-charging fitting. Support vertical tanks with steel legs or base; support horizontal tanks with steel saddles. Factory fabricate and test tank with taps and supports installed and labeled according to the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1.
- E. Tangential-Type Air Separators: Welded black steel; ASME constructed and labeled for 125-psig (860-kPa) minimum working pressure and 375 deg F (191 deg C) maximum operating temperature; perforated stainless-steel air collector tube designed to direct released air into expansion tank; tangential inlet and outlet connections; threaded connections for NPS 2 (DN 50) and smaller; flanged connections for NPS 2-1/2 (DN 65) and larger; threaded blowdown connection. Provide units in sizes for full-system flow capacity.
- F. In-Line Air Separators: One-piece cast iron with an integral weir designed to decelerate system flow to maximize air separation at a working pressure up to 175 psig (1206 kPa) and liquid temperature up to 300 deg F (149 deg C).
- G. Air Purgers: Cast-iron body with internal baffles that slow the water velocity to separate the air from solution and divert it to the vent for quick removal. Maximum working pressure of 150 psig (1035 kPa) and temperature of 250 deg F (121 deg C).
- H. Bypass Chemical Feeder: Welded steel construction; 125-psig (860-kPa) working pressure; 5-gal. (19-L) capacity; with fill funnel and inlet, outlet, and drain valves.
1. Chemicals: Specially formulated, based on analysis of makeup water, to prevent accumulation of scale and corrosion in piping and connected equipment.
- I. Diverting Fittings: 125-psig (860-kPa) working pressure; 250 deg F (121 deg C) maximum operating temperature; cast-iron body with threaded ends, or wrought copper with soldered ends. Indicate flow direction on fitting.
- J. Y-Pattern Strainers: 125-psig (860-kPa) working pressure; cast-iron body (ASTM A 126, Class B), flanged ends for NPS 2-1/2 (DN 65) and larger, threaded connections for NPS 2 (DN 50) and smaller, bolted cover, perforated stainless-steel basket, and bottom drain connection.
- K. Basket Strainers: 125-psig (860-kPa) working pressure; high-tensile cast-iron body (ASTM A 126, Class B), flanged-end connections, bolted cover, perforated stainless-steel basket, and bottom drain connection.
- L. T-Pattern Strainers: 750-psig (5170-kPa) working pressure; ductile-iron or malleable-iron body, grooved-end connections, stainless-steel basket with 57 percent free area; removable access coupling and end cap for strainer maintenance.

- M. Flexible Connectors: Stainless-steel bellows with woven, flexible, bronze, wire-reinforcing protective jacket; 150-psig (1035-kPa) minimum working pressure and 250 deg F (121 deg C) maximum operating temperature. Connectors shall have flanged- or threaded-end connections to match equipment connected and shall be capable of 3/4-inch (20-mm) misalignment.
- N. Spherical, Rubber, Flexible Connectors: Fiber-reinforced rubber body with steel flanges drilled to align with Classes 150 and 300 steel flanges; operating temperatures up to 250 deg F (121 deg C) and pressures up to 150 psig (1035 kPa).
- O. Packed, Slip, Expansion Joints: 150-psig (1035-kPa) minimum working pressure, steel pipe fitting consisting of telescoping body and slip-pipe sections, packing ring, packing, limit rods, flanged ends, and chrome-plated finish on slip-pipe telescoping section.

### PART 3 - EXECUTION

#### 3.1 PIPING APPLICATIONS

- A. Hot and Chilled Water, NPS 2 (DN 50) and Smaller: Aboveground, use Type L (Type B) drawn-temper copper tubing with soldered joints or Schedule 40 steel pipe with threaded joints.
- B. Hot and Chilled Water, NPS 2-1/2 (DN 65) and Larger: Aboveground, use Schedule 40 steel pipe with welded and flanged joints or grooved mechanical-joint couplings.
- C. Condenser Water, NPS 2 (DN 50) and Smaller: Aboveground, use Type L (Type B) drawn-temper copper tubing with soldered joints or Schedule 40 steel pipe with threaded joints. Belowground or within slabs, use Type K (Type A) annealed-temper copper tubing with brazed joints.
- D. Condenser Water, NSP 2-1/2 (DN 65) and Larger: Aboveground, use Schedule 40 steel pipe with welded or flanged joints or grooved mechanical-joint couplings. Belowground, use Schedule 40 steel pipe with welded joints. Wrap pipe with 3M scotchwrap weather corrosion protection tape 20 mils thick, in accordance with manufacturer's recommendations. Clean and remove rust from pipe, as per Specification 09912, apply 3M scotchwrap pipe primer, as per manufacturer's recommendation.
- E. Condensate Drain Lines: Type L (Type B) drawn-temper copper tubing with soldered joints.

#### 3.2 VALVE APPLICATIONS

- A. General-Duty Valve Applications: Unless otherwise indicated, use the following valve types:
  1. Shutoff Duty: Gate, ball, and butterfly valves.
  2. Throttling Duty: Globe, ball, and butterfly valves.
- B. Install shutoff duty valves at each branch connection to supply mains, at supply connection to each piece of equipment, unless only one piece of equipment is connected in the branch line. Install throttling duty valves at each branch connection to return mains, at return connections to each piece of equipment, and elsewhere as indicated.

- C. Install calibrated balancing valves in the return water line of each heating or cooling element and elsewhere as required to facilitate system balancing.
- D. Install check valves at each pump discharge and elsewhere as required to control flow direction.
- E. Install safety valves on hot-water generators and elsewhere as required by the ASME Boiler and Pressure Vessel Code. Install safety-valve discharge piping, without valves, to floor. Comply with the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, for installation requirements.
- F. Install pressure-reducing valves on hot-water generators and elsewhere as required to regulate system pressure.

### 3.3 PIPING INSTALLATIONS

- A. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for basic piping installation requirements.
- B. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
- C. Install drains, consisting of a tee fitting, NPS 3/4 (DN 20) ball valve, and short NPS 3/4 (DN 20) threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.
- D. Install piping at a uniform grade of 0.2 percent upward in direction of flow.
- E. Reduce pipe sizes using eccentric reducer fitting installed with level side up.
- F. Unless otherwise indicated, install branch connections to mains using tee fittings in main pipe, with the takeoff coming out the bottom of the main pipe. For up-feed risers, install the takeoff coming out the top of the main pipe.
- G. Install strainers on supply side of each control valve, pressure-reducing valve, solenoid valve, in-line pump, and elsewhere as indicated. Install NPS 3/4 (DN 20) nipple and ball valve in blowdown connection of strainers NPS 2 (DN 50) and larger. Match size of strainer blowoff connection for strainers smaller than NPS 2 (DN 50).
- H. Anchor piping for proper direction of expansion and contraction.

### 3.4 HANGERS AND SUPPORTS

- A. Hanger, support, and anchor devices are specified in Division 15 Section "Hangers and Supports." Comply with requirements below for maximum spacing of supports.
- B. Install the following pipe attachments:
  - 1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet (6 m) long.

2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet (6 m) or longer.
  3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet (6 m) or longer, supported on a trapeze.
  4. Spring hangers to support vertical runs.
  5. On plastic pipe, install pads or cushions on bearing surfaces to prevent hanger from scratching pipe.
- C. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:
1. NPS 3/4 (DN 20): Maximum span, 7 feet (2.1 m); minimum rod size, 1/4 inch (6.4 mm).
  2. NPS 1 (DN 25): Maximum span, 7 feet (2.1 m); minimum rod size, 1/4 inch (6.4 mm).
  3. NPS 1-1/2 (DN 40): Maximum span, 9 feet (2.7 m); minimum rod size, 3/8 inch (10 mm).
  4. NPS 2 (DN 50): Maximum span, 10 feet (3 m); minimum rod size, 3/8 inch (10 mm).
  5. NPS 2-1/2 (DN 65): Maximum span, 11 feet (3.4 m); minimum rod size, 3/8 inch (10 mm).
  6. NPS 3 (DN 80): Maximum span, 12 feet (3.7 m); minimum rod size, 3/8 inch (10 mm).
  7. NPS 4 (DN 100): Maximum span, 14 feet (4.3 m); minimum rod size, 1/2 inch (13 mm).
  8. NPS 6 (DN 150): Maximum span, 17 feet (5.2 m); minimum rod size, 1/2 inch (13 mm).
  9. NPS 8 (DN 200): Maximum span, 19 feet (5.8 m); minimum rod size, 5/8 inch (16 mm).
  10. NPS 10 (DN 250): Maximum span, 20 feet (6.1 m); minimum rod size, 3/4 inch (19 mm).
  11. NPS 12 (DN 300): Maximum span, 23 feet (7 m); minimum rod size, 7/8 inch (22 mm).
  12. NPS 14 (DN 350): Maximum span, 25 feet (7.6 m); minimum rod size, 1 inch (25 mm).
  13. NPS 16 (DN 400): Maximum span, 27 feet (8.2 m); minimum rod size, 1 inch (25 mm).
  14. NPS 18 (DN 450): Maximum span, 28 feet (8.5 m); minimum rod size, 1-1/4 inches (32 mm).
  15. NPS 20 (DN 500): Maximum span, 30 feet (9.1 m); minimum rod size, 1-1/4 inches (32 mm).
- D. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:
1. NPS 3/4 (DN 20): Maximum span, 5 feet (1.5 m); minimum rod size, 1/4 inch (6.4 mm).
  2. NPS 1 (DN 25): Maximum span, 6 feet (1.8 m); minimum rod size, 1/4 inch (6.4 mm).
  3. NPS 1-1/2 (DN 40): Maximum span, 8 feet (2.4 m); minimum rod size, 3/8 inch (10 mm).
  4. NPS 2 (DN 50): Maximum span, 8 feet (2.4 m); minimum rod size, 3/8 inch (10 mm).
  5. NPS 2-1/2 (DN 65): Maximum span, 9 feet (2.7 m); minimum rod size, 3/8 inch (10 mm).
  6. NPS 3 (DN 80): Maximum span, 10 feet (3 m); minimum rod size, 3/8 inch (10 mm).
- E. Plastic Piping Hanger Spacing: Space hangers according to pipe manufacturer's written instructions for service conditions. Avoid point loading. Space and install hangers with the fewest practical rigid anchor points.
- F. Support vertical runs at roof, at each floor, and at 10-foot (3-m) intervals between floors.

### 3.5 PIPE JOINT CONSTRUCTION

- A. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for joint construction requirements for soldered and brazed joints in copper tubing; threaded, welded, and flanged joints in steel piping; and solvent-welded joints for PVC and CPVC piping.

### 3.6 HYDRONIC SPECIALTIES INSTALLATION

- A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.
- B. Install automatic air vents in mechanical equipment rooms only at high points of system piping, at heat-transfer coils, and elsewhere as required for system air venting.
- C. Install dip-tube fittings in boiler outlet. Install piping to expansion tank with a 2 percent upward slope toward tank. Connect boiler-outlet piping.
- D. Install in-line air separators in pump suction lines. Install piping to compression tank with a 2 percent upward slope toward tank. Install drain valve on units NPS 2 (DN 50) and larger.
- E. Install combination air separator and strainer in pump suction lines. Install piping to compression tank with a 2 percent upward slope toward tank. Install blowdown piping with gate valve; extend to nearest drain.
- F. Install bypass chemical feeders in each hydronic system where indicated, in upright position with top of funnel not more than 48 inches (1200 mm) above floor. Install feeder in bypass line, off main, using globe valves on each side of feeder and in the main between bypass connections. Pipe drain, with ball valve, to nearest equipment drain.
- G. Install expansion tanks above air separator. Install gage glass and cocks on end of tank. Install tank fitting in tank bottom and charge tank. Use manual vent for initial fill to establish proper water level in tank.
  - 1. Support tank from floor or structure above with sufficient strength to carry weight of tank, piping connections, and fittings, plus weight of a full tank of water. Do not overload building components and structural members.
- H. Install expansion tanks on floor. Vent and purge air from hydronic system, and ensure tank is properly charged with air to suit system design requirements.

### 3.7 TERMINAL EQUIPMENT CONNECTIONS

- A. Size for supply and return piping connections shall be same as for equipment connections.
- B. Install control valves in accessible locations close to connected equipment.
- C. Install bypass piping with globe valve around control valve. If multiple, parallel control valves are installed, only one bypass is required.
- D. Install ports for pressure and temperature gages at coil inlet connections.

### 3.8 CHEMICAL TREATMENT

- A. Perform an analysis of supply water to determine the type and quantities of chemical treatment needed to keep system free of scale, corrosion, and fouling, and to sustain the following water characteristics:
  - 1. PH: 7.
- B. Fill system and perform initial chemical treatment.

### 3.9 FIELD QUALITY CONTROL

- A. Prepare hydronic piping according to ASME B31.9 and as follows:
  - 1. Leave joints, including welds, uninsulated and exposed for examination during test.
  - 2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
  - 3. Flush system with clean water. Clean strainers.
  - 4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
  - 5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.
- B. Perform the following tests on hydronic piping:
  - 1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
  - 2. While filling system, use vents installed at high points of system to release trapped air. Use drains installed at low points for complete draining of liquid.
  - 3. Check expansion tanks to determine that they are not air bound and that system is full of water.
  - 4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the design pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed either 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A of ASME B31.9, "Building Services Piping."
  - 5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
  - 6. Prepare written report of testing.

### 3.10 ADJUSTING

- A. Mark calibrated nameplates of pump discharge valves after hydronic system balancing has been completed, to permanently indicate final balanced position.
- B. Perform these adjustments before operating the system:

1. Open valves to fully open position. Close coil bypass valves.
2. Check pump for proper direction of rotation.
3. Set automatic fill valves for required system pressure.
4. Check air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
5. Set temperature controls so all coils are calling for full flow.
6. Check operation of automatic bypass valves.
7. Check and set operating temperatures of boilers, chillers, and cooling towers to design requirements.
8. Lubricate motors and bearings.

3.11 CLEANING

- A. Flush hydronic piping systems with clean water. Remove and clean or replace strainer screens. After cleaning and flushing hydronic piping systems, but before balancing, remove disposable fine-mesh strainers in pump suction diffusers.

END OF SECTION 15181

## SECTION 15189 - HVAC WATER TREATMENT

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

- A. This Section includes water-treatment systems for the following:
  1. Heating (reheat), hot-water piping (closed-loop system).
  2. Chilled-water piping (closed-loop system).
  3. Condenser water piping (open system).

## 1.3 CHEMICAL FEED SYSTEM DESCRIPTION

- A. Closed-Loop System: One bypass feeder on each system with isolating and drain valves downstream from circulating pumps, unless otherwise indicated.
  1. Introduce chemical treatment through bypass feeder when required or indicated by test.
- B. Open-Loop Condenser Water Piping: Pump sequestering agent and corrosion inhibitor from solution tank into condenser water supply to tower. Use agitator as required.
  1. Intermittently feed biocide to condenser water to achieve a toxic level of the chemical to kill the organism present.
  2. Change biocides periodically to avoid chemical immunity.
  3. Activate chemical solution pump from water meter in makeup water line to cooling tower when condenser water pumps are running.
  4. Automatically feed chemical with electronic solid-state controllers.
  5. Deactivate solution pump and signal alarm by a liquid-level switch in each solution tank on low chemicals.

## 1.4 PERFORMANCE REQUIREMENTS

- A. Maintain water quality for HVAC systems that controls corrosion and build-up of scale and biological growth for maximum efficiency of installed equipment without posing a hazard to operating personnel or the environment.
- B. Base chemical treatment performance requirements on quality of water available at Project site, HVAC system equipment material characteristics and functional performance characteristics, operating personnel capabilities, and requirements and guidelines of authorities having jurisdiction.



1. Closed System: Maintain system essentially free of scale, corrosion, and fouling.
2. Condenser Water, Medium-to-Large Cooling Tower System: Maintain system essentially free of scale and total suspended solids.

### 1.5 SUBMITTALS

- A. Product Data: Include rated capacities; water-pressure drops; shipping, installed, and operating weights; and furnished products listed below:
  1. Pumps.
  2. Chemical solution tanks.
  3. Agitators.
  4. Control equipment and devices.
  5. Test equipment.
  6. Chemicals.
  7. Filters.
  8. Chemical feeders.
- B. Shop Drawings: Detail equipment assemblies indicating dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  1. Wiring Diagrams: Detail power and control wiring and differentiate between manufacturer-installed and field-installed wiring.
- C. Water Analysis: Submit a copy of the water analysis to illustrate water quality available at Project site.
- D. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.
- E. Maintenance Data: For pumps, agitators, filters, system controls, and accessories to include in maintenance manuals specified in Division 1.

### 1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who is an authorized representative of the chemical treatment manufacturer for both installation and maintenance of chemical treatment equipment required for this Project.
- 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.

### 1.7 MAINTENANCE

- A. Scope of Service: Provide chemicals and service program for maintaining optimum conditions in the circulating water for inhibiting corrosion, scale, and organic growths in the cooling, chilled-water piping, heating (reheat) hot-water piping, condenser water piping and equipment. Services and chemicals shall be provided for a period of one year from date of Substantial Completion, including the following:
1. Initial water analysis and recommendations.
  2. Startup assistance.
  3. Periodic field service and consultation.
  4. Customer report charts and log sheets.
  5. Laboratory technical assistance.
  6. Analyses and reports of all chemical items concerning safety and compliance with government regulations.

## 1.8 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Chemicals: Furnish quantity equal to 200 percent of amount initially installed.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. HVAC Water-Treatment Products:
    - a. Ampion Corp.
    - b. Anderson Chemical Co., Inc.
    - c. Barclay Chemical Co., Water Management, Inc.
    - d. Betz Dearborn, Inc.
    - e. Calgon Corp., ECC International.
    - f. Diversey Water Technologies, Inc.
    - g. DuBois Chemicals, Inc.; DuBois USA Subsidiary.
    - h. Fluids Pumps & Controllers, Inc.
    - i. Harmsco Industrial Filters.
    - j. Metro Group., Inc.; Metropolitan Refining Div.
    - k. Nalco Chemical Co.
    - l. Selick & Bird, Inc.
    - m. Stewart-Hall, Div. of the Rectorseal Corp.
    - n. Trane Boland Services; Water Treatment.
    - o. Watcon, Inc.

## 2.2 CHEMICAL FEEDING EQUIPMENT

- A. Bypass Feeders: Cast iron or steel, for introducing chemicals into system; with funnel shutoff valve on top, air-release valve on top, drain valve on bottom, and recirculating shutoff valves on sides.
  - 1. Capacity: 1.8 gal. (6.8 L).
  - 2. Working Pressure: 125 psig (860 kPa).
- B. Drip Feeders: Plastic reservoir with capillary tubing probe, weight, charging syringe, and clip.
- C. Positive-Displacement Diaphragm Pump: Simplex, self-priming, rated for intended chemical with 25 percent safety factor for design pressure and temperature.
  - 1. Adjustable flow rate.
  - 2. Thermoplastic construction.
  - 3. Fully enclosed, continuous-duty, 120-V, 60-Hz, single-phase motor.
  - 4. Built-in relief valve.
- D. Positive-Displacement Piston Pump: Metal and thermoplastic construction.
  - 1. Fully enclosed, continuous-duty, 120-V, 60-Hz, single-phase motor.
  - 2. Built-in relief valve.
- E. Chemical Solution Tanks: Chemical-resistant reservoirs fabricated from high-density opaque polyethylene with graduated markings.
  - 1. Molded fiberglass cover with recess for mounting pump, agitator, and liquid-level switch.
  - 2. Capacity: 30 gal. (114 L).
- F. Agitator: Direct drive, 1750 rpm, mounted on tank with angle adjustment.
  - 1. Fully enclosed, continuous-duty, 120-V, 60-Hz, single-phase motor.
  - 2. Stainless-steel clamp and motor mount, with stainless-steel shaft and propeller.
- G. Liquid-Level Switch: Polypropylene housing, integrally mounted PVC air trap, receptacles for connection to metering pump, and low-level alarm.
- H. Packaged Conductivity Controller: Solid-state circuitry, 5 percent accuracy, linear dial adjustment, built-in calibration switch, on-off switch and light, control-function light, output to control circuit, and recorder.
- I. Cold-Water Meter: Positive-displacement type with sealed, tamperproof magnetic drive; impulse contact register; single-pole, double-throw, dry-contact switch.
  - 1. Rotating-disc type with bronze or cast-iron body rated for 125 psig (860 kPa).
  - 2. Magnetic-drive or mechanical-impulse contactor matched to signal receiver.
  - 3. At least six-digit totalizers.
  - 4. 120-V ac.
- J. Solenoid Valves: Forged-brass body, globe pattern, and general-purpose solenoid enclosure with 120-V, continuous-duty coil.

- K. Electronic Timers: 150-second and 5-minute ranges, with infinite adjustment over full range, and mounted in cabinet with hand-off-auto switches and status lights.
- L. Chemical Tubing: Schedule 40, PVC with solvent-cement joints; or polypropylene tubing with heat fusion.
- M. Plastic Ball Valves: Rigid PVC or CPVC body, integral union ends, and polytetrafluoroethylene seats and seals.
- N. Plastic-Body Strainer: Rigid PVC or CPVC with cleanable stainless-steel strainer element.
- O. Condenser Water-Treatment Control Panel: Incorporate solid-state integrated circuits and digital LED displays, in NEMA 250, Type 12 enclosure with gasketed and lockable door.
  - 1. Control dissolved solids, based on conductivity, and include the following:
    - a. Digital readout display.
    - b. Temperature-compensated sensor probe adaptable to sample stream manifold.
    - c. High, low, and normal conductance indicator lights.
    - d. High or low conductance alarm light, trip points field adjustable; with silence switch.
    - e. Hand-off-auto switch for solenoid bleed-off valve.
    - f. Bleed-off light to indicate valve operation.
    - g. Internal adjustable hysteresis or dead band.
  - 2. Control inhibitor feeding, based on makeup volume, and include the following:
    - a. Solid-state reset counter (accumulator), with selections from 1 to 15.
    - b. Solid-state timer, adjustable from 15 to 300 seconds.
    - c. Test switch.
    - d. Hand-off-auto switch for chemical pump.
    - e. Illuminated legend to indicate feed when pump is activated.
    - f. Solid-state lockout timer, adjustable from 15 to 180 minutes, with indicator light. Lockout timer to deactivate the pump and activate alarm circuits.
    - g. Electromechanical-type, panel-mounted makeup totalizer to measure amount of makeup water.
  - 3. Control biocide with an adjustable time programmer and include the following:
    - a. 24-hour timer with 14-day skip feature to permit activation any hour of day.
    - b. Precision, solid-state, bleed-off lockout timer (zero to nine hours) and clock-controlled biocide pump timer (zero to two and one-half hours). Prebleed and bleed lockout.
    - c. Solid-state alternator to enable the use of two different formulations.
    - d. 24-hour digital display of time of day.
    - e. 14-day LED display of day of week.
    - f. Fast and slow internal clock set controls.
    - g. Battery backup so clock is not disturbed by power outages.
    - h. Quartz timekeeping accuracy.
    - i. Hand-off-auto switches for biocide pumps.
    - j. Biocide A and Biocide B illuminated legends to indicate pump is running.

### 2.3 CHEMICAL TREATMENT TEST EQUIPMENT

- A. Test Kit: Manufacturer recommended equipment and chemicals, in a carrying case, for testing pH, total dissolved solids, dissolved oxygen, biocount, chloride, and total alkalinity and for calcium hardness field tests.

### 2.4 CHEMICALS

- A. Furnish chemicals recommended by water-treatment system manufacturer that are compatible with piping system components and connected equipment.
- B. System Cleaner: Liquid alkaline compound with emulsifying agents and detergents to remove grease and petroleum products.
  - 1. Quantity: One year supply.
- C. Biocide: Chlorine release agents or microbiocides.
  - 1. Quantity: One year supply.
- D. Closed-Loop, Water Piping Chemicals: Sequestering agent to reduce deposits and adjust pH, corrosion inhibitors, and conductivity enhancers.
  - 1. Quantity: One year supply.
- E. Open-Loop, Condenser Water Piping Chemicals: Sequestering agent to inhibit scaling, acid to reduce alkalinity and pH, corrosion inhibitor, and biocide.
  - 1. Quantity: One year supply.

### 2.5 CONDENSER WATER FILTRATION UNIT

- A. Description: Filtration unit, including sand filter, filter pump, strainer, and controls; factory assembled, piped, and wired; mounted to steel skid (in the case of independent condenser water systems, provide one for each system).
- B. Sand Filter: Glass-fiber-reinforced polyester tank, internal distribution piping, differential gage panel, manual and automatic pressure relief valves, backwash valve, and backwash sight tube; graded silica sand installed according to manufacturer's written instructions.
- C. Pump: All-bronze, centrifugal filter pump with totally enclosed, fan-cooled motor; strainer mounted on pump suction; and manually reset, motor-overload switch with pilot light.
- D. Backwash Control: Automatic, with time clocks and differential pressure switches; mounted in NEMA 250, Type 4 control panel; factory wired for single, external electrical connection.

### 2.6 HOT-WATER/CHILLED-WATER FILTRATION UNIT

- A. Filtration Unit: Stainless-steel housing and polypropylene filter with polypropylene core.

- B. Replaceable Filter Media: Compatible with antifreeze and water-treatment chemicals.
- C. Filter Media for Sediment Removal Service: Rated at 98 percent efficiency for 20-micrometer particulate.
- D. Pressure Drop through the Filter Cartridge: Not to exceed 5 psig at design-flow rate when clean, and 10 psig when filter is dirty.

### PART 3 - EXECUTION

#### 3.1 WATER ANALYSIS

- A. Perform an analysis of supply water to determine the type and quantities of chemical treatment needed to maintain the water quality as specified in "Performance Requirements" Article.

#### 3.2 INSTALLATION

- A. Install treatment equipment level and plumb.
- B. Add cleaning chemicals as recommended by manufacturer.

#### 3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.
- C. Confirm applicable electrical requirements in Division 16 Sections for connecting electrical equipment.
- D. Ground equipment.
  - 1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

#### 3.4 FIELD QUALITY CONTROL

- A. Engage a factory-authorized service representative to perform startup service.
  - 1. Inspect field-assembled components and equipment installation, including piping and electrical connections. Report results in writing.
  - 2. Inspect piping and equipment to determine that systems and equipment have been cleaned, flushed, and filled with water, and are fully operational before introducing chemicals for water-treatment system.

3. Place HVAC water-treatment system into operation and calibrate controls during the preliminary phase of HVAC systems' startup procedures.
- B. Test chemical feed piping as follows:
1. Do not enclose, cover, or put piping into operation until it is tested and satisfactory test results are achieved.
  2. Test for leaks and defects. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
  3. Leave uncovered and unconcealed new, altered, extended, and replaced water piping until it has been tested and approved. Expose work that has been covered or concealed before it has been tested and approved.
  4. Cap and subject piping to static water pressure of 50 psig (345 kPa) above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow test pressure to stand for four hours. Leaks and loss in test pressure constitute defects.
  5. Repair leaks and defects with new materials and retest piping until satisfactory results are obtained.
  6. Prepare test reports, including required corrective action.

### 3.5 ADJUSTING

- A. Sample boiler water at one-week intervals after boiler startup for a period of five weeks, and prepare certified test report for each required water performance characteristic. Where applicable, comply with ASTM D 3370 and the following standards:
1. Silica: ASTM D 859.
  2. Steam System: ASTM D 1066.
  3. Acidity and Alkalinity: ASTM D 1067.
  4. Iron: ASTM D 1068.
  5. Water Hardness: ASTM D 1126.
- B. Occupancy Adjustments: Within 12 months of Substantial Completion, perform two separate water analyses to prove that automatic chemical feed systems are maintaining water quality within performance requirements specified in this Section. Perform analyses at least 60 days apart. Submit written reports of water analysis.

### 3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC water-treatment systems and equipment.
1. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining equipment and schedules.
- B. Review manufacturer's safety data sheets for handling of chemicals.

- C. Review data in maintenance manuals, especially data on recommended parts inventory and supply sources and on availability of parts and service. Refer to Division 1 Section "Contract Closeout."
- D. Review data in maintenance manuals, especially data on recommended parts inventory and supply sources and on availability of parts and service. Refer to Division 1 Section "Operation and Maintenance Data."
- E. Schedule at least 8 hours of training with Owner, through Engineer, with at least seven days' advance notice.

END OF SECTION 15189





SECTION 15241 - MECHANICAL VIBRATION CONTROLS AND SEISMIC RESTRAINTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes vibration isolators, vibration isolation bases, vibration isolation roof curbs, and seismic restraints and snubbers.
- B. Related Sections include the following:
  - 1. Division 15 Section "Hangers and Supports" for pipe hanger restraints.
  - 2. Division 15 Section "Metal Ductwork" for flexible duct connectors.
  - 3. Division 15 piping Sections for flexible pipe connectors.

1.3 SUBMITTALS

- A. Product Data: Indicate types, styles, materials, and finishes for each type of isolator specified. Include load deflection curves.
- B. Shop Drawings: Show designs and calculations, certified by a professional engineer, for the following:
  - 1. Design Calculations: Calculations for selection of vibration isolators, design of vibration isolation bases, and selection of seismic restraints.
  - 2. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to the structure and to the supported equipment. Include auxiliary motor slides and rails, and base weights.
  - 3. Seismic Restraint Details: Detail fabrication and attachment of restraints and snubbers.

1.4 QUALITY ASSURANCE

- A. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in the jurisdiction where the Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of vibration isolation bases and seismic restraints that are similar to those indicated for this Project in material, design, and extent.

1.5 PROJECT CONDITIONS

- A. Project seismic zone is 4 with a zone factor of 0.40.
- B. Building Importance Factor: 1.5.

1.6 COORDINATION

- A. Coordinate layout and installation of vibration isolation and seismic-restraint devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.
- B. Coordinate size and location of concrete housekeeping and vibration isolation bases. Cast anchor-bolt inserts into base. Concrete, reinforcement, and formwork requirements are specified in Division 3 Sections.
- C. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 7 Sections.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Ace Mountings Co., Inc.
  - 2. Amber/Booth Company, Inc.
  - 3. Apex Molded Products Co.
  - 4. B-Line Systems, Inc.
  - 5. Bramec Corp.
  - 6. California Dynamics Corp.
  - 7. Cannon Fabrication, Inc.
  - 8. Diversitech Corp.
  - 9. Fabreeka International, Inc.
  - 10. GMT International Corp.
  - 11. Greene Rubber Co.
  - 12. Isolation Technology, Inc.
  - 13. Karman Rubber.
  - 14. Kinetics Noise Control, Inc.
  - 15. King, H.A., Ltd.
  - 16. Lord Industrial Products.
  - 17. Mason Industries, Inc.
  - 18. Metalastik, Inc.
  - 19. Minor Rubber Co., Inc.
  - 20. Rubatex Corp.
  - 21. Service Rubber Group, Inc.

22. Stock Drive Products.
23. Tech Products Corp.
24. Vibration Eliminator Co., Inc.
25. Vibration Isolation Co., Inc.
26. Wagner Products Corp.

## 2.2 VIBRATION ISOLATORS

- A. Isolator Pads: Oil and water resistant and factory cut to sizes that match requirements of the equipment supported.
  1. Rubber Isolator Pads: Elastomer (neoprene or silicone) arranged in single or multiple layers and molded with a nonslip pattern and steel baseplates of sufficient stiffness to provide uniform loading over the pad area.
  2. Fiberglass or Cork Isolator Pads: Molded cork or glass fiber not less than 1 inch (25 mm) thick and precompressed through 10 compression cycles at 3 times the rated load.
  3. Load Range: From 10 to 50 psig (69 to 345 kPa) and a deflection not less than 0.08 inch per 1 inch (2 mm per 25 mm) of thickness. Do not exceed a loading of 50 psig (345 kPa).
- B. Rubber Isolator Mounts: Double-deflection type, with molded, oil-resistant rubber or neoprene isolator elements, with encapsulated top- and baseplates. Factory-drilled and tapped top plate for bolted equipment mounting. Factory-drilled baseplate for bolted connection to structure. Color-code to indicate capacity range.
- C. Spring Isolators: Freestanding, laterally stable, open-spring-type isolators.
  1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
  2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
  3. Lateral Stiffness: More than 1.2 times the rated vertical stiffness.
  4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
  5. Baseplates: Factory drilled for bolting to structure and bonded to a 1/4-inch- (6-mm-) thick, rubber isolator pad attached to the baseplate underside. Size baseplates to limit floor loading to 100 psig (690 kPa).
  6. Top Plates: Provide threaded studs for fastening and leveling equipment.
  7. Finishes: Manufacturer's standard corrosive-resistant finish.
- D. Restrained Spring Isolators: Vertically restrained, freestanding, laterally stable, steel open-spring-type isolators.
  1. Housing: Welded steel with resilient vertical limit stops to prevent spring extension due to wind loads or when weight is removed. Factory-drilled baseplate for bolting to structure and bonded to a 1/4-inch- (6-mm-) thick, rubber isolator pad attached to the baseplate underside. Provide adjustable equipment mounting and leveling bolt.
  2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
  3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
  4. Lateral Stiffness: More than 0.8 times the rated vertical stiffness.

5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
  6. Finishes: Baked enamel for metal components on isolators for interior use. Hot-dip galvanized for metal components on isolators for exterior use.
- E. Rubber Hangers: Double-deflection type, with molded, oil-resistant rubber or neoprene isolator elements bonded to formed-steel housings with threaded connections for hanger rods. Color-code to indicate capacity range.
- F. Spring Hangers: Combination spring and elastomeric hanger with coil spring and elastomeric insert in compression.
1. Frame: Formed steel, fabricated for connection to threaded rods and to allow for 30 degrees of angular hanger rod misalignment without binding or reducing isolation efficiency.
  2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
  3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
  4. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
  5. Finishes: Baked enamel for metal components. Color-code to indicate capacity range.

### 2.3 SEISMIC CONTROLS

- A. Thrust Restraints: Combination spring and elastomeric restraints with coil spring and elastomeric insert in compression. Factory set for thrust.
1. Frame: Formed steel, fabricated for connection to threaded rods and to allow for 30 degrees of angular hanger rod misalignment without binding or reducing isolation efficiency.
  2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
  3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
  4. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
  5. Finishes: Baked enamel for metal components. Color-code to indicate capacity range.
- B. Manufactured Seismic Snubbers: All-directional, double-acting snubbers.
1. Construction: Interlocking steel members restrained by a 3/4-inch- (19-mm-) thick, replaceable, shock-absorbing neoprene insert. Maintain 1/8-inch (3-mm) clearance in all directions between rigid and resilient surfaces.
- C. Fabricated Seismic Snubbers: Welded structural-steel shapes designed and fabricated to restrain equipment or vibration isolation bases from excessive movement during a seismic event. Design to resist gravity forces identified by authorities having jurisdiction.
1. Construction: Welded steel shapes conforming to ASTM A 36 (ASTM A 36M).
  2. Resilient Components: 3/4-inch- (19-mm-) thick, replaceable, shock-absorbing neoprene insert.

## 2.4 VIBRATION ISOLATION BASES

- A. Fabricated Steel Bases: Structural-steel bases and rails designed and fabricated by the isolation equipment manufacturer. Include equipment static loadings, power transmission, component misalignment, and cantilever loadings.
1. Fabricate bases to shapes required, with welded structural-steel shapes, plates, and bars conforming to ASTM A 36 (ASTM A 36M). Include support brackets to anchor base to isolation units. Include prelocated equipment anchor bolts and auxiliary motor slide bases or rails.
  2. Design and fabricate bases to result in the lowest possible mounting height with not less than 1-inch (25-mm) clearance above the floor.
  3. Concrete-Filled Inertia Bases: Weld reinforcing bars to the structural frame. Pour concrete into base with relocated equipment anchor bolts.
  4. Weld steel angles on frame for outrigger isolation mountings, and provide for anchor bolts and equipment support.
  5. Configure inertia bases to accommodate equipment supported.
  6. Pump Bases: Size to support pump and piping elbows.
  7. Factory Finish: Manufacturer's standard corrosive-resistant finish.

## 2.5 VIBRATION ISOLATION ROOF CURBS

- A. Description: Factory-assembled, fully enclosed, insulated, air- and watertight curb designed to resiliently support roof-mounted equipment and to withstand 145-mph (64.8-m/s) wind impinging laterally against the side of the equipment. Design restraints to meet seismic requirements of authorities having jurisdiction.
- B. Components: Upper support frame; lower support assembly; freestanding, unhoused, laterally stable steel springs; vertical and horizontal restraints.
1. Lower Support Assembly: Provide a means of attachment to the building structure and include a wood nailer stripe for attachment of roof material and 2 inches (50 mm) of rigid insulation on the inside of the assembly.
  2. Spring Isolators: As indicated or scheduled. Include adjustment bolt to permit leveling of equipment after installation. Attach to lower assembly with a rubber isolation pad. Locate spring isolators so they are accessible for adjustment at any time during the life of the installation without interfering with the integrity of the roof.
  3. Water Seal: Elastomeric seal conforming to UL Class A roofing materials, attached to the upper support frame, extending down past the wood nailer of the lower support assembly, and counterflashed over the roof materials.

## PART 3 - EXECUTION

## 3.1 INSTALLATION

- A. Install and anchor vibration-, sound-, and seismic-control products according to manufacturer's written instructions and authorities having jurisdiction.

- B. Anchor interior mounts, isolators, hangers, and snubbers to vibration isolation bases. Bolt isolator baseplates to structural floors as required by authorities having jurisdiction.
- C. Anchor exterior mounts, isolators, hangers, and snubbers to vibration isolation bases. Bolt isolator baseplates to structural supports as required by authorities having jurisdiction.
- D. Fill concrete inertia bases, after installing base frame, with 3000-psig (20.7-MPa) concrete, and trowel to a smooth, hard finish. Cast-in-place concrete is specified in Division 3.
- E. Install pipe connectors at connections for equipment supported on vibration isolators.

### 3.2 SEISMIC CONTROL

- A. Vibration Isolation Bases: Mount equipment on structural-steel bases or concrete inertia bases.
- B. Snubbers: Install the required number of seismic snubbers on each spring-mounted piece of equipment. Locate snubbers as close as possible to the vibration isolators and bolt to supporting structure.

### 3.3 ADJUSTING AND CLEANING

- A. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operations.
- B. Adjust thrust restraints for a maximum of 1/4 inch (6 mm) of movement at start and stop.

END OF SECTION 15241

## SECTION 15815 - 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.

## 1.2 SUMMARY

- A. This Section includes rectangular, round, and flat-oval metal ducts and plenums for ventilating, and air-conditioning systems in pressure classes from minus 2- to plus 10-inch wg (minus 500 to plus 2490 Pa).
- B. Related Sections include the following:
  - 1. Division 7 Section "Joint Sealants" for fire-resistant sealants for use around duct penetrations and fire-damper installations in fire-rated floors, partitions, and walls.
  - 2. Division 8 Section "Access Doors" for wall- and ceiling-mounted access doors for access to concealed ducts.
  - 3. Division 10 Section "Louvers and Vents" for intake and relief louvers and vents connected to ducts and installed in exterior walls.
  - 4. Division 15 Section "Mechanical Insulation" for duct insulation.
  - 5. Division 15 Section "Fibrous-Glass Ducts."
  - 6. Division 15 Section "HVAC Casings" for factory- and field-fabricated casings for mechanical equipment.
  - 7. Division 15 Section "Duct Accessories" for dampers, sound-control devices, duct-mounted access doors and panels, turning vanes, and flexible ducts.
  - 8. Division 15 Section "Air Terminals" for constant-volume and variable-air-volume control boxes, and reheat boxes.
  - 9. Division 15 Section "Diffusers, Registers, and Grilles."
  - 10. Division 15 Section "Control Systems Equipment" for automatic volume-control dampers and operators.
  - 11. Division 15 Section "Testing, Adjusting, and Balancing" for air balancing and final adjusting of manual-volume dampers.

## 1.3 DEFINITIONS

- A. Thermal Conductivity and Apparent Thermal Conductivity (k-Value): As defined in ASTM C 168. In this Section, these values are the result of the formula  $\text{Btu} \times \text{in./h} \times \text{sq. ft.} \times \text{deg F}$  or  $\text{W/m} \times \text{K}$  at the temperature differences specified. Values are expressed as Btu or W.
  - 1. Example: Apparent Thermal Conductivity (k-Value): 0.26 or 0.037.

## 1.4 SYSTEM DESCRIPTION



- A. Duct system design, as indicated, has been used to select and size air-moving and -distribution equipment and other components of air system. Changes to layout or configuration of duct system must be specifically approved in writing by the Engineer. Accompany requests for layout modifications with calculations showing that proposed layout will provide original design results without increasing system total pressure.

#### 1.5 SUBMITTALS

- A. Product Data: For duct liner and sealing materials.
- B. Shop Drawings: Show details of the following:
  1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
  2. Duct layout indicating pressure classifications and sizes on plans.
  3. Fittings.
  4. Reinforcement and spacing.
  5. Seam and joint construction.
  6. Penetrations through fire-rated and other partitions.
  7. Terminal unit and coil, installations.
  8. Hangers and supports, including methods for building attachment, vibration isolation, seismic restraints, and duct attachment.
- C. Coordination Drawings: Reflected ceiling plans drawn to scale and coordinating penetrations and ceiling-mounted items. Show the following:
  1. Ceiling suspension assembly members.
  2. Other systems installed in same space as ducts.
  3. Ceiling- and wall-mounted access doors and panels required to provide access to dampers and other operating devices.
  4. Coordination with ceiling-mounted items, including lighting fixtures, diffusers, grilles, speakers, sprinkler heads, access panels, and special moldings.
- D. Welding Certificates: Copies of certificates indicating welding procedures and personnel comply with requirements in "Quality Assurance" Article.
- E. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.
- F. Record Drawings: Indicate actual routing, fitting details, reinforcement, support, and installed accessories and devices.

#### 1.6 QUALITY ASSURANCE

- A. Welding Standards: Qualify welding procedures and welding personnel to perform welding processes for this Project 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.

- B. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," unless otherwise indicated.
- C. Comply with NFPA 96, "Ventilation Control and Fire Protection of Commercial Cooking Operations," Chapter 3, "Duct System," for range hood ducts, unless otherwise indicated.
- D. Mockups: Before installing duct systems, erect mockups representing system pressure classifications higher than 2-inch wg (500 Pa). Build mockups to comply with the following requirements, using materials indicated for completed Work:
  - 1. Locate mockups in the locations and of the size indicated or, if not indicated, as directed by the Engineer. Mockup may be a representative section of the actual duct system.
  - 2. Include the minimum number of each of the following features and fittings:
    - a. Five transverse joints.
    - b. One access door.
    - c. Two typical branch connections, each with at least one elbow.
    - d. Two typical flexible duct or flexible connector connections for each duct and apparatus.
  - 3. Perform tests specified in "Field Quality Control" Article. Modify mockup construction and perform additional tests as required to achieve specified minimum acceptable results.
  - 4. Obtain Engineer's approval of mockups before starting Work.
  - 5. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
  - 6. When directed, demolish and remove mockups from Project site.
  - 7. Approved mockups in an undisturbed condition at the time of Substantial Completion may become part of the completed Work.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver sealant and firestopping materials to site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration period for use, pot life, curing time, and mixing instructions for multicomponent materials.
- B. Store and handle sealant and firestopping materials according to manufacturer's written recommendations.
- C. Deliver and store stainless-steel sheets with mill-applied adhesive protective paper maintained through fabrication and installation.

### PART 2 - PRODUCTS

#### 2.1 SHEET METAL MATERIALS

- A. Galvanized, Sheet Steel: Lock-forming quality; ASTM A 653/A 653M, G90 (Z275) coating designation; mill-phosphatized finish for surfaces of ducts exposed to view.

- B. PVC-Coated Galvanized Steel: UL 181, Class 1 listing. Lock-forming-quality, galvanized, sheet steel with ASTM A 653/A 653M, G90 (Z275) coating designation; factory-applied, 4-mil (0.10-mm) PVC coating on exposed surfaces of ducts and fittings (exterior of ducts and fittings for underground applications and interior of ducts and fittings for fume-handling applications) and with factory-applied, 2-mil (0.05-mm) PVC coating on reverse side of ducts and fittings.
- C. Carbon-Steel Sheets: ASTM A 366/A 366M, cold-rolled sheets; commercial quality; with oiled, exposed matte finish.
- D. Stainless Steel: ASTM A 480/A 480M, Type 316, sheet form with No. 4 finish for surfaces of ducts exposed to view; and Type 304, sheet form with No. 1 finish for concealed ducts.
- E. Aluminum Sheets: ASTM B 209 (ASTM B 209M), Alloy 3003, Temper H14, sheet form with standard, one-side bright finish for ducts exposed to view and with mill finish for concealed ducts.
- 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 36-inch (900-mm) length or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

## 2.2 DUCT LINER

- A. General: Comply with NFPA 90A or NFPA 90B and NAIMA's "Fibrous Glass Duct Liner Standard."
- B. Materials: ASTM C 1071 with coated surface exposed to airstream to prevent erosion of glass fibers.
  - 1. Thickness: 1/2 inch (13 mm).
  - 2. Thickness: 1 inch (25 mm).
  - 3. Thickness: 1-1/2 inches (38 mm).
  - 4. Thermal Conductivity (k-Value): 0.26 at 75 deg F (0.037 at 24 deg C) mean temperature.
  - 5. Fire-Hazard Classification: Maximum flame-spread rating of 25 and smoke-developed rating of 50, when tested according to ASTM C 411.
  - 6. Liner Adhesive: Comply with NFPA 90A or NFPA 90B and ASTM C 916.
  - 7. Mechanical Fasteners: Galvanized steel, suitable for adhesive attachment, mechanical attachment, or welding attachment to duct without damaging liner when applied as recommended by manufacturer and without causing leakage in duct.
    - a. Tensile Strength: Indefinitely sustain a 50-lb- (23-kg-) tensile, dead-load test perpendicular to duct wall.
    - b. Fastener Pin Length: As required for thickness of insulation and without projecting more than 1/8 inch (3 mm) into airstream.
    - c. Adhesive for Attaching Mechanical Fasteners: Comply with fire-hazard classification of duct liner system.

## 2.3 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.
1. Joint and Seam Tape: 2 inches (50 mm) wide; glass-fiber fabric reinforced.
  2. Tape Sealing System: Woven-fiber tape impregnated with a gypsum mineral compound and a modified acrylic/silicone activator to react exothermically with tape to form a hard, durable, airtight seal.
  3. Joint and Seam Sealant: One-part, nonsag, solvent-release-curing, polymerized butyl sealant, formulated with a minimum of 75 percent solids.
  4. Flanged Joint Mastics: One-part, acid-curing, silicone, elastomeric joint sealants, complying with ASTM C 920, Type S, Grade NS, Class 25, Use O.

## 2.4 HANGERS AND SUPPORTS

- A. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for building materials.
1. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches (100 mm) thick.
  2. Exception: Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches (100 mm) thick.
- B. Hanger Materials: Galvanized, sheet steel or round, threaded steel rod.
1. Hangers Installed in Corrosive Atmospheres: Electrogalvanized, all-thread rod or galvanized rods with threads painted after installation.
  2. Straps and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for sheet steel width and thickness and for steel rod diameters.
- C. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- D. 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 ductwork.

## 2.5 RECTANGULAR DUCT FABRICATION

- A. General: Fabricate ducts, elbows, transitions, offsets, branch connections, and other construction with galvanized, sheet steel, according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible." Comply with requirements for metal thickness, reinforcing types and intervals, tie-rod applications, and joint types and intervals.
1. Lengths: Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure classification.

2. Materials: Free from visual imperfections such as pitting, seam marks, roller marks, stains, and discolorations.
- B. Fabricate range hood exhaust ducts with 0.0598-inch- (1.5-mm-) thick, carbon-steel sheet for concealed ducts and 0.0500-inch- (1.3-mm-) thick stainless steel for exposed ducts. Weld and flange seams and joints. Comply with NFPA 96.
  - C. Fabricate dishwasher hood exhaust ducts with 0.0500-inch- (1.3-mm-) thick stainless steel. Weld and flange seams and joints.
  - D. Acid-Resistant Ducts: PVC-coated galvanized steel.
  - E. Static-Pressure Classifications: Unless otherwise indicated, construct ducts to the following:
    1. Supply Ducts: 3-inch wg (750 Pa).
    2. Return Ducts: 2-inch wg (500 Pa), negative pressure.
    3. Exhaust Ducts: 2-inch wg (500 Pa), negative pressure.
  - F. 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 unbraced panel area, unless ducts are lined.

## 2.6 SHOP APPLICATION OF LINER IN RECTANGULAR DUCTS

- A. Adhere a single layer of indicated thickness of duct liner with 90 percent coverage of adhesive at liner contact surface area. Multiple layers of insulation to achieve indicated thickness are prohibited.
- B. Apply adhesive to liner facing in direction of airflow not receiving metal nosing.
- C. Butt transverse joints without gaps and coat joint with adhesive.
- D. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
- E. Do not apply liners in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and standard liner product dimensions make longitudinal joints necessary.
- F. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm (12.7 m/s).
- G. Secure liner with mechanical fasteners 4 inches (100 mm) from corners and at intervals not exceeding 12 inches (300 mm) transversely around perimeter; at 3 inches (75 mm) from transverse joints and at intervals not exceeding 18 inches (450 mm) longitudinally.
- H. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profile or are integrally formed from duct wall. Fabricate edge facings at the following locations:
  1. Fan discharge.
  2. Intervals of lined duct preceding unlined duct.
  3. Upstream edges of transverse joints in ducts.

- I. Secure insulation liner with perforated sheet metal liner of same metal thickness as specified for duct, secured to ducts with mechanical fasteners that maintain metal liner distance from duct without compressing insulation.
  - 1. Sheet Metal Liner Perforations: 3/32-inch (2.4-mm) diameter, with an overall open area of 23 percent.
- J. Terminate liner with duct buildouts installed in ducts to attach dampers, turning vane assemblies, and other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct wall with bolts, screws, rivets, or welds. Terminate liner at fire dampers at connection to fire-damper sleeve.

## 2.7 ROUND AND FLAT-OVAL DUCT FABRICATION

- A. General: Diameter as applied to flat-oval ducts in this Article is the diameter of the size of round duct that has a circumference equal to perimeter of a given size of flat-oval duct.
- B. Round Ducts: Fabricate supply ducts of galvanized steel according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."
- C. Flat-Oval Ducts: Fabricate supply ducts with standard spiral lock seams or with butt-welded longitudinal seams according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."
- D. Double-Wall (Insulated) Ducts: Fabricate double-wall (insulated) ducts with an outer shell and an inner liner. Dimensions indicated on internally insulated ducts are inside dimensions.
  - 1. Thermal Conductivity (k-Value): 0.26 at 75 deg F (0.037 at 24 deg C) mean temperature.
  - 2. Outer Shell: Base outer-shell metal thickness on actual outer-shell dimensions. Fabricate outer-shell lengths 2 inches (50 mm) longer than inner shell and insulation, and in metal thickness specified for single-wall duct.
  - 3. Insulation: 1-inch- (25-mm-) thick fibrous-glass insulation, unless otherwise indicated. Terminate insulation where internally insulated duct connects to single-wall duct or uninsulated components. Terminate insulation and reduce outer duct diameter to inner liner diameter.
  - 4. Solid Inner Liner: Fabricate round and flat-oval inner liners with solid sheet metal of thickness listed below:
  - 5. Perforated Inner Liner: Fabricate round and flat-oval inner liners with sheet metal having 3/32-inch- (2.4-mm-) diameter perforations, with an overall open area of 23 percent. Use the following sheet metal thicknesses and seam construction:
    - a. Ducts 3 to 8 Inches (75 to 200 mm) in Diameter: 0.019 inch (0.5 mm) with standard spiral seam construction.
    - b. Ducts 9 to 42 Inches (225 to 1070 mm) in Diameter: 0.019 inch (0.5 mm) with single-rib spiral seam construction.
    - c. Ducts 44 to 60 Inches (1120 to 1525 mm) in Diameter: 0.022 inch (0.55 mm) with single-rib spiral seam construction.
    - d. Ducts 62 to 88 Inches (1575 to 2235 mm) in Diameter: 0.034 inch (0.85 mm) with standard spiral seam construction.

6. Maintain concentricity of liner to outer shell by mechanical means. Retain insulation from dislocation by mechanical means.

## 2.8 ROUND AND FLAT-OVAL SUPPLY AND EXHAUST FITTING FABRICATION

- A. 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 duct.
- B. Diverging-Flow Fittings: Fabricate with a reduced entrance to branch taps with no excess material projecting from body onto branch tap entrance.
- C. Elbows: Fabricate in die-formed, gored, pleated, or mitered construction. Fabricate bend radius of die-formed, gored, and pleated elbows one and one-half times elbow diameter. Unless elbow construction type is indicated, fabricate elbows as follows:
  1. Mitered-Elbow Radius and Number of Pieces: Welded construction complying with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," unless otherwise indicated.
  2. Round Mitered Elbows: Welded construction with the following metal thickness for pressure classes from minus 2- to plus 2-inch wg (minus 500 to plus 500 Pa):
    - a. Ducts 3 to 26 Inches (75 to 660 mm) in Diameter: 0.028 inch (0.7 mm).
    - b. Ducts 27 to 36 Inches (685 to 915 mm) in Diameter: 0.034 inch (0.85 mm).
    - c. Ducts 37 to 50 Inches (940 to 1270 mm) in Diameter: 0.040 inch (1.0 mm).
    - d. Ducts 52 to 60 Inches (1320 to 1525 mm) in Diameter: 0.052 inch (1.3 mm).
    - e. Ducts 62 to 84 Inches (1575 to 2130 mm) in Diameter: 0.064 inch (1.6 mm).
  3. Round Mitered Elbows: Welded construction with the following metal thickness for pressure classes from 2- to 10-inch wg (500 to 2490 Pa):
    - a. Ducts 3 to 14 Inches (75 to 355 mm) in Diameter: 0.028 inch (0.7 mm).
    - b. Ducts 15 to 26 Inches (380 to 660 mm) in Diameter: 0.034 inch (0.85 mm).
    - c. Ducts 27 to 50 Inches (685 to 1270 mm) in Diameter: 0.040 inch (1.0 mm).
    - d. Ducts 52 to 60 Inches (1320 to 1525 mm) in Diameter: 0.052 inch (1.3 mm).
    - e. Ducts 62 to 84 Inches (1575 to 2130 mm) in Diameter: 0.064 inch (1.6 mm).
  4. Flat-Oval Mitered Elbows: Welded construction with same metal thickness as longitudinal seam flat-oval duct.
  5. 90-Degree, Two-Piece, Mitered Elbows: Use only for supply systems, or exhaust systems for material-handling classes A and B; and only where space restrictions do not permit using 1.5 bend radius elbows. Fabricate with single-thickness turning vanes.
  6. Round Elbows, 8 Inches (200 mm) and Smaller: 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 configuration or nonstandard diameter elbows with gored construction.
  7. Round Elbows, 9 through 14 Inches (225 through 355 mm): Fabricate gored or pleated elbows for 30, 45, 60, and 90 degrees, unless space restrictions require a mitered elbow. Fabricate nonstandard bend-angle configuration or nonstandard diameter elbows with gored construction.

8. Round Elbows, Larger Than 14 Inches (355 mm), and All Flat-Oval Elbows: Fabricate gored elbows, unless space restrictions require a mitered elbow.
  9. Die-Formed Elbows for Sizes through 8 Inches (200 mm) and All Pressures: 0.040 inch (1.0 mm) thick with two-piece welded construction.
  10. Round Gored-Elbow Metal Thickness: Same as non-elbow fittings specified above.
  11. Flat-Oval Elbow Metal Thickness: Same as longitudinal seam flat-oval duct specified above.
  12. Pleated Elbows for Sizes through 14 Inches (355 mm) and Pressures through 10-Inch wg (2490 Pa): 0.022 inch (0.55 mm).
- D. Double-Wall (Insulated) Fittings: Fabricate double-wall (insulated) fittings with an outer shell and an inner liner. Dimensions indicated on internally insulated ducts are inside dimensions.
1. Thermal Conductivity (k-Value): 0.26 at 75 deg F (0.037 at 24 deg C) mean temperature.
  2. Outer Shell: Base outer-shell metal thickness on actual outer-shell dimensions. Fabricate outer-shell lengths 2 inches (50 mm) longer than inner shell and insulation. Use the same metal thicknesses for outer duct as for uninsulated fittings.
  3. Insulation: 1-inch- (25-mm-) thick fibrous-glass insulation, unless otherwise indicated. Terminate insulation where internally insulated duct connects to single-wall duct or uninsulated components. Terminate insulation and reduce outer duct diameter to nominal single-wall size.
  4. Solid Inner Liner: Fabricate round and flat-oval inner liners with solid sheet metal of thickness listed below:
  5. Perforated Inner Liner: Fabricate round and flat-oval inner liners with sheet metal having 3/32-inch- (2.4-mm-) diameter perforations, with an overall open area of 23 percent. Use the following sheet metal thicknesses:
    - a. Ducts 3 to 34 Inches (75 to 865 mm) in Diameter: 0.028 inch (0.7 mm).
    - b. Ducts 35 to 58 Inches (890 to 1475 mm) in Diameter: 0.034 inch (0.85 mm).
    - c. Ducts 60 to 88 Inches (1525 to 2235 mm) in Diameter: 0.040 inch (1.0 mm).
  6. Maintain concentricity of liner to outer shell by mechanical means. Retain insulation from dislocation by mechanical means.
- E. PVC-Coated Elbows and Fittings: Fabricate elbows and fittings as follows:
1. Round Elbows 4 to 8 Inches (100 to 200 mm) in Diameter: Two piece, die stamped, with longitudinal seams spot welded, bonded, and painted with a PVC aerosol spray.
  2. Round Elbows 9 to 26 Inches (230 to 660 mm) in Diameter: Standing seam construction.
  3. Round Elbows 28 to 60 Inches (710 to 1525 mm) in Diameter: Standard gore construction, riveted and bonded.
  4. Other Fittings: Riveted and bonded joints.
  5. Couplings: Slip-joint construction with a minimum 2-inch (50-mm) insertion length.

## PART 3 - EXECUTION

### 3.1 DUCT INSTALLATION, GENERAL



- A. Duct installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of ducts, fittings, and accessories.
- B. Construct and install each duct system for the specific duct pressure classification indicated.
- C. Install round and flat-oval ducts in lengths not less than 12 feet (3.7 m), unless interrupted by fittings.
- D. Install ducts with fewest possible joints.
- E. Install fabricated fittings for changes in directions, changes in size and shape, and connections.
- F. Install couplings tight to duct wall surface with a minimum of projections into duct.
- G. Install ducts, unless otherwise indicated, vertically and horizontally, parallel and perpendicular to building lines; avoid diagonal runs.
- H. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- I. Install ducts with a clearance of 1 inch (25 mm), plus allowance for insulation thickness.
- J. Conceal ducts from view in finished spaces. Do not encase horizontal runs in solid partitions, unless specifically indicated.
- K. Coordinate layout with suspended ceiling, fire- and smoke-control dampers, lighting layouts, and similar finished work.
- L. Electrical Equipment Spaces: Route ductwork 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 space between construction opening and duct or duct insulation with sheet metal flanges of same metal thickness as duct. Overlap opening on four 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 damper, sleeve, and firestopping sealant. Fire and smoke dampers are specified in Division 15 Section "Duct Accessories." Firestopping materials and installation methods are specified in Division 7 Section "Firestopping."

### 3.2 PVC-COATED DUCT INSTALLATION

- A. Install PVC-coated duct and fittings according to manufacturer's written instructions.
- B. Seal all joints and seams. Apply sealer to male end connectors before insertion, and afterward to cover entire joint and sheet metal screws.
- C. Secure couplings with sheet metal screws. Install screws at an interval of 12 inches (300 mm), with a minimum of three screws in each coupling.

- D. Repair damage to PVC coating with manufacturer's recommended materials.

### 3.3 UNDERSLAB DUCT INSTALLATIONS

- A. Verify undamaged conditions of duct before enclosure with fill or encasement.
- B. Install underslab ducts according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" and as indicated.
- C. Protect ducts from damage by equipment used in placing concrete on or around ducts.
- D. Protect duct openings.

### 3.4 RANGE HOOD EXHAUST DUCT INSTALLATIONS

- A. Install ducts to allow for thermal expansion of ductwork through 2000 deg F (1100 deg C) temperature range.
- B. Install ducts without dips or traps that may collect residues, unless traps have continuous or automatic residue removal.
- C. Install access openings at each change in direction and at 50-foot (15-m) intervals; locate on sides of duct a minimum of 1-1/2 inches (38 mm) from bottom; and fit with grease-tight covers of same material as duct.
- D. Do not penetrate fire-rated assemblies.

### 3.5 DISHWASHER EXHAUST DUCT INSTALLATIONS

- A. Install dishwasher exhaust ducts according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."

### 3.6 SEAM AND JOINT SEALING

- A. General: Seal duct seams and joints according to the duct pressure class indicated and as described in SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."
- B. Pressure Classification Less Than 2-Inch wg (500 Pa): Transverse joints.
- C. Seal externally insulated ducts before insulation installation.

### 3.7 HANGING AND SUPPORTING

- A. Install rigid round, rectangular, and flat-oval metal duct with support systems indicated in SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."

- B. Support horizontal ducts within 24 inches (600 mm) of each elbow and within 48 inches (1200 mm) of each branch intersection.
- C. Support vertical ducts at a maximum interval of 16 feet (5 m) and at each floor.
- D. Install upper attachments to structures with an allowable load not exceeding one-fourth of failure (proof-test) load.
- E. Install concrete inserts before placing concrete.
- F. Install powder-actuated concrete fasteners after concrete is placed and completely cured.

### 3.8 CONNECTIONS

- A. Connect equipment with flexible connectors according to Division 15 Section "Duct Accessories."
- B. For branch, outlet and inlet, and terminal unit connections, comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."

### 3.9 FIELD QUALITY CONTROL

- A. Disassemble, reassemble, and seal segments of systems as required to accommodate leakage testing and as required for compliance with test requirements.
- B. Conduct tests, in presence of Architect, at static pressures equal to maximum design pressure of system or section being tested. If pressure classifications 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.
- C. Determine leakage from entire system or section of system by relating leakage to surface area of test section.
- D. Maximum Allowable Leakage: Comply with requirements for Leakage Classification 3 for round and flat-oval ducts, Leakage Classification 12 for rectangular ducts in pressure classifications less than and equal to 2-inch wg (500 Pa) (both positive and negative pressures), and Leakage Classification 6 for pressure classifications from 2- to 10-inch wg (500 to 2490 Pa).
- E. Remake leaking joints and retest until leakage is less than maximum allowable.
- F. Leakage Test: Perform tests according to SMACNA's "HVAC Air Duct Leakage Test Manual."

### 3.10 ADJUSTING

- A. Adjust volume-control dampers in ducts, outlets, and inlets to achieve design airflow.
- B. Refer to Division 15 Section "Testing, Adjusting, and Balancing" for detailed procedures.

3.11 CLEANING

- A. After completing system installation, including outlet fittings and devices, inspect the system. Vacuum ducts before final acceptance to remove dust and debris.

END OF SECTION 15815



## SECTION 15820 – 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.

## 1.2 SUMMARY

- A. This Section includes the following:

1. Backdraft dampers.
2. Manual-volume dampers.
3. Fire and smoke dampers.
4. Duct silencers.
5. Turning vanes.
6. Duct-mounted access doors and panels.
7. Flexible ducts.
8. Flexible connectors.
9. Duct accessory hardware.

- B. Related Sections include the following:

1. Division 8 Section "Access Doors" for wall and ceiling-mounted access doors and panels.
2. Division 10 Section "Louvers and Vents" for intake and relief louvers and vents connected to ducts and installed in exterior walls.
3. Division 15 Section "Air Terminals" for constant-volume and variable-air-volume control boxes, and reheat boxes.
4. Division 15 Section "Diffusers, Registers, and Grilles."
5. Division 15 Section "Control Systems Equipment" for electric and pneumatic damper actuators.
6. Division 16 Section "Fire Alarm Systems" for duct-mounted fire and smoke detectors.

## 1.3 SUBMITTALS

- A. Product Data: For the following:

1. Backdraft dampers.
2. Manual-volume dampers.
3. Fire and smoke dampers.
4. Duct silencers.
5. Duct-mounted access doors and panels.
6. Flexible ducts.

- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loadings, required clearances, method of field assembly, components, location, and size of each field connection. Detail the following:
  - 1. Special fittings and manual- and automatic-volume-damper installations.
  - 2. Fire- and smoke-damper installations, including sleeves and duct-mounted access doors and panels.
- C. Product Certificates: Submit certified test data on dynamic insertion loss; self-noise power levels; and airflow performance data, static-pressure loss, dimensions, and weights.

#### 1.4 QUALITY ASSURANCE

- A. NFPA Compliance: Comply with the following NFPA standards:
  - 1. NFPA 90A, "Installation of Air Conditioning and Ventilating Systems."

#### 1.5 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.
  - 1. Fusible Links: Furnish quantity equal to 10 percent of amount installed.

### PART 2 - PRODUCTS

#### 2.1 SHEET METAL MATERIALS

- A. Galvanized, Sheet Steel: Lock-forming quality; ASTM A 653/A 653M, G90 (Z275) coating designation; mill-phosphatized finish for surfaces of ducts exposed to view.
- B. Carbon-Steel Sheets: ASTM A 366/A 366M, cold-rolled sheets, commercial quality, with oiled, exposed matte finish.
- C. Aluminum Sheets: ASTM B 209 (ASTM B 209M), Alloy 3003, Temper H14, sheet form; with standard, one-side bright finish for ducts exposed to view and mill finish for concealed ducts.
- D. Extruded Aluminum: ASTM B 221 (ASTM B 221M), Alloy 6063, Temper T6.
- E. Reinforcement Shapes and Plates: Galvanized steel reinforcement where installed on galvanized, sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- F. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for 36-inch (900-mm) length or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

#### 2.2 BACKDRAFT DAMPERS

- A. Description: Suitable for horizontal or vertical installations.
- B. Frame: 0.052-inch- (1.3-mm-) thick, galvanized, sheet steel, with welded corners and mounting flange.
- C. Frame: 0.052-inch- (1.3-mm-) thick, galvanized, sheet steel, with welded corners.
- D. Frame: 0.063-inch- (1.6-mm-) thick extruded aluminum, with mounting flange.
- E. Frame: 0.063-inch- (1.6-mm-) thick extruded aluminum.
- F. Blades: 0.025-inch- (0.6-mm-) thick, roll-formed aluminum.
- G. Blades: 0.050-inch- (1.2-mm-) thick aluminum sheet.
- H. Blade Seals: Felt.
- I. Blade Seals: Vinyl.
- J. Blade Seals: Neoprene.
- K. Blade Axles: Nonferrous.
- L. Blade Axles: Galvanized steel.
- M. Tie Bars and Brackets: Aluminum.
- N. Tie Bars and Brackets: Galvanized steel.
- O. Return Spring: Adjustable tension.

### 2.3 MANUAL-VOLUME DAMPERS

- A. General: Factory fabricated with required hardware and accessories. Stiffen damper blades for stability. Include locking device to hold single-blade dampers in a fixed position without vibration. Close duct penetrations for damper components to seal duct consistent with pressure class.
  - 1. Pressure Classifications 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.
- B. Standard Volume Dampers: Multiple- or single-blade, parallel- or opposed-blade design as indicated, standard leakage rating, with linkage outside airstream, and suitable for horizontal or vertical applications.
- C. Standard Volume Dampers: Multiple- or single-blade, parallel- or opposed-blade design as indicated, standard leakage rating, and suitable for horizontal or vertical applications.
  - 1. Steel Frames: Hat-shaped, galvanized, sheet steel channels, minimum of 0.064 inch (1.62 mm) thick, with mitered and welded corners; frames with flanges where indicated for attaching to walls; and flangeless frames where indicated for installing in ducts.



2. Aluminum Frames: Hat-shaped, 0.10-inch- (2.5-mm-) thick, aluminum sheet channels; frames with flanges where indicated for attaching to walls; and flangeless frames where indicated for installing in ducts.
  3. Roll-Formed Steel Blades: 0.064-inch- (1.62-mm-) thick, galvanized, sheet steel.
  4. Roll-Formed Aluminum Blades: 0.10-inch- (2.5-mm-) thick aluminum sheet.
  5. Extruded-Aluminum Blades: 0.050-inch- (1.2-mm-) thick extruded aluminum.
  6. Blade Axles: Nonferrous.
  7. Blade Axles: Galvanized steel.
  8. Tie Bars and Brackets: Aluminum.
  9. Tie Bars and Brackets: Galvanized steel.
- D. Low-Leakage Volume Dampers: Multiple- or single-blade, parallel- or opposed-blade design as indicated, low-leakage rating, with linkage outside airstream, and suitable for horizontal or vertical applications.
- E. Low-Leakage Volume Dampers: Multiple- or single-blade, parallel- or opposed-blade design as indicated, low-leakage rating, and suitable for horizontal or vertical applications.
1. Steel Frames: Hat-shaped, galvanized, sheet steel channels, minimum of 0.064 inch (1.62 mm) thick, with mitered and welded corners; frames with flanges where indicated for attaching to walls; and flangeless frames where indicated for installing in ducts.
  2. Aluminum Frames: Hat-shaped, 0.063-inch- (1.6-mm-) thick, extruded-aluminum channels; frames with flanges where indicated for attaching to walls; and flangeless frames where indicated for installing in ducts.
  3. Roll-Formed Steel Blades: 0.064-inch- (1.62-mm-) thick, galvanized, sheet steel.
  4. Roll-Formed Aluminum Blades: 0.10-inch- (2.5-mm-) thick aluminum sheet.
  5. Extruded-Aluminum Blades: 0.050-inch- (1.2-mm-) thick extruded aluminum.
  6. Blade Seals: Felt.
  7. Blade Seals: Vinyl.
  8. Blade Seals: Neoprene.
  9. Blade Axles: Nonferrous.
  10. Blade Axles: Galvanized steel.
  11. Tie Bars and Brackets: Aluminum.
  12. Tie Bars and Brackets: Galvanized steel.
- F. High-Performance Volume Dampers: Multiple- or single-blade, parallel- or opposed-blade design as indicated, low-leakage rating, with linkage outside airstream, and suitable for horizontal or vertical applications.
1. Steel Frames: Hat-shaped, galvanized steel channels, minimum of 0.064 inch (1.62 mm) thick, with mitered and welded corners; frames with flanges where indicated for attaching to walls; and flangeless frames where indicated for installing in ducts.
  2. Aluminum Frames: Hat-shaped, 0.125-inch- (3-mm-) thick, extruded-aluminum channels; frames with flanges where indicated for attaching to walls; and flangeless frames where indicated for installing in ducts.
  3. Steel Blades: 0.052-inch- (1.3-mm-) thick, galvanized, sheet steel; airfoil shaped.
  4. Extruded-Aluminum Blades: Minimum of 0.081-inch- (2-mm-) thick, 6063T extruded aluminum.
  5. Blade Seals: Dual-durometer vinyl on blade edges; metallic compression on jambs.
  6. Blade Axles: Nonferrous.
  7. Blade Axles: Galvanized steel.

- 8. Tie Bars and Brackets: Aluminum.
  - 9. Tie Bars and Brackets: Galvanized steel.
- G. Jackshaft: 1-inch- (25-mm-) diameter, galvanized steel pipe rotating within a 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 of a multiple-damper assembly.
- H. 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. Include center hole to suit damper operating-rod size. Include elevated platform for insulated duct mounting.

#### 2.4 FIRE DAMPERS

- A. General: Labeled to UL 555.
- B. Fire Rating: One and one-half hours.
- C. Fire Rating: One and one-half and three hours.
- D. Frame: SMACNA Type A with blades in airstream; fabricated with roll-formed, 0.034-inch- (0.85-mm-) thick galvanized steel; with mitered and interlocking corners.
- E. Frame: SMACNA Type B with blades out of airstream; fabricated with roll-formed, 0.034-inch- (0.85-mm-) thick galvanized steel; with mitered and interlocking corners.
- F. Mounting Sleeve: Factory- or field-installed galvanized, sheet steel.
  - 1. Minimum Thickness: 0.052 inch (1.3 mm) or 0.138 inch (3.5 mm) thick as indicated, and length to suit application.
  - 2. Exceptions: Omit sleeve where damper frame width permits direct attachment of perimeter mounting angles on each side of wall or floor, and thickness of damper frame complies with sleeve requirements.
- G. Mounting Orientation: Vertical or horizontal as indicated.
- H. Blades: Roll-formed, interlocking, 0.034-inch- (0.85-mm-) thick, galvanized, sheet steel. In place of interlocking blades, use full-length, 0.034-inch- (0.85-mm-) thick, galvanized steel blade connectors.
- I. Horizontal Dampers: Include a blade lock and stainless-steel negator closure spring.
- J. Fusible Link: Replaceable, 165 or 212 deg F (74 or 100 deg C) rated as indicated.

#### 2.5 CEILING FIRE DAMPERS

- A. General: Labeled to UL 555C; comply with construction details for tested floor- and roof-ceiling assemblies as indicated in UL's "Fire Resistance Directory."

- B. Frame: 0.040-inch- (1.0-mm-) thick, galvanized, sheet steel; round or rectangular; style to suit ceiling construction.
- C. Blades: 0.034-inch- (0.85-mm-) thick, galvanized, sheet steel with nonasbestos refractory insulation.
- D. Volume Adjustment: UL-labeled, fusible volume-control adjustment.
- E. Fusible Link: Replaceable, 165 deg F (74 deg C) rated.
- F. Fusible Link: Replaceable, 212 deg F (100 deg C) rated.
- G. Fusible Link: Replaceable, 285 deg F (141 deg C) rated.

## 2.6 SMOKE DAMPERS

- A. General: Labeled to UL 555S. Combination fire and smoke dampers shall be labeled for one-and-one-half-hour rating to UL 555.
- B. Fusible Link: Replaceable, 165 or 212 deg F (74 or 100 deg C) rated as indicated.
- C. Frame and Blades: 0.064-inch- (1.62-mm-) thick, galvanized, sheet steel.
- D. Mounting Sleeve: Factory-installed, 0.052-inch- (1.3-mm-) thick, galvanized, sheet steel; length to suit wall or floor application.
- E. Damper Motors: Provide for modulating or two-position action.
  1. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
  2. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 in. x lbf (17 N x m) and breakaway torque rating of 150 in. x lbf (17 N x m).
  3. Outdoor Motors and Motors in Outside-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F (minus 40 deg C).
  4. Nonspring-Return Motors: For dampers larger than 25 sq. ft. (2.3 sq. m), size motor for running torque rating of 150 in. x lbf (17 N x m) and breakaway torque rating of 300 in. x lbf (34 N x m).
  5. Two-Position Motor: 115 V, single phase, 60 Hz.
  6. Two-Position Motor: 230 V, single phase, 60 Hz.
  7. Two-Position Motor: 230 V, 3 phase, 60 Hz.
  8. Two-Position Motor: 460 V, 3 phase, 60 Hz.
  9. Modulating, Spring-Return Motor: 115 V, single phase, 60 Hz.
  10. Modulating, Spring-Return Motor: 230 V, single phase, 60 Hz.
  11. Modulating, Spring-Return Motor: 230 V, 3 phase, 60 Hz.
  12. Modulating, Spring-Return Motor: 460 V, 3 phase, 60 Hz.

## 2.7 DUCT SILENCERS

- A. General: Factory-fabricated and -tested, round or rectangular silencer with performance characteristics and physical requirements as indicated.
- B. Fire Performance: Adhesives, sealers, packing materials, and accessory materials shall have fire ratings not exceeding 25 for flame spread and 50 for smoke developed when tested according to ASTM E 84.
- C. Rectangular Units: Fabricate casings with a minimum of 0.034-inch- (0.85-mm-) thick, solid sheet metal for outer casing and 0.022-inch- (0.55-mm-) thick, perforated sheet metal for inner casing.
- D. Round Units: Casings with sheet metal thicknesses for diameters listed below:
  - 1. Up to 24 Inches (600 mm): 0.034 inch (0.85 mm).
  - 2. 26 through 40 Inches (660 through 1000 mm): 0.040 inch (1.0 mm).
  - 3. 42 through 52 Inches (1060 through 1300 mm): 0.052 inch (1.3 mm).
  - 4. 54 through 60 Inches (1370 through 1500 mm): 0.064 inch (1.62 mm).
  - 5. Casings fabricated of spiral lock-seam duct may be one size thinner than that indicated.
  - 6. Interior Partitions and Baffles: At least 0.034 inch (0.85 mm) and designed for minimum aerodynamic losses.
- E. Sheet Metal Perforations: 1/8-inch (3-mm) diameter for inner casing and baffle sheet metal.
- F. Fibrous Acoustic-Fill Material: Inert and vermin-proof fibrous material, packed under not less than 5 percent compression.
- G. Nonfibrous Acoustic-Fill Material: Moisture-proof nonfibrous material.
- H. Fabricate silencers to form rigid units that will not pulsate, vibrate, rattle, or otherwise react to system pressure variations.
  - 1. Do not use nuts, bolts, and sheet metal screws for unit assemblies.
  - 2. Lock form and seal or continuously weld joints.
  - 3. Suspended Units: Factory-installed suspension hooks or lugs attached to frame in quantities and spaced to prevent deflection or distortion.
  - 4. Reinforcement: Cross or trapeze angles for rigid suspension.
- I. Source Quality Control: Perform the following factory tests:
  - 1. Acoustic Performance: Test according to ASTM E 477, with airflow in both directions through silencer.
  - 2. Record acoustic ratings, including dynamic insertion loss and self-noise power levels, for both forward flow (air and noise in same direction) and reverse flow (air and noise in opposite directions) with an airflow of at least 2000-fpm (10-m/s) face velocity.
  - 3. Leak Test: Test units for airtightness at 200 percent of associated fan static pressure or 6-inch wg (1500-Pa) static pressure, whichever is greater.

## 2.8 TURNING VANES

- A. Fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."
- B. **Manufactured Turning Vanes:** Fabricate of 1-1/2-inch- (38-mm-) wide, curved blades set 3/4 inch (19 mm) o.c.; support with bars perpendicular to blades set 2 inches (50 mm) o.c.; and set into side strips suitable for mounting in ducts.
- C. **Acoustic Turning Vanes:** Fabricate of airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.

## 2.9 DUCT-MOUNTED ACCESS DOORS AND PANELS

- A. **General:** Fabricate doors and panels airtight and suitable for duct pressure class.
- B. **Frame:** Galvanized, sheet steel, with bend-over tabs and foam gaskets.
- C. **Door:** Double-wall, galvanized, sheet metal construction with insulation fill and thickness, and number of hinges and locks as indicated for duct pressure class. Include vision panel where indicated. Include 1-by-1-inch (25-by-25-mm) butt or piano hinge and cam latches.
- D. **Seal around frame attachment to duct and door to frame with neoprene or foam rubber.**
- E. **Insulation:** 1-inch- (25-mm-) thick, fibrous-glass or polystyrene-foam board.

## 2.10 FLEXIBLE CONNECTORS

- A. **General:** Flame-retarded or noncombustible fabrics, coatings, and adhesives complying with UL 181, Class 1.
- B. **Standard Metal-Edged Connectors:** Factory fabricated with a strip of fabric 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) aluminum sheets. Select metal compatible with connected ducts.
- C. **Extra-Wide Metal-Edged Connectors:** Factory fabricated with a strip of fabric 5-3/4 inches (146 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) aluminum sheets. Select metal compatible with connected ducts.
- D. **Transverse Metal-Edged Connectors:** Factory fabricated with a strip of fabric 3-1/2 inches (89 mm) wide attached to two strips of 4-3/8-inch- (111-mm-) wide, 0.028-inch- (0.7-mm-) thick, galvanized, sheet steel or 0.032-inch (0.8-mm) aluminum sheets. Select metal compatible with connected ducts.
- E. **Conventional, Indoor System Flexible Connector Fabric:** Glass fabric double coated with polychloroprene.
  - 1. **Minimum Weight:** 26 oz./sq. yd. (880 g/sq. m).
  - 2. **Tensile Strength:** 480 lbf/inch (84 N/mm) in the warp, and 360 lbf/inch (63 N/mm) in the filling.

- F. Conventional, Outdoor System Flexible Connector Fabric: Glass fabric double coated with a synthetic-rubber, weatherproof coating resistant to the sun's ultraviolet rays and ozone environment.
  1. Minimum Weight: 26 oz./sq. yd. (880 g/sq. m).
  2. Tensile Strength: 530 lbf/inch (93 N/mm) in the warp, and 440 lbf/inch (77 N/mm) in the filling.
- G. High-Temperature System Flexible Connectors: Glass fabric coated with silicone rubber and having a minimum weight of 16 oz./sq. yd. (542 g/sq. m) and tensile strength of 285 lbf/inch (50 N/mm) in the warp, and 185 lbf/inch (32 N/mm) in the filling.
- H. High-Corrosive-Environment System Flexible Connectors: Glass fabric coated with a chemical-resistant coating.
  1. Minimum Weight: 14 oz./sq. yd. (474 g/sq. m).
  2. Tensile Strength: 450 lbf/inch (79 N/mm) in the warp, and 340 lbf/inch (60 N/mm) in the filling.

#### 2.11 FLEXIBLE DUCTS

- A. General: Comply with UL 181, Class 1.
- B. Flexible Ducts, Uninsulated: Spiral-wound steel spring with flameproof vinyl sheathing.
- C. Flexible Ducts, Uninsulated: Corrugated aluminum.
- D. Flexible Ducts, Insulated: Factory-fabricated, insulated, round duct, with an outer jacket enclosing 1-1/2-inch- (38-mm-) thick, glass-fiber insulation around a continuous inner liner.
  1. Reinforcement: Steel-wire helix encapsulated in inner liner.
  2. Outer Jacket: Glass-reinforced, silver Mylar with a continuous hanging tab, integral fibrous-glass tape, and nylon hanging cord.
  3. Outer Jacket: Polyethylene film.
  4. Inner Liner: Polyethylene film.
- E. Pressure Rating: 6-inch wg (1500 Pa) positive, 1/2-inch wg (125 Pa) negative.

#### 2.12 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 length to suit duct insulation thickness.
- B. Splitter Damper Accessories: Zinc-plated damper blade bracket; 1/4-inch (6-mm), zinc-plated operating rod; and a duct-mounted, ball-joint bracket with flat rubber gasket and square-head set screw.
- C. Flexible Duct Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action, in sizes 3 to 18 inches (75 to 450 mm) to suit duct size.

- D. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Install duct accessories according to applicable details shown in SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for metal ducts and NAIMA's "Fibrous Glass Duct Construction Standards" for fibrous-glass ducts.
- B. Install volume dampers in lined duct; avoid damage to and erosion of duct liner.
- C. Provide test holes at fan inlet and outlet and elsewhere as indicated.
- D. Install fire and smoke dampers according to manufacturer's UL-approved written instructions.
  - 1. Install fusible links in fire dampers.
- E. Install duct access panels for access to both sides of duct coils. Install duct access panels downstream from volume dampers, fire dampers, turning vanes, and equipment.
  - 1. Install duct access panels to allow access to interior of ducts for cleaning, inspecting, adjusting, and maintaining accessories and terminal units.
  - 2. Install access panels on side of duct where adequate clearance is available.
- F. Label access doors according to Division 15 Section "Mechanical Identification."

#### 3.2 ADJUSTING

- A. Adjust duct accessories for proper settings.
- B. Adjust fire and smoke dampers for proper action.
- C. Final positioning of manual-volume dampers is specified in Division 15 Section "Testing, Adjusting, and Balancing."

END OF SECTION 15820

SECTION 15900 - HVAC INSTRUMENTATION AND CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes control equipment for HVAC systems and components, including control components for terminal heating and cooling units not supplied with factory-wired controls.
- B. Related Sections include the following:
  - 1. Division 13 Section "Fire Alarm" for fire and smoke detectors mounted in HVAC systems and equipment.

1.3 DEFINITIONS

- A. DDC: Direct-digital controls.
- B. LAN: Local area network.
- C. MS/TP: Master-slave/token-passing.
- D. PICS: Protocol Implementation Conformance Statement.

1.4 SYSTEM DESCRIPTION

- A. Control system consists of sensors, indicators, actuators, final control elements, interface equipment, other apparatus, accessories, and software connected to distributed controllers operating in multiuser, multitasking environment on token-passing network and programmed to control mechanical systems.

1.5 SEQUENCE OF OPERATION

1.6 SUBMITTALS

- A. Product Data: Include manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated.
  - 1. Each control device labeled with setting or adjustable range of control.



- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
1. Schematic flow diagrams showing fans, pumps, coils, dampers, valves, and control devices.
  2. Wiring Diagrams: Power, signal, and control wiring. Differentiate between manufacturer-installed and field-installed wiring.
  3. Details of control panel faces, including controls, instruments, and labeling.
  4. Written description of sequence of operation.
  5. Schedule of dampers including size, leakage, and flow characteristics.
  6. Schedule of valves including leakage and flow characteristics.
  7. Trunk cable schematic showing programmable control unit locations and trunk data conductors.
  8. Listing of connected data points, including connected control unit and input device.
  9. System graphics indicating monitored systems, data (connected and calculated) point addresses, and operator notations.
  10. System configuration showing peripheral devices, batteries, power supplies, diagrams, modems, and interconnections.
- C. ASHRAE BACnet Statement: PICS for each DDC system component (panel, zone controller, field devices, and operator workstation) proposed.
- D. Samples: For each color required, of each type of thermostat cover.
- E. Software and Firmware Operational Documentation: Include the following:
1. Software operating and upgrade manuals.
  2. Program Software Backup: On a magnetic media or compact disc, complete with data files.
  3. Device address list.
  4. Printout of software application and graphic screens.
  5. Software license required by and installed for DDC workstations and control systems.
- F. Software Upgrade Kit: For Owner to use in modifying software to suit future power system revisions or monitoring and control revisions.
- G. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.
- H. Maintenance Data: For systems to include in maintenance manuals specified in Division 1. Include the following:
1. Maintenance instructions and lists of spare parts for each type of control device and compressed-air station.
  2. Interconnection wiring diagrams with identified and numbered system components and devices.
  3. Keyboard illustrations and step-by-step procedures indexed for each operator function.
  4. Inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
  5. Calibration records and list of set points.

- I. Qualification Data: For firms and persons specified in "Quality Assurance" Article.
- J. Project Record Documents: Record actual locations of control components, including control units, thermostats, and sensors. Revise Shop Drawings to reflect actual installation and operating sequences.

#### 1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who is an authorized representative of the automatic control system manufacturer for both installation and maintenance of units required for this Project.
- B. Manufacturer Qualifications: A firm experienced in manufacturing automatic temperature-control systems similar to those indicated for this Project and with a record of successful in-service performance.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilation Systems."
- E. Comply with ASHRAE 135 for DDC system control components.
- F. Year-2000 Compliant: Computer hardware and software shall be capable of accurately processing, providing, and receiving date data from, into, and between the twentieth and twenty-first centuries, including leap-year calculations.

#### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Factory-Mounted Components: Where control devices specified in this Section are indicated to be factory mounted on equipment, arrange for shipping of control devices to unit manufacturer.

#### 1.9 COORDINATION

- A. Coordinate location of thermostats, humidistats, and other exposed control sensors with plans and room details before installation.
- B. Coordinate equipment with Division 13 Section "Fire Alarm" to achieve compatibility with equipment that interfaces with that system.
- C. Coordinate supply of conditioned electrical circuits for control units and operator workstation.
- D. Coordinate equipment with Division 16 Section "Panelboards" to achieve compatibility with starter coils and annunciation devices.
- E. Coordinate equipment with Division 16 Section "Motor-Control Centers" to achieve compatibility with motor starters and annunciation devices.

- F. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3 Section "Cast-in-Place Concrete."

1.10 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. Replacement Materials: One replacement diaphragm or relay mechanism for each unique pneumatic damper motor, valve motor, controller, thermostat, positioning relay.
- C. Maintenance Materials: Ten thermostat adjusting keys.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Control Systems Components:
    - a. Air Monitor Corp.
    - b. Atkomatic Valve Company, Inc.
    - c. BEC Controls Corp.
    - d. Belimo Aircontrols (USA), Inc.
    - e. CEA Instruments Inc.
    - f. Channel Products Inc.
    - g. Condyne Technology, Inc.
    - h. Delta Controls Inc.
    - i. DGH Systems, LLC
    - j. Diversified Electronics, Inc.
    - k. Ebtron, Inc.
    - l. Energyline Systems; Industrial Products Group.
    - m. Enerstat Corp.
    - n. Erie Controls.
    - o. Functional Devices Inc.
    - p. Gems Sensors.
    - q. General Eastern Instruments, Inc.
    - r. Greystone Energy Systems Inc.
    - s. Hayward Industrial Products, Inc.
    - t. Heat-Timer Corp.
    - u. Honeywell, Inc.; Home & Building Control.
    - v. HyCal Sensing Products.

- w. ICM Corp.
- x. Intec Controls Corp.
- y. Johnson Controls, Inc.; Controls Group.
- z. KMC Controls/Kreuter Manufacturing Company.
- aa. Landis & Staefa, Inc.
- bb. Leslie Controls, Inc.
- cc. Magnatrol Valve Corporation.
- dd. Mamac Systems.
- ee. Paragon Electric Co., Inc.
- ff. Parker Hannifin Corp.; Skinner Valve Division.
- gg. RAM Electronics Corp.
- hh. RDF Corporation.
- ii. Sauter Controls Corporation.
- jj. Sensidyne, Inc.
- kk. Sherwood Products, Inc.
- ll. Spence Engineering Co., Inc.
- mm. SSAC Inc.
- nn. TCS/BASYS Controls; HVAC Sensors & Transducers Division.
- oo. Texas Instruments, Inc.; Commercial Sensors & Controls.
- pp. Thunder Scientific Corporation.
- qq. Time Mark Corporation.
- rr. Tour & Andersson Control, Inc.; HVAC Sensors & Transducers Div.
- ss. TSI Inc.; Environmental Measurements & Controls Div.
- tt. Uni-Line North America; Robertshaw Division.
- uu. Vaisala, Inc.
- vv. Valvcon Corporation.
- ww. Vent Products Co., Inc.

2. Electric, Electronic, and DDC Systems:

- a. Alerton Technologies, Inc.
- b. Andover Controls Corp.
- c. Automated Logic Corporation.
- d. Auto-Matrix, Inc.; Auto-Flow Division.
- e. CSI Control Systems International, Inc.
- f. Danfoss Automatic Controls.
- g. Delta Controls Inc.
- h. EDA Controls Corp.
- i. Electronic Systems USA, Inc.
- j. G C Controls, Inc.
- k. Honeywell, Inc.; Home & Building Control.
- l. Impact Energy Controls Corp.
- m. Johnson Controls, Inc.; Controls Group.
- n. KMC Controls/Kreuter Manufacturing Company.
- o. Landis & Staefa, Inc.
- p. Luwa Bahnson Inc.
- q. McQuay International.
- r. Neles-Jamesbury.
- s. Pneuline Controls Co.; National Energy Controls Corp.
- t. Scientific-Atlanta, Inc.; Control Systems Div.
- u. Siebe Environmental Controls; Barber-Coleman/Robertshaw Products.

- v. Solidyne Corp.
- w. TCS/BASYS Controls; HVAC Sensors & Transducers Division.
- x. Teletrol Systems Inc.
- y. Trane Co. (The); North American Commercial Group.
- z. Triangle MicroSystems, Inc.
- aa. Uni-Line North America; Robertshaw Division.

## 2.2 DDC EQUIPMENT

- A. Operator Station: Microcomputer station with printer.
- B. Workstation: IBM-compatible microcomputer with minimum configuration as follows:
  - 1. Processor: Intel Pentium IV, 1600 MHz.
  - 2. Random-Access Memory: 256 MB.
  - 3. Cache Memory: 512 kB.
  - 4. Graphics: Super video graphic adapter (SVGA), minimum 1280 x 1024 pixels, 4.0-MB EDO video memory.
  - 5. Monitor: 17 inches (432 mm), noninterlaced, color, with maximum 0.28-mm dot pitch.
  - 6. Keyboard: QWERTY, 105 keys in ergonomic shape.
  - 7. Floppy-Disk Drives: 1.44 MB.
  - 8. Hard-Disk Drive: 40.0 GB.
  - 9. CD-ROM Drive: 36x.
  - 10. Mouse: Three button.
  - 11. Modem: Autodial, internal, minimum 56 kBaud.
  - 12. Tape Backup: Internal Zip-drive, 250 MB.
  - 13. Operating System: Microsoft Windows 98 or later.
  - 14. BACnet Conformance: Workstation shall support BACnet device and have minimum capabilities defined in PICS for the following areas:
    - a. Network.
    - b. Functional groups.
    - c. Standard application services supported.
    - d. Standard objects supported.
- C. Printer: Dot-matrix type as follows:
  - 1. Print Head: 24 pin, 360 x 360 dpi resolution.
  - 2. Carriage: Wide, 132 characters per line of paper.
  - 3. Paper Handling: Fan-fold paper, with 2 cartons containing minimum of 2500 sheets each.
  - 4. Print Speed: Minimum of 120 characters per second.
- D. Printer: Color, ink-jet type as follows:
  - 1. Print Head: 1440 x 1440 dpi photoquality color resolution.
  - 2. Internal Memory Buffer: 32 kB.
  - 3. Paper Handling: Minimum of 100 sheets.
  - 4. Print Speed: Minimum of 8 ppm in black and 4 ppm in color.

- E. Application Software: Include the following:
1. Input/output capability from operator station.
  2. Operator system access levels via software password.
  3. Database creation and support.
  4. Dynamic color graphic displays.
  5. Alarm processing.
  6. Event processing.
  7. Automatic restart of field equipment on restoration of power.
  8. Data collection.
  9. Graphic development on workstation.
  10. Maintenance management.
- F. Control Units: Modular, comprising processor board with programmable, nonvolatile, random-access memory; local operator access and display panel; integral interface equipment; and backup power source.
1. Units monitor or control each input/output point; process information; execute commands from other control units, devices, and operator stations; and download from or upload to operator station.
  2. Stand-alone mode control functions operate regardless of network status. Functions include the following:
    - a. Global communications.
    - b. Discrete/digital, analog, and pulse input/output.
    - c. Monitoring, controlling, or addressing data points.
    - d. Testing and developing control algorithms without disrupting field hardware and controlled environment.
  3. Local operator interface provides for download from or upload to mobile operator station.
  4. BACnet Conformance: Reside on BACnet LAN in Ethernet IEEE 802.3, Class 3, minimum, with routers between LAN and other panels, with at least one communication port, and have minimum capabilities defined in PICS for the following areas:
    - a. Network.
    - b. Functional groups.
    - c. Standard application services supported.
    - d. Standard objects supported.
- G. Local Control Units: Modular, comprising processor board with electronically programmable, nonvolatile, read-only memory; and backup power source.
1. Units monitor or control each input/output point; process information; and download from or upload to operator station.
  2. Stand-alone mode control functions operate regardless of network status. Functions include the following:
    - a. Global communications.
    - b. Discrete/digital, analog, and pulse input/output.
    - c. Monitoring, controlling, or addressing data points.

3. Local operator interface provides for download from or upload to mobile operator station.
  4. BACnet Conformance: Reside on BACnet LAN using MS/TP, Class 2, minimum, with at least one communication port, and have minimum capabilities defined in PICS for the following areas:
    - a. Network.
    - b. Functional groups.
    - c. Standard application services supported.
    - d. Standard objects supported.
- H. LANs: Capacity for a minimum of 10 workstations connected to multiuser, multitasking environment with concurrent capability to access DDC network or control units.
1. Media: Ethernet, peer-to-peer CMA/CD, operating at 100 MBps.
- I. Software: Update to latest version of software at Project completion. Include and implement the following capabilities from the control units:
1. Units of Measure: Inch-pound and SI (metric).
  2. Load Control Programs: Demand limiting, duty cycling, automatic time scheduling, start/stop time optimization, night setback/setup, DDC with fine tuning, and trend logging.
  3. HVAC Control Programs: Optimal run time, supply-air reset, and enthalpy switchover.
  4. Chiller Control Programs: Control function of condenser water reset, chilled-water reset, and equipment sequencing.
  5. Programming Application Features: Include trend point, alarm messages, weekly scheduling, and interlocking.

## 2.3 CONTROL PANELS

- A. Central (Master) Control Panels: Fully enclosed, steel-rack-type cabinet with locking doors or locking removable backs. Match finish of panels and provide multicolor graphic displays, schematically showing system being controlled.
- B. Local Control Panels: Unitized cabinet with suitable brackets for wall or floor mounting, located adjacent to each system under automatic control. Provide common keying for all panels.
1. Fabricate panels of 0.06-inch- (1.5-mm-) thick, furniture-quality steel, or extruded-aluminum alloy, totally enclosed, with hinged doors and keyed lock and with manufacturer's standard shop-painted finish.
  2. Panel-Mounted Equipment: Temperature and humidity controllers, relays, and automatic switches; except safety devices. Mount devices with adjustments accessible through front of panel.
  3. Door-Mounted Equipment: Flush-mount (on hinged door) manual switches, including damper-positioning switches, changeover switches, thermometers, and gages.
  4. Graphics: Color-coded graphic, laminated-plastic displays on doors, schematically showing system being controlled, with protective, clear plastic sheet bonded to entire door.

- C. Alarm Panels: Indicating light for each alarm point, single horn, acknowledge switch, and test switch, mounted in hinged-cover enclosure.
  1. Alarm Condition: Indicating light flashes and horn sounds.
  2. Acknowledge Switch: Horn is silent and indicating light is steady.
  3. Second Alarm: Horn sounds and indicating light is steady.
  4. Alarm Condition Cleared: System is reset and indicating light is extinguished.
  5. Contacts in alarm panel allow remote monitoring by independent alarm company.

## 2.4 ANALOG CONTROLLERS

- A. Step Controllers: Six- or 10-stage type, with heavy-duty switching rated to handle loads and operated by electric motor.
- B. Electric, Outdoor-Reset Controllers: Remote-bulb or bimetal rod-and-tube type, proportioning action with adjustable throttling range, adjustable set point, scale range minus 10 to plus 70 deg F (minus 23 to plus 21 deg C), and single- or double-pole contacts.
- C. Electronic Controllers: Wheatstone-bridge-amplifier type, in steel enclosure with provision for remote-resistance readjustment. Identify adjustments on controllers, including proportional band and authority.
  1. Single controllers can be integral with control motor if provided with accessible control readjustment potentiometer.
- D. Fan-Speed Controllers: Solid-state model providing field-adjustable proportional control of motor speed from maximum to minimum of 55 percent and on-off action below minimum fan speed. Controller shall briefly apply full voltage, when motor is started, to rapidly bring motor up to minimum speed. Equip with filtered circuit to eliminate radio interference.
- E. Receiver Controllers: Single- or multiple-input models with control-point adjustment, direct or reverse acting with mechanical set-point adjustment with locking device, proportional band adjustment, authority adjustment, and proportional control mode.
  1. Remote-control-point adjustment shall be plus or minus 20 percent of sensor span, input signal of 3 to 13 psig (21 to 90 kPa).
  2. Proportional band shall extend from 2 to 20 percent for 5 psig (34 kPa).
  3. Authority shall be 20 to 200 percent.
  4. Air-supply pressure of 18 psig (124 kPa), input signal of 3 to 15 psig (21 to 103 kPa), and output signal 0 to supply pressure.
  5. Gages: 3-1/2 inches (89 mm) in diameter, 2.5 percent wide-scale accuracy, and range to match transmitter input or output pressure.

## 2.5 TIME CLOCKS

- A. Seven-day, programming-switch timer with synchronous-timing motor and seven-day dial; continuously charged, nickel-cadmium-battery-driven, eight-hour, power-failure carryover; multiple-switch trippers; minimum of two and maximum of eight signals per day with two normally open and two normally closed output contacts.



- B. Solid-state, programmable time control with 4 separate programs; 24-hour battery carryover; individual on-off-auto switches for each program; 365-day calendar with 20 programmable holidays; choice of fail-safe operation for each program; and system fault alarm.

## 2.6 SENSORS

- A. Electronic Sensors: Vibration and corrosion resistant; for wall, immersion, or duct mounting as required.
  - 1. Thermistor temperature sensors as follows:
    - a. Accuracy: Plus or minus 0.36 deg F (0.2 deg C) at calibration point.
    - b. Wire: Twisted, shielded-pair cable.
    - c. Insertion Elements in Ducts: Single point, 18 inches (46 cm) long; use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft. (1 sq. m).
    - d. Averaging Elements in Ducts: 72 inches (183 cm) long, flexible; use where prone to temperature stratification or where ducts are larger than 9 sq. ft. (1 sq. m); length as required.
    - e. Insertion Elements for Liquids: Brass socket with minimum insertion length of 2-1/2 inches (64 mm).
    - f. Room Sensors: Match room thermostats, locking cover.
    - g. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.
    - h. Room Security Sensors: Stainless-steel cover plate with insulated back and security screws.
  - 2. Resistance Temperature Detectors: Platinum.
    - a. Accuracy: Plus or minus 0.2 percent at calibration point.
    - b. Wire: Twisted, shielded-pair cable.
    - c. Insertion Elements in Ducts: Single point, [**8 inches (20 cm)**] [**18 inches (46 cm)**] long; use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft. (1 sq. m).
    - d. Averaging Elements in Ducts: [**36 inches (91 cm) long, flexible**] [**72 inches (183 cm) long, flexible**] [**18 inches (46 cm) long, rigid**]; use where prone to temperature stratification or where ducts are larger than 9 sq. ft. (1 sq. m); length as required.
    - e. Insertion Elements for Liquids: Brass socket with minimum insertion length of 2-1/2 inches (64 mm).
    - f. Room Sensors: Match room thermostats, locking cover.
    - g. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.
    - h. Room Security Sensors: Stainless-steel cover plate with insulated back and security screws.
  - 3. Humidity Sensors: Bulk polymer sensor element.
    - a. Accuracy: 5 percent full range with linear output.
    - b. Room Sensors: With locking cover matching room thermostats, span of 25 to 90 percent relative humidity.

- c. Duct and Outside-Air Sensors: With element guard and mounting plate, range of 0 to 100 percent relative humidity.
  - 4. Static-Pressure Transmitter: Nondirectional sensor with suitable range for expected input, and temperature compensated.
    - a. Accuracy: 2 percent of full scale with repeatability of 0.5 percent.
    - b. Output: 4 to 20 mA.
    - c. Building Static-Pressure Range: 0 to 0.25 inch wg (0 to 62 Pa).
    - d. Duct Static-Pressure Range: 0 to 5 inches wg (0 to 1243 Pa).
  - 5. Pressure Transmitters: Direct acting for gas, liquid, or steam service; range suitable for system; proportional output 4 to 20 mA.
- B. Equipment operation sensors as follows:
  - 1. Status Inputs for Fans: Differential-pressure switch with adjustable range of 0 to 5 inches wg (0 to 1243 Pa).
  - 2. Status Inputs for Pumps: Differential-pressure switch piped across pump with adjustable pressure-differential range of 8 to 60 psig (55 to 414 kPa).
  - 3. Status Inputs for Electric Motors: Current-sensing relay with current transformers, adjustable and set to 175 percent of rated motor current.
- C. Digital-to-Pneumatic Transducers: Convert plus or minus 12-V dc pulse-width-modulation outputs, or continuous proportional current or voltage to 0 to 20 psig (0 to 138 kPa).
- D. Pneumatic Valve/Damper Position Indication: Potentiometer mounted in enclosure with adjustable crank-arm assembly connected to damper to transmit 0 to 100 percent valve/damper travel.
- E. Electronic Valve/Damper Position Indication: Visual scale indicating percent of travel and 2- to 10-V dc, feedback signal.
- F. Water-Flow Switches: Pressure-flow switches of bellows-actuated mercury or snap-acting type, with appropriate scale range and differential adjustment, with stainless-steel or bronze paddle. For chilled-water applications, provide vaporproof type.
- G. Carbon-Monoxide Detectors: Single or multichannel, dual-level detectors, using solid-state sensors with 3-year minimum life, maximum 15-minute sensor replacement, suitable over a temperature range of 23 to 130 deg F (minus 5 to plus 55 deg C), calibrated for 50 and 100 ppm, with maximum 120-second response time to 100-ppm carbon monoxide.
- H. Carbon-Dioxide Sensor and Transmitter: Single detectors, using solid-state infrared sensors, suitable over a temperature range of 23 to 130 deg F (minus 5 to plus 55 deg C), calibrated for 0 to 2 percent, with continuous or averaged reading, 4 to 20 mA output, and wall mounted.
- I. Oxygen Sensor and Transmitter: Single detectors, using solid-state zircon cell sensing, suitable over a temperature range of minus 32 to plus 1100 deg F (0 to 593 deg C), calibrated for 0 to 5 percent, with continuous or averaged reading, 4 to 20 mA output, and wall mounted.

- J. Refrigerant Detectors: Dual-level detectors, using solid-state sensors, with alarm preset for 300 ppm, alarm indicator light, alarm silence light and button, alarm test light and button, and trouble light. Provide auxiliary relay preset for 150 ppm.
- K. Occupancy Sensor: Passive infrared, with time delay, daylight sensor lockout, sensitivity control, and 180-degree field of view with vertical sensing adjustment, for flush mounting.

## 2.7 THERMOSTATS

- A. Combination Thermostat and Fan Switches: Line-voltage thermostat with two-, three-, or four-position, push-button or lever-operated fan switch.
  - 1. Label switches "FAN ON-OFF," "FAN HIGH-LOW-OFF," "FAN HIGH-MED-LOW-OFF." Provide unit for mounting on two-gang switch box.
- B. Electric solid-state, microcomputer-based room thermostat with remote sensor.
  - 1. Automatic switching from heating to cooling.
  - 2. Preferential rate control to minimize overshoot and deviation from set point.
  - 3. Set up for four separate temperatures per day.
  - 4. Instant override of set point for continuous or timed period from 1 hour to 31 days.
  - 5. Short-cycle protection.
  - 6. Programming based on every day of week.
  - 7. Selection features include deg F or deg C display, 12- or 24-hour clock, keyboard disable, remote sensor, fan on-auto.
  - 8. Battery replacement without program loss.
  - 9. Thermostat display features include the following:
    - a. Time of day.
    - b. Actual room temperature.
    - c. Programmed temperature.
    - d. Programmed time.
    - e. Duration of timed override.
    - f. Day of week.
    - g. System mode indications include "heating," "off," "fan auto," and "fan on."
- C. Low-Voltage, On-Off Thermostats: NEMA DC 3, 24-V, bimetal-operated, mercury-switch type, with adjustable or fixed anticipation heater.
- D. Line-Voltage, On-Off Thermostats: Bimetal-actuated, open contact or bellows-actuated, enclosed, snap-switch type, or equivalent solid-state type, with heat anticipator, integral manual on-off-auto selector switch.
  - 1. Equip thermostats, which control electric heating loads directly, with off position on dial wired to break ungrounded conductors.
  - 2. Dead Band: Maximum 2 deg F (1 deg C).
- E. Remote-Bulb Thermostats: On-off or modulating type, liquid filled to compensate for changes in ambient temperature, with copper capillary and bulb, unless otherwise indicated.

1. Bulbs in water lines with separate wells of same material as bulb.
  2. Bulbs in air ducts with flanges and shields.
  3. Averaging Elements: Copper tubing with either single- or multiple-unit elements, extended to cover full width of duct or unit, adequately supported.
  4. Scale settings and differential settings are clearly visible and adjustable from front of instrument.
  5. On-Off Thermostat: With precision snap switches, with electrical ratings required by application.
  6. Modulating Thermostats: Construct so complete potentiometer coil and wiper assembly is removable for inspection or replacement without disturbing calibration of instrument.
- F. Fire-Protection Thermostats: UL listed with fixed or adjustable settings to operate at not less than 75 deg F (24 deg C) above normal maximum operating temperature, with the following:
1. Reset: Manual.
- G. Room Thermostat Cover Construction: Manufacturer's standard locking covers.
1. Set-Point Adjustment: Exposed.
  2. Set-Point Indication: Exposed.
  3. Thermometer: Exposed.
  4. Color: Submit for approval.
  5. Orientation: Vertical.
- H. Room thermostat accessories include the following:
1. Insulating Bases: For thermostats located on exterior walls.
  2. Thermostat Guards: Locking; heavy-duty, transparent plastic; mounted on separate base.
  3. Adjusting Key: As required for calibration and cover screws.
  4. Aspirating Boxes: For flush-mounted aspirating thermostats.
  5. Set-Point Adjustment: 1/2-inch- (13-mm-) diameter, adjustment knob.
- I. Immersion Thermostat: Remote-bulb or bimetal rod-and-tube type, proportioning action with adjustable throttling range and adjustable set point.
- J. Airstream Thermostats: Two-pipe, fully proportional, single-temperature type, with adjustable set point in middle of range and adjustable throttling range, plug-in test fitting or permanent pressure gage, remote bulb, bimetal rod and tube, or averaging element.
- K. Electric Low-Limit Duct Thermostat: Snap-acting, single-pole, single-throw, manual- or automatic-reset switch that trips if temperature sensed across any 12 inches (300 mm) of bulb length is equal to or below set point.
1. Bulb Length: Minimum 20 feet (6 m).
  2. Quantity: One thermostat for every 20 sq. ft. (2 sq. m) of coil surface.
- L. Electric High-Limit Duct Thermostat: Snap-acting, single-pole, single-throw, manual- or automatic-reset switch that trips if temperature sensed across any 12 inches (300 mm) of bulb length is equal to or above set point.
1. Bulb Length: Minimum 20 feet (6 m).

2. Quantity: One thermostat for every 20 sq. ft. (2 sq. m) of coil surface.
- M. Heating/Cooling Valve-Top Thermostats: Proportional acting for proportional flow, molded-rubber diaphragm, remote-bulb liquid-filled element, direct and reverse acting at minimum shutoff pressure of 25 psig (172 kPa), and cast housing with position indicator and adjusting knob.

## 2.8 ACTUATORS

- A. Electric Motors: Size to operate with sufficient reserve power to provide smooth modulating action or two-position action.
1. Permanent Split-Capacitor or Shaded-Pole Type: Gear trains completely oil immersed and sealed. Equip spring-return motors with integral spiral-spring mechanism in housings designed for easy removal for service or adjustment of limit switches, auxiliary switches, or feedback potentiometer.
  2. Nonspring-Return Motors for Valves Larger Than NPS 2-1/2 (DN 65): Size for running torque of 150 in. x lbf (16.9 N x m) and breakaway torque of 300 in. x lbf (33.9 N x m).
  3. Spring-Return Motors for Valves Larger Than NPS 2-1/2 (DN 65): Size for running and breakaway torque of 150 in. x lbf (16.9 N x m).
  4. Nonspring-Return Motors for Dampers Larger Than 25 Sq. Ft. (2.3 sq. m): Size for running torque of 150 in. x lbf (16.9 N x m) and breakaway torque of 300 in. x lbf (33.9 N x m).
  5. Spring-Return Motors for Dampers Larger Than 25 Sq. Ft. (2.3 sq. m): Size for running and breakaway torque of 150 in. x lbf (16.9 N x m).
- B. Electronic Damper, Large-Valve Actuators: Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque.
1. Valves: Size for torque required for valve close-off at maximum pump differential pressure.
  2. Dampers: Size for running torque calculated as follows:
    - a. Parallel-Blade Damper with Edge Seals: 7 inch-pounds/sq. ft. (86.8 kg-cm/sq. m) of damper.
    - b. Opposed-Blade Damper with Edge Seals: 5 inch-pounds/sq. ft. (62 kg-cm/sq. m) of damper.
    - c. Parallel-Blade Damper without Edge Seals: 4 inch-pounds/sq. ft. (49.6 kg-cm/sq. m) of damper.
    - d. Opposed-Blade Damper without Edge Seals: 3 inch-pounds/sq. ft. (37.2 kg-cm/sq. m) of damper.
    - e. Dampers with 2 to 3 Inches wg (500 to 750 Pa) of Pressure Drop or Face Velocities of 1000 to 2500 FPM (5 to 13 m/s): Multiply the minimum full-stroke cycles above by 1.5.
    - f. Dampers with 3 to 4 Inches wg (750 to 1000 Pa) of Pressure Drop or Face Velocities of 2500 to 3000 FPM (13 to 15 m/s): Multiply the minimum full-stroke cycles above by 2.0.
  3. Coupling: V-bolt and V-shaped, toothed cradle.
  4. Overload Protection: Electronic overload or digital rotation-sensing circuitry.

5. Fail-Safe Operation: Mechanical, spring-return mechanism. Provide external, manual gear release on non-spring-return actuators.
  6. Power Requirements (Two-Position Spring Return): 120-V ac.
  7. Power Requirements (Modulating): Maximum 10 VA at 24-V ac or 8 W at 24-V dc.
  8. Proportional Signal: 2- to 10-V dc or 4 to 20 mA, and 2- to 10-V dc position feedback signal.
  9. Temperature Rating: 40 to 122 deg F (4 to 40 deg C).
  10. Temperature Rating (Smoke Dampers): Minus 22 to plus 250 deg F (minus 30 to plus 121 deg C).
  11. Run Time: 12 seconds open, 5 seconds.
- C. Pneumatic Valve Operators: Rolling-diaphragm, spring-loaded, piston type with spring range as required and start-point adjustment and positioning relay. Operator shall maintain full shutoff at maximum pump differential pressure.
- D. Pneumatic Damper Operators: Rolling-diaphragm, piston type with adjustable stops and spring return, sized to operate with sufficient reserve power to provide smooth modulating action or two-position action. Where actuators operate in sequence, provide pilot positioners.
1. Pilot Positioners: Start point adjustable from 2 to 12 psig (14 to 83 kPa), and operating span adjustable from 5 to 13 psig (35 to 90 kPa).
  2. Inlet-Vane Operators: High pressure with pilot positioners.

## 2.9 CONTROL VALVES

- A. Control Valves: Factory fabricated, of type, body material, and pressure class based on maximum pressure and temperature rating of piping system, unless otherwise indicated.
- B. Globe Valves NPS 2 (DN 50) and Smaller: Bronze body, bronze trim, rising stem, renewable composition disc, and screwed ends with backseating capacity repackable under pressure.
- C. Globe Valves NPS 2-1/2 (DN 65) and Larger: Iron body, bronze trim, rising stem, plug-type disc, flanged ends, and renewable seat and disc.
- D. Hydronic system globe valves shall have the following characteristics:
1. Rating: Class 125 for service at 125 psig (862 kPa) and 250 deg F (121 deg C) operating conditions.
  2. Internal Construction: Replaceable plugs and seats of stainless steel or brass.
    - a. Single-Seated Valves: Cage trim provides seating and guiding surfaces for plug on top and bottom of guided plugs.
    - b. Double-Seated Valves: Balanced plug; cage trim provides seating and guiding surfaces for plugs on top and bottom of guided plugs.
  3. Sizing: 3-psig (21-kPa) maximum pressure drop at design flow rate.
  4. Flow Characteristics: Two-way valves shall have equal percentage characteristics; three-way valves shall have linear characteristics. Operators shall close valves against pump shutoff head.

- E. Steam system globe valves shall have the following characteristics:
1. Rating: Class 125 for service at 125 psig (862 kPa) and 250 deg F (121 deg C) operating conditions.
  2. Internal Construction: Replaceable plugs and seats of stainless steel.
    - a. Single-Seated Valves: Cage trim provides seating and guiding surfaces for plug on top and bottom of guided plugs.
    - b. Double-Seated Valves: Balanced plug; cage trim provides seating and guiding surfaces for plugs on top and bottom of guided plugs.
  3. Sizing: 10-psig (69-kPa) inlet pressure and 5-psig (35-kPa) pressure drop.
  4. Sizing: Pressure drop across steam valve at a maximum flow of 80 percent of inlet pressure for low-pressure systems and 42 percent for high-pressure systems.
  5. Flow Characteristics: Modified linear characteristics.
- F. Butterfly Valves: 200-psig (1380-kPa), 150-psig (1035-kPa) maximum pressure differential, ASTM A 126 cast-iron or ASTM A 536 ductile-iron body and bonnet, extended neck, stainless-steel stem, field-replaceable EPDM or Buna N sleeve and stem seals.
1. Body Style Lug.
  2. Disc Type: Aluminum bronze.
  3. Sizing: 1-psig (7-kPa) maximum pressure drop at design flow rate.
- G. Terminal Unit Control Valves: Bronze body, bronze trim, two- or three-port as indicated, replaceable plugs and seats, union and threaded ends.
1. Rating: Class 125 for service at 125 psig (862 kPa) and 250 deg F (121 deg C) operating conditions.
  2. Sizing: 3-psig (21-kPa) maximum pressure drop at design flow rate, to close against pump shutoff head.
  3. Flow Characteristics: Two-way valves shall have equal percentage characteristics; three-way valves shall have linear characteristics.

## 2.10 DAMPERS

- A. Dampers: AMCA-rated, opposed-blade design; 0.1084-inch (2.8-mm) minimum, galvanized-steel frames with holes for duct mounting; damper blades shall not be less than 0.0635-inch (1.6-mm) galvanized steel with maximum blade width of 8 inches (203 mm).
1. Blades shall be secured to 1/2-inch- (13-mm-) diameter, zinc-plated axles using zinc-plated hardware, with nylon blade bearings, blade-linkage hardware of zinc-plated steel and brass, ends sealed against spring-stainless-steel blade bearings, and thrust bearings at each end of every blade.
  2. Operating Temperature Range: From minus 40 to plus 200 deg F (minus 40 to plus 93 deg C).
  3. For standard applications, include optional closed-cell neoprene edging.
  4. For low-leakage applications, use parallel- or opposed-blade design with inflatable seal blade edging, or replaceable rubber seals, rated for leakage at less than 10 cfm per sq. ft. (51 L/s per sq. m) of damper area, at differential pressure of 4 inches wg (995 Pa) when

damper is being held by torque of 50 in. x lbf (5.6 N x m); when tested according to AMCA 500D.

## 2.11 AIR SUPPLY

- A. Control and Instrumentation Tubing: Type K, seamless copper tubing complying with ASTM B 88 (ASTM B 88M) or Type ACR, copper tubing complying with ASTM B 280.
  - 1. Fittings: Cast-bronze solder fittings complying with ASME B16.18; or wrought-copper solder fittings complying with ASME B16.22, except forged-brass compression-type fittings at connections to equipment.
  - 2. Joining Method: Soldered or brazed.
- B. Control and Instrumentation Tubing: Virgin-polyethylene, flame-retardant, nonmetallic tubing complying with ASTM D 2737 with flame-retardant harness for multiple tubing.
  - 1. Fittings: Compression or push-on polyethylene fittings.
- C. Tank: ASME storage tank with drain test cock, automatic moisture removal trap, tank relief valve, and rubber-cork vibration isolation mounting pads.
- D. Duplex Air Compressor: Capacity to supply compressed air to temperature-control system.
  - 1. Adjustable electric contacts pressure control, set to start and stop both compressors at different pressures.
  - 2. Electrical alternation set with motor starters and disconnect to operate compressors alternately or on time schedule.
- E. Simplex Air Compressor: Tank-mounted compressor with capacity to supply compressed air to temperature-control system, with starter and disconnect.
  - 1. Adjustable electric contacts pressure control, set to start and stop compressor.
- F. Compressor Type: Scroll.
- G. Size compressor and tank to operate compressor not more than 30 minutes during a 60-minute period.
- H. Compressor Accessories: Low-resistance intake-air filter, and belt guards.
- I. System Accessories: Air filter rated for 97 percent efficiency at rated airflow, and combination filter/pressure-reducing station or separate filter and pressure-reducing station.
- J. Refrigerated Air Dryer: Self-contained, refrigerated air dryer complete with heat exchangers, moisture separator, internal wiring and piping, and with manual bypass valve.
  - 1. Heat Exchangers: Air-to-refrigerant coils with centrifugal-type moisture separator and automatic trap assembly.
  - 2. Refrigeration Unit: Hermetically sealed, operating to maintain dew point of 13 deg F (minus 11 deg C) at 20 psig (138 kPa), housed in steel cabinet with access door and panel.



3. Accessories: Air-inlet temperature gage, air-inlet pressure gage, on-off switch, high-temperature light, power-on light, refrigerant gage on back, air-outlet temperature gage, air-outlet pressure gage, and with contacts for remote indication of power status and high-temperature alarm.
- K. Desiccant Dryer: Obtains dew point in pneumatic air piping between compressor and tank at least 15 deg F (minus 9 deg C) below inlet-air dew point at design conditions.
- L. Pressure Gages: Black letters on white background, 2-1/2-inch (64-mm) diameter, flush or surface mounted, with front calibration screw to match sensor, in appropriate units.
- M. Instrument Pressure Gages: Black letters on white background, 1-1/2-inch (38-mm) diameter, stem mounted, with suitable dial range.
- N. Diaphragm Control and Instrument Valves: 1/4-inch (6-mm) forged-brass body with reinforced polytetrafluoroethylene diaphragm, stainless-steel spring, and color-coded phenolic handle.
- O. Gage Cocks: Tee or level handle, bronze, rated for 125 psig (862 kPa).
- P. Relays: For summing, reversing, amplifying, highest or lowest pressure selection, with adjustable input/output ratio.
- Q. Switches: With indicating plates, accessible adjustment, calibrated and marked.
- R. Pressure Regulators: Zinc or aluminum castings with elastomeric diaphragm, balanced construction to automatically prevent pressure build-up, and producing flat reduced-pressure curve.
- S. Particle Filters: Zinc or aluminum castings with 97 percent filtration efficiency at rated airflow, quick-disconnect service devices, and aluminum or plastic bowl with metal guard and manual drain cock.
- T. Combination Filter/Regulators: Zinc or aluminum castings with elastomeric diaphragm, balanced construction to automatically prevent pressure build-up, and producing flat reduced-pressure curve; with threaded pipe connections, quick-disconnect service devices, and aluminum or plastic bowl with metal guard and manual drain cock.
- U. Airborne Oil Filter: Filtration efficiency of 99.9 percent for particles of 0.025 micrometer or larger particles of airborne lubricating oil.
- V. Pressure Relief Valves: ASME rated and labeled.
  1. High Pressure: Size for installed capacity.
  2. Low Pressure: Size for installed capacity of pressure regulators and set at 20 percent above low pressure.
- W. Pressure-Reducing Stations: Two parallel pressure regulators.

## 2.12 CONTROL CABLE

- A. Electronic and Fiber-Optic Cable for Control Wiring: As specified in Division 16 Section "Control/Signal Transmission Media."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that conditioned power supply is available to control units and operator workstation.
- B. Verify that duct-, pipe-, and equipment-mounted devices and wiring and pneumatic piping are installed before proceeding with installation.

3.2 INSTALLATION

- A. Install equipment level and plumb.
- B. Install software in control units and operator workstation. Implement all features of programs to specified requirements and as appropriate to sequence of operation.
- C. Connect and configure equipment and software to achieve sequence of operation specified.
- D. Mount compressor and tank unit on restrained spring vibration isolators with 1-inch (25-mm) static deflection according to Division 15 Section "Mechanical Vibration Controls and Seismic Restraints." Isolate air supply with wire-braid-reinforced rubber hose. Secure and anchor according to manufacturer's written instructions and seismic control requirements.
  - 1. Pipe manual and automatic drains to nearest floor drain.
  - 2. Supply instrument air from compressor units through filter, pressure-reducing valve, and pressure relief valve, with pressure gages and shutoff and bypass valves.
- E. Verify location of thermostats, humidistats, and other exposed control sensors with plans and room details before installation. Locate all 60 inches (1524 mm) above the floor.
  - 1. Install averaging elements in ducts and plenums in crossing or zigzag pattern.
- F. Install guards on thermostats in the following locations:
  - 1. Entrances.
  - 2. Public areas.
  - 3. Where indicated.
- G. Install automatic dampers according to Division 15 Section "Duct Accessories."
- H. Install damper motors on outside of duct in warm areas, not in locations exposed to outdoor temperatures.
- I. Install labels and nameplates to identify control components according to Division 15 Section "Basic Mechanical Materials and Methods."

- J. Install labels and nameplates to identify control components according to Division 15 Section "Mechanical Identification."
- K. Install hydronic instrument wells, valves, and other accessories according to Division 15 Section "Hydronic Piping."
- L. Install steam and condensate instrument wells, valves, and other accessories according to Division 15 Section "Steam and Condensate Piping."
- M. Install refrigerant instrument wells, valves, and other accessories according to Division 15 Section "Refrigerant Piping."
- N. Install duct volume-control dampers according to Division 15 Sections specifying air ducts.
- O. Install electronic and fiber-optic cables according to Division 16 Section "Control/Signal Transmission Media."

### 3.3 PNEUMATIC PIPING INSTALLATION

- A. Install piping in mechanical equipment rooms inside mechanical equipment enclosures, in pipe chases, or suspended ceilings with easy access.
  - 1. Install copper tubing with maximum unsupported length of 36 inches (914 mm), for tubing exposed to view.
  - 2. Install polyethylene tubing in metallic raceways or electrical metallic tubing. Electrical metallic tubing materials and installation requirements are specified in Division 16 Section "Raceways and Boxes."
- B. Install terminal single-line connections, less than 18 inches (450 mm) in length, with copper or polyethylene tubing run inside flexible steel protection.
- C. In concealed locations, such as pipe chases and suspended ceilings with easy access, install **polyethylene tubing in electrical metallic** tubing. Electrical metallic tubing materials and installation requirements are specified in Division 16 Section "Raceways and Boxes."
- D. In concrete slabs, furred walls, or ceilings with no access, install copper or polyethylene tubing in electrical metallic tubing or vinyl-jacketed polyethylene tubing.
  - 1. Protect embedded-copper and vinyl-jacketed polyethylene tubing with electrical metallic tubing extending 6 inches (150 mm) above finished slab and 6 inches (150 mm) into slab. Pressure test tubing before and after pour for leak and pinch.
  - 2. Install polyethylene tubing in electrical metallic tubing extending 6 inches (150 mm) above floor line; pull tubing into electrical metallic tubing after pour.
- E. Purge tubing with dry, oil-free compressed air before connecting control instruments.
  - 1. Bridge cabinets and doors with flexible connections fastened along hinge side; protect against abrasion. Tie and support tubing.
- F. Number-code or color-code control air piping for future identification and service of control system, except local individual room control tubing.

- G. Pressure Gages or Test Plugs: Install on branch lines at each receiver controller and on signal lines at each transmitter, except individual room controllers.

### 3.4 ELECTRICAL WIRING AND CONNECTION INSTALLATION

- A. Install raceways, boxes, and cabinets according to Division 16 Section "Raceways and Boxes."
- B. Install building wire and cable according to Division 16 Section "Conductors and Cables."
- C. Install signal and communication cable according to Division 16 Section "Control/Signal Transmission Media."
  - 1. Conceal cable, except in mechanical rooms and areas where other conduit and piping are exposed.
  - 2. Install exposed cable in raceway.
  - 3. Install concealed cable in raceway.
  - 4. Bundle and harness multiconductor instrument cable in place of single cables where several cables follow a common path.
  - 5. Fasten flexible conductors, bridging cabinets and doors, along hinge side; protect against abrasion. Tie and support conductors.
  - 6. Number-code or color-code conductors for future identification and service of control system, except local individual room control cables.
- D. Connect manual-reset limit controls independent of manual-control switch positions. Automatic duct heater resets may be connected in interlock circuit of power controllers.
- E. Connect hand-off-auto selector switches to override automatic interlock controls when switch is in hand position.

### 3.5 CONNECTIONS

- A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
  - 1. Install piping adjacent to machine to allow service and maintenance.
- B. Ground equipment.
  - 1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

### 3.6 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including piping and electrical connections. Report results in writing.

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
  2. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove malfunctioning units, replace with new units, and retest.
  3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment, and retest.
  4. Pressure test control air piping at 30 psig (207 kPa) or 1.5 times the operating pressure for 24 hours, with maximum 5-psig (35-kPa) loss.
  5. Pressure test high-pressure control air piping at 150 psig (1034 kPa) and low-pressure control air piping at 30 psig (207 kPa) for 2 hours, with maximum 1-psig (7-kPa) loss.
  6. Calibration test electronic controllers by disconnecting input sensors and stimulating operation with compatible signal generator.
- B. Engage a factory-authorized service representative to perform startup service.
- C. Replace damaged or malfunctioning controls and equipment.
1. Start, test, and adjust control systems.
  2. Demonstrate compliance with requirements, including calibration and testing, and control sequences.
  3. Adjust, calibrate, and fine tune circuits and equipment to achieve sequence of operation specified.
- D. Verify DDC as follows:
1. Verify software including automatic restart, control sequences, scheduling, reset controls, and occupied/unoccupied cycles.
  2. Verify operation of operator workstation.
  3. Verify local control units including self-diagnostics.

### 3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain control systems and components.
1. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining equipment and schedules.
  2. Provide operator training on data display, alarm and status descriptors, requesting data, executing commands, calibrating and adjusting devices, resetting default values, and requesting logs. Include a minimum of 40 hours' dedicated instructor time on-site.
  3. Review data in maintenance manuals. Refer to Division 1 Section "Contract Closeout."
  4. Review data in maintenance manuals. Refer to Division 1 Section "Operation and Maintenance Data."
  5. Schedule training with Owner, through Architect, with at least seven days' advance notice.

### 3.8 ON-SITE ASSISTANCE

- A. Occupancy Adjustments: Within one year of date of Substantial Completion, provide up to three Project site visits, when requested by Owner, to adjust and calibrate components and to assist Owner's personnel in making program changes and in adjusting sensors and controls to suit actual conditions.

END OF SECTION 15900



SECTION 15985 - SEQUENCE OF OPERATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes control sequences for HVAC systems and terminal units.
- B. Related Section: Division 15 Section "Control Systems Equipment" contains requirements that relate to this Section.

1.3 SYSTEM DESCRIPTION

1.4 SUBMITTALS

- A. General: Submit the following according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Shop Drawings showing operating sequences of various equipment, devices, components, and materials included in the Text and defining the components' contribution to the system.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 15985





## SECTION 15990 - 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.

## 1.2 SUMMARY

- A. This Section includes testing, adjusting, and balancing HVAC systems to produce design objectives, including the following:
  - 1. Balancing airflow and water flow within distribution systems, including submains, branches, and terminals, to indicated quantities according to specified tolerances.
  - 2. Adjusting total HVAC systems to provide indicated quantities.
  - 3. Measuring electrical performance of HVAC equipment.
  - 4. Setting quantitative performance of HVAC equipment.
  - 5. Verifying that automatic control devices are functioning properly.
  - 6. Measuring sound and vibration.
  - 7. Reporting results of the activities and procedures specified in this Section.
- B. Related Sections include the following:
  - 1. Testing and adjusting requirements unique to particular systems and equipment are included in the Sections that specify those systems and equipment.
  - 2. Field quality-control testing to verify that workmanship quality for system and equipment installation is specified in system and equipment Sections.

## 1.3 DEFINITIONS

- A. Adjust: To regulate fluid flow rate and air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.
- B. Balance: To proportion flows within the distribution system, including submains, branches, and terminals, according to design quantities.
- C. Draft: A current of air, when referring to localized effect caused by one or more factors of high air velocity, low ambient temperature, or direction of airflow, whereby more heat is withdrawn from a person's skin than is normally dissipated.
- D. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.
- E. Report Forms: Test data sheets for recording test data in logical order.

- F. Static Head: The pressure due to the weight of the fluid above the point of measurement. In a closed system, static head is equal on both sides of the pump.
- G. Suction Head: The height of fluid surface above the centerline of the pump on the suction side.
- H. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
- I. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.
- J. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.
- K. Test: A procedure to determine quantitative performance of a system or equipment.
- L. Testing, Adjusting, and Balancing Agent: The entity responsible for performing and reporting the testing, adjusting, and balancing procedures.
- M. AABC: Associated Air Balance Council.
- N. AMCA: Air Movement and Control Association.
- O. CTI: Cooling Tower Institute.
- P. NEBB: National Environmental Balancing Bureau.
- Q. SMACNA: Sheet Metal and Air Conditioning Contractors' National Association.

#### 1.4 SUBMITTALS

- A. Quality-Assurance Submittals: Within 30 days from the Contractor's Notice to Proceed, submit 2 copies of evidence that the testing, adjusting, and balancing Agent and this Project's testing, adjusting, and balancing team members meet the qualifications specified in the "Quality Assurance" Article below.
- B. Contract Documents Examination Report: Within 45 days from the Contractor's Notice to Proceed, submit 2 copies of the Contract Documents review report as specified in Part 3 of this Section.
- C. Strategies and Procedures Plan: Within 60 days from the Contractor's Notice to Proceed, submit 2 copies of the testing, adjusting, and balancing strategies and step-by-step procedures as specified in Part 3 "Preparation" Article below. Include a complete set of report forms intended for use on this Project.
- D. Certified Testing, Adjusting, and Balancing Reports: Submit 2 copies of reports prepared, as specified in this Section, on approved forms certified by the testing, adjusting, and balancing Agent.
- E. Sample Report Forms: Submit 2 sets of sample testing, adjusting, and balancing report forms.

- F. Warranty: Submit 2 copies of special warranty specified in the "Warranty" Article below.

1.5 QUALITY ASSURANCE

- A. Agent Qualifications: Engage a testing, adjusting, and balancing agent certified by NEBB.
- B. Testing, Adjusting, and Balancing Conference: Meet with the Owner's and the Engineer 's representatives on approval of the testing, adjusting, and balancing strategies and procedures plan to develop a mutual understanding of the details. Ensure the participation of testing, adjusting, and balancing team members, equipment manufacturers' authorized service representatives, HVAC controls Installer, and other support personnel. Provide 7 days' advance notice of scheduled meeting time and location.
  - 1. Agenda Items: Include at least the following:
    - a. Submittal distribution requirements.
    - b. Contract Documents examination report.
    - c. Testing, adjusting, and balancing 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 Testing, Adjusting, and Balancing Reports: Certify the testing, adjusting, and balancing field data reports. This certification includes the following:
  - 1. Review field data reports to validate accuracy of data and to prepare certified testing, adjusting, and balancing reports.
  - 2. Certify that the testing, adjusting, and balancing team complied with the approved testing, adjusting, and balancing plan and the procedures specified and referenced in this Specification.
- D. Testing, Adjusting, and Balancing Reports: Use standard forms from 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 6 months or more frequently if required by the instrument manufacturer.

1.6 PROJECT CONDITIONS

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

- B. Partial Owner Occupancy: The Owner may occupy completed areas of the building before Substantial Completion. Cooperate with the Owner during testing, adjusting, and balancing operations to minimize conflicts with the Owner's operations.

#### 1.7 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 testing, adjusting, and balancing activities.
- B. Notice: Provide 7 days' advance notice for each test. Include scheduled test dates and times.
- C. Perform testing, adjusting, and balancing after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

#### 1.8 WARRANTY

- A. General Warranty: The special guarantee specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.
- B. Special Guarantee: Provide a guarantee on NEBB forms stating that NEBB will assist in completing the requirements of the Contract Documents if the testing, adjusting, and balancing Agent fails to comply with the Contract Documents. Guarantee includes the following provisions:
  - 1. The certified Agent has tested and balanced systems according to the Contract Documents.
  - 2. Systems are balanced to optimum performance capabilities within design and installation limits.

#### PART 2 - PRODUCTS (Not Applicable)

#### PART 3 - EXECUTION

##### 3.1 EXAMINATION

- A. Examine Contract Documents to become familiar with project requirements and to discover conditions in systems' designs that may preclude proper testing, adjusting, and balancing of systems and equipment.
  - 1. Contract Documents are defined in the General and Supplementary Conditions of the Contract.
  - 2. Verify that balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are required by the Contract Documents. Verify that quantities and locations of these balancing de-

vices are accessible and appropriate for effective balancing and for efficient system and equipment operation.

- B. Examine approved submittal data of HVAC systems and equipment.
- C. Examine project record documents described in Division 1 Section "Project Record Documents."
- D. Examine Engineer's and Engineer's design data, including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.
- E. Examine equipment performance data, including fan and pump curves. 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. Calculate system effect factors to reduce the performance ratings of HVAC equipment when installed under conditions different from those presented when the equipment was performance tested at the factory. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," Sections 7 through 10; or in SMACNA's "HVAC Systems--Duct Design," Sections 5 and 6. Compare this data with the design data and installed conditions.
- F. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Specification Sections have been performed.
- G. Examine system and equipment test reports.
- H. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are properly installed, and their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.
- I. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.
- J. Examine air-handling equipment to ensure clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- K. Examine terminal units, such as variable-air-volume boxes and mixing boxes, to verify that they are accessible and their controls are connected and functioning.
- L. Examine strainers for clean screens and proper perforations.
- M. Examine 3-way valves for proper installation for their intended function of diverting or mixing fluid flows.
- N. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- O. Examine open-piping-system pumps to ensure absence of entrained air in the suction piping.

- P. Examine equipment for installation and for properly operating safety interlocks and controls.
- Q. Examine automatic temperature system components to verify the following:
  1. Dampers, valves, and other controlled devices operate by the intended controller.
  2. Dampers and valves are in the position indicated by the controller.
  3. Integrity of valves and dampers for free and full operation and for tightness of fully closed and fully open positions. This includes dampers in multizone units, mixing boxes, and variable-air-volume terminals.
  4. Automatic modulating and shutoff valves, including 2-way valves and 3-way mixing and diverting valves, are properly connected.
  5. Thermostats and humidistats are located to avoid adverse effects of sunlight, drafts, and cold walls.
  6. Sensors are located to sense only the intended conditions.
  7. Sequence of operation for control modes is according to the Contract Documents.
  8. Controller set points are set at design values. Observe and record system reactions to changes in conditions. Record default set points if different from design values.
  9. Interlocked systems are operating.
- R. Report deficiencies discovered before and during performance of testing, adjusting, and balancing procedures.

### 3.2 PREPARATION

- A. Prepare a testing, adjusting, and balancing plan that includes strategies and step-by-step procedures.
- B. Complete system readiness checks and prepare system readiness 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 design conditions for system operations can be met.

### 3.3 GENERAL TESTING AND BALANCING PROCEDURES

- A. Perform testing and balancing procedures on each system according to the procedures contained in NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and this Section.
- B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to the insulation Specifications for this Project.

- C. Mark equipment settings with paint or other suitable, permanent identification material, including damper-control positions, valve indicators, fan-speed-control levers, and similar controls and devices, to show final settings.

#### 3.4 FUNDAMENTAL AIR SYSTEMS' BALANCING PROCEDURES

- 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 the airflow patterns from the outside-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.

#### 3.5 CONSTANT-VOLUME AIR SYSTEMS' BALANCING PROCEDURES

- A. The procedures in this Article apply to constant-volume supply-, return-, and exhaust-air systems. Additional procedures are required for variable-air-volume, multizone, dual-duct, induction-unit supply-air systems and process exhaust-air systems. These additional procedures are specified in other articles in this Section.
- B. Adjust fans to deliver total design airflows within the maximum allowable rpm listed by the fan manufacturer.
  - 1. Measure fan static pressures to determine actual static pressure as follows:
    - a. Measure outlet static pressure as far downstream from the fan as practicable and upstream from restrictions in ducts such as elbows and transitions.
    - b. Measure static pressure directly at the fan outlet or through the flexible connection.
    - c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from flexible connection and downstream from duct restrictions.



- d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
- 2. Measure static pressure across each air-handling unit component.
  - a. Simulate dirty filter operation and record the point at which maintenance personnel must change filters.
- 3. Measure static pressures entering and leaving other devices such as sound traps and heat recovery equipment under final balanced conditions.
- 4. Compare design data with installed conditions to determine variations in design static pressures versus actual static pressures. Compare actual system effect factors with calculated system effect factors to identify where variations occur. Recommend corrective action to align design and actual conditions.
- 5. Adjust fan speed higher or lower than design with the approval of the Engineer. Make required adjustments to pulley sizes, motor sizes, and electrical connections to accommodate fan-speed changes.
- 6. 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 no overload will occur. Measure amperage in full cooling, full heating, and economizer modes to determine the maximum required brake horsepower.
- C. Adjust volume dampers for main duct, submain ducts, and major branch ducts to design airflows within specified tolerances.
  - 1. Measure static pressure at a point downstream from the balancing damper and adjust volume dampers until the proper static pressure is achieved.
    - a. Where sufficient space in submains and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
  - 2. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submains and branch ducts to design airflows within specified tolerances.
- D. Measure terminal outlets and inlets without making adjustments.
  - 1. Measure terminal outlets using a direct-reading hood or the outlet manufacturer's written instructions and calculating factors.
- E. Adjust terminal outlets and inlets for each space to design airflows within specified tolerances of design values. Make adjustments using volume dampers rather than extractors and the dampers at the air terminals.
  - 1. Adjust each outlet in the same room or space to within specified tolerances of design quantities without generating noise levels above the limitations prescribed by the Contract Documents.
  - 2. Adjust patterns of adjustable outlets for proper distribution without drafts.

### 3.6 VARIABLE-AIR-VOLUME SYSTEMS' ADDITIONAL PROCEDURES

- A. **Compensating for Diversity:** When the total airflow of all terminal units is more than the fan design airflow volume, place a selected number of terminal units at a maximum set-point airflow condition until the total airflow of the terminal units equals the design airflow of the fan. Select the reduced airflow terminal units so they are distributed evenly among the branch ducts.
- B. **Pressure-Independent, Variable-Air-Volume Systems:** After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
1. Set outside-air dampers at minimum, and return- and exhaust-air dampers at a position that simulates full-cooling load.
  2. Select the terminal unit that is most critical to the supply-fan airflow and static pressure. Measure static pressure. Adjust system static pressure so the entering static pressure for the critical terminal unit is not less than the sum of the terminal unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge duct losses.
  3. Measure total system airflow. Adjust to within 10 percent of design airflow.
  4. Set terminal units at maximum airflow and adjust controller or regulator to deliver the designed maximum airflow. Use the terminal unit manufacturer's written instructions to make this adjustment. When total airflow is correct, balance the air outlets downstream from terminal units as described for constant-volume air systems.
  5. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow as described for constant-volume air systems.
    - a. If air outlets are out of balance at minimum airflow, report the condition but leave the outlets balanced for maximum airflow.
  6. Remeasure the return airflow to the fan while operating at maximum return airflow and minimum outside airflow. Adjust the fan and balance the return-air ducts and inlets as described for constant-volume air systems.
  7. Measure static pressure at the most critical terminal unit and adjust the static-pressure controller at the main supply-air sensing station to ensure adequate static pressure is maintained at the most critical unit.
  8. Record the final fan performance data.
- C. **Pressure-Dependent, Variable-Air-Volume Systems without Diversity:** After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
1. Balance systems similar to constant-volume air systems.
  2. Set terminal units and supply fan at full-airflow condition.
  3. Adjust inlet dampers of each terminal unit to design airflow and verify operation of the static-pressure controller. When total airflow is correct, balance the air outlets downstream from terminal units as described for constant-volume air systems.
  4. Readjust fan airflow for final maximum readings.
  5. Measure operating static pressure at the sensor that controls the supply fan, if one is installed, and verify operation of the static-pressure controller.
  6. Set supply fan at minimum airflow if minimum airflow is indicated. Measure static pressure to verify that it is being maintained by the controller.
  7. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow as described for constant-volume air systems.

- a. If air outlets are out of balance at minimum airflow, report the condition but leave the outlets balanced for maximum airflow.
- 8. Measure the return airflow to the fan while operating at maximum return airflow and minimum outside airflow. Adjust the fan and balance the return-air ducts and inlets as described for constant-volume air systems.
- D. Pressure-Dependent, Variable-Air-Volume Systems with Diversity: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
  - 1. Set system at maximum design airflow by setting the required number of terminal units at minimum airflow. Select the reduced airflow terminal units so they are distributed evenly among the branch ducts.
  - 2. Adjust supply fan to maximum design airflow with the variable-airflow controller set at maximum airflow.
  - 3. Set terminal units being tested at full-airflow condition.
  - 4. Adjust terminal units starting at the supply-fan end of the system and continuing progressively to the end of the system. Adjust inlet dampers of each terminal unit to design airflow. When total airflow is correct, balance the air outlets downstream from terminal units as described for constant-volume air systems.
  - 5. Adjust terminal units for minimum airflow.
  - 6. Measure static pressure at the sensor.
  - 7. Measure the return airflow to the fan while operating at maximum return airflow and minimum outside airflow. Adjust the fan and balance the return-air ducts and inlets as described for constant-volume air systems.

### 3.7 MULTIZONE SYSTEMS' ADDITIONAL PROCEDURES

- A. Set unit at full flow through the cooling coil if coil has that capacity.
- B. Adjust each zone damper to design airflow.

### 3.8 INDUCTION-UNIT SYSTEMS' ADDITIONAL PROCEDURES

- A. Balance primary-air risers by measuring static pressure at the nozzles of the top and bottom units of each riser to determine which risers must be throttled. Adjust risers to design airflow within specified tolerances.
- B. Adjust each induction unit.

### 3.9 FUNDAMENTAL PROCEDURES FOR HYDRONIC SYSTEMS

- A. Prepare test reports with pertinent design data and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against approved pump flow rate. Correct variations that exceed plus or minus 5 percent.
- B. Prepare schematic diagrams of systems' "as-built" piping layouts.

- C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:
1. Open all manual valves for maximum flow.
  2. Check expansion tank liquid level.
  3. Check makeup-water-station pressure gage for adequate pressure for highest vent.
  4. Check flow-control valves for specified sequence of operation and set at design flow.
  5. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type, unless several terminal valves are kept open.
  6. Set system controls so automatic valves are wide open to heat exchangers.
  7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.
  8. Check air vents for a forceful liquid flow exiting from vents when manually operated.

### 3.10 HYDRONIC SYSTEMS' BALANCING PROCEDURES

- A. Determine 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. Verify with the pump manufacturer that this will not damage pump. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on the manufacturer's pump curve at zero flow and confirm that the pump has the intended impeller size.
  2. Check system resistance. With all valves open, read pressure differential across the pump and mark the pump manufacturer's head-capacity curve. Adjust pump discharge valve until design water flow is achieved.
  3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on the pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.
  4. Report flow rates that are not within plus or minus 5 percent of design.
- B. Set calibrated balancing valves, if installed, at calculated presettings.
- C. 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.
- D. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than design flow.
- E. Adjust balancing stations to within specified tolerances of design flow rate as follows:
1. Determine the balancing station with the highest percentage over design flow.
  2. Adjust each station in turn, beginning with the station with the highest percentage over design flow and proceeding to the station with the lowest percentage over design flow.
  3. Record settings and mark balancing devices.

- F. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures, including outdoor-air temperature.
- G. Measure the differential-pressure control valve settings existing at the conclusions of balancing.

### 3.11 VARIABLE-FLOW HYDRONIC SYSTEMS' ADDITIONAL PROCEDURES

- A. Balance systems with automatic 2- and 3-way control valves by setting systems at maximum flow through heat-exchange terminals and proceed as specified above for hydronic systems.

### 3.12 PRIMARY-SECONDARY-FLOW HYDRONIC SYSTEMS' ADDITIONAL PROCEDURES

- A. Balance the primary system crossover flow first, then balance the secondary system.

### 3.13 HEAT EXCHANGERS

- A. Measure water flow through all circuits.
- B. Adjust water flow to within specified tolerances.
- C. Measure inlet and outlet water temperatures.
- D. Measure inlet steam pressure. Check the setting and operation of automatic temperature-control valves, self-contained control valves, and pressure-reducing valves.
- E. Record safety valve settings.
- F. Verify operation of steam traps.

### 3.14 MOTORS

- A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
  - 1. Manufacturer, model, and serial numbers.
  - 2. Motor horsepower rating.
  - 3. Motor rpm.
  - 4. Efficiency rating if high-efficiency motor.
  - 5. Nameplate and measured voltage, each phase.
  - 6. Nameplate and measured amperage, each phase.
  - 7. Starter thermal-protection-element rating.
- B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass for the controller to prove proper operation. Record observations, including controller manufacturer, model and serial numbers, and nameplate data.

### 3.15 CHILLERS

- A. Balance water flow through each evaporator and condenser to within specified tolerances of design flow with all pumps operating. With only one chiller operating in a multiple chiller installation, do not exceed the flow for the maximum tube velocity recommended by the chiller manufacturer. Measure and record the following data with each chiller operating at design conditions:
1. Evaporator water entering and leaving temperatures, pressure drop, and water flow.
  2. Condenser water entering and leaving temperatures, pressure drop, and water flow.
  3. Evaporator and condenser refrigerant temperatures and pressures, using instruments furnished by the chiller manufacturer.
  4. Power factor if factory-installed instrumentation is furnished for measuring kW.
  5. The kW input if factory-installed instrumentation is furnished for measuring kW.
  6. Capacity: Calculate in tons of cooling.
  7. Air-Cooled Chillers: Verify condenser-fan rotation and record fan data, including number of fans and entering- and leaving-air temperatures.

### 3.16 COOLING TOWERS

- A. Shut off makeup water for the duration of the test, and then make sure the makeup and blow-down systems are fully operational after tests and before leaving the equipment. Perform the following tests and record the results:
1. Measure condenser water flow to each cell of the cooling tower.
  2. Measure entering- and leaving-water temperatures.
  3. Measure wet- and dry-bulb temperatures of entering air.
  4. Measure wet- and dry-bulb temperatures of leaving air.
  5. Measure condenser water flow rate recirculating through the cooling tower.
  6. Measure cooling tower pump discharge pressure.
  7. Adjust water level and feed rate of makeup-water system.

### 3.17 CONDENSING UNITS

- A. Verify proper rotation of fans and measure entering- and leaving-air temperatures. Record compressor data.

### 3.18 HEAT-TRANSFER COILS

- A. Water Coils: Measure the following data for each coil:
1. Entering- and leaving- water temperatures.
  2. Water flow rate.
  3. Water pressure drop.
  4. Dry-bulb temperatures of entering and leaving air.
  5. Wet-bulb temperatures of entering and leaving air for cooling coils.
  6. Airflow.
  7. Air pressure drop.
- B. Electric-Heating Coils: Measure the following data for each coil:

8. Nameplate data.
9. Airflow.
10. Entering-and leaving- air temperatures at full load,.
11. Voltage and amperage input of each phase at full load and at each incremental stage.
12. Calculated kW at full load.
13. Fuse or circuit-breaker rating for overload protection.

### 3.19 TEMPERATURE TESTING

- A. During testing, adjusting, and balancing, report need for adjustment in temperature regulation within the automatic temperature-control system.
- B. Measure indoor wet- and dry-bulb temperatures every other hour for a period of 2 successive 8-hour days, in each separately controlled zone, to prove correctness of final temperature settings. Measure when the building or zone is occupied.
- C. Measure outside-air, wet- and dry-bulb temperatures.

### 3.20 FUME HOODS

- A. Determine total airflow into the room where the fume hood is located and balance systems to ensure adequate air supply to all hoods.
  1. Set fume-hood door opening at position of normal use.
  2. Energize the exhaust fan and adjust airflow to provide the indicated average fume-hood face velocity at hood opening.
  3. Measure exhaust airflow volume by measuring airflow by Pitot-tube duct traverse.
  4. Measure air velocity using Pitot-tube traverse method.
  5. Record each face velocity measurement taken at 4- to 6-inch (100- to 150-mm) increments over the entire hood door opening.
  6. Calculate the average face velocity by averaging all velocity measurements.
  7. Calculate the airflow volume of exhaust-hood face velocity by multiplying the calculated average face velocity by the opening area. Compare this quantity with exhaust volume at exhaust fan and report duct leakage.
  8. Measure airflow volume supplied by makeup fan. Verify that the makeup system supplies the proper amount of air to keep the space at the indicated pressure with the exhaust systems in all operating conditions.
  9. Retest for average face velocity. Adjust hood baffles, fan drives, and other parts of the system to provide the indicated average face velocity and the indicated auxiliary air-supply percentages.
  10. Retest and adjust the systems until fume-hood performance complies with Contract Documents.

### 3.21 TEMPERATURE-CONTROL VERIFICATION

- A. Verify that controllers are calibrated and commissioned.

- B. Check transmitter and controller locations and note conditions that would adversely affect control functions.
- C. Record controller settings and note variances between set points and actual measurements.
- D. Verify operation of limiting controllers (i.e., high- and low-temperature controllers).
- E. Verify free travel and proper operation of control devices such as damper and valve operators.
- F. Verify sequence of operation of control devices. Note air pressures and device positions and correlate with airflow and water-flow measurements. Note the speed of response to input changes.
- G. Confirm interaction of electrically operated switch transducers.
- H. Confirm interaction of interlock and lockout systems.
- I. Verify main control supply-air pressure and observe compressor and dryer operations.
- J. Record voltages of power supply and controller output. Determine if the system operates on a grounded or nongrounded power supply.
- K. Note operation of electric actuators using spring return for proper fail-safe operations.

### 3.22 TOLERANCES

- A. Set HVAC system airflow and water flow rates within the following tolerances:
  1. Supply, Return, and Exhaust Fans: Plus 5 to plus 10 percent.
  2. Air Outlets and Inlets: 0 to minus 10 percent.
  3. Heating (Re-heat)-Water Flow Rate: 0 to minus 10 percent.
  4. Cooling-Water Flow Rate: 0 to minus 5 percent.

### 3.23 REPORTING

- A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article above, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.
- B. Status Reports: As Work progresses, prepare reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

### 3.24 FINAL REPORT



- A. General: Typewritten, or computer printout in letter-quality font, on standard bond paper, in 3-ring binder, tabulated and divided into sections by tested and balanced systems.
- B. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing engineer.
  - 1. Include a list of the instruments used for procedures, along with proof of calibration.
- C. Final Report Contents: In addition to the certified field report data, include the following:
  - 1. Pump curves.
  - 2. Fan curves.
  - 3. Manufacturers' test data.
  - 4. Field test reports prepared by system and equipment installers.
  - 5. Other information relative to equipment performance, but do not include approved Shop Drawings and Product Data.
- D. General Report Data: In addition to the form titles and entries, include the following data in the final report, as applicable:
  - 1. Title page.
  - 2. Name and address of testing, adjusting, and balancing Agent.
  - 3. Project name.
  - 4. Project location.
  - 5. Engineer's name and address.
  - 6. Engineer's name and address.
  - 7. Contractor's name and address.
  - 8. Report date.
  - 9. Signature of testing, adjusting, and balancing Agent who certifies the report.
  - 10. Summary of contents, including the following:
    - a. Design versus final performance.
    - b. Notable characteristics of systems.
    - c. Description of system operation sequence if it varies from the Contract Documents.
  - 11. Nomenclature sheets for each item of equipment.
  - 12. Data for terminal units, including manufacturer, type size, and fittings.
  - 13. Notes to explain why certain final data in the body of reports vary from design values.
  - 14. Test conditions for fans and pump performance forms, including the following:
    - a. Settings for outside-, return-, and exhaust-air dampers.
    - b. Conditions of filters.
    - c. Cooling coil, wet- and dry-bulb conditions.
    - d. Face and bypass damper settings at coils.
    - e. Fan drive settings, including settings and percentage of maximum pitch diameter.
    - f. Inlet vane settings for variable-air-volume systems.
    - g. Settings for supply-air, static-pressure controller.
    - h. Other system operating conditions that affect performance.

- E. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present with single-line diagrams and include the following:
1. Quantities of outside, supply, return, and exhaust airflows.
  2. Water and steam flow rates.
  3. Duct, outlet, and inlet sizes.
  4. Pipe and valve sizes and locations.
  5. Terminal units.
  6. Balancing stations.
- F. Air-Handling Unit Test Reports: For air-handling units with coils, include the following:
1. Unit Data: Include the following:
    - a. Unit identification.
    - b. Location.
    - c. Make and type.
    - d. Model number and unit size.
    - e. Manufacturer's serial number.
    - f. Unit arrangement and class.
    - g. Discharge arrangement.
    - h. Sheave make, size in inches, and bore.
    - i. Sheave dimensions, center-to-center and amount of adjustments in inches.
    - j. Number of belts, make, and size.
    - k. Number of filters, type, and size.
  2. Motor Data: Include the following:
    - a. Make and frame type and size.
    - b. Horsepower and rpm.
    - c. Volts, phase, and hertz.
    - d. Full-load amperage and service factor.
    - e. Sheave make, size in inches, and bore.
    - f. Sheave dimensions, center-to-center and amount of adjustments in inches.
  3. Test Data: Include design and actual values for the following:
    - a. Total airflow rate in cfm .
    - b. Total system static pressure in inches wg .
    - c. Fan rpm.
    - d. Discharge static pressure in inches wg.
    - e. Filter static-pressure differential in inches wg.
    - f. Cooling coil static-pressure differential in inches wg .
    - g. Heating coil static-pressure differential in inches wg .
    - h. Outside airflow in cfm.
    - i. Return airflow in cfm.
    - j. Outside-air damper position.
    - k. Return-air damper position.
    - l. Vortex damper position.
- G. Apparatus-Coil Test Reports: For apparatus coils, include the following:

1. Coil Data: Include the following:
  - a. System identification.
  - b. Location.
  - c. Coil type.
  - d. Number of rows.
  - e. Fin spacing in fins per inch .
  - f. Make and model number.
  - g. Face area in sq. ft.
  - h. Tube size in NPS.
  - i. Tube and fin materials.
  - j. Circuiting arrangement.
  
2. Test Data: Include design and actual values for the following:
  - a. Airflow rate in cfm.
  - b. Average face velocity in fpm.
  - c. Air pressure drop in inches wg.
  - d. Outside-air, wet- and dry-bulb temperatures in deg F.
  - e. Return-air, wet- and dry-bulb temperatures in deg F.
  - f. Entering-air, wet- and dry-bulb temperatures in deg F.
  - g. Leaving-air, wet- and dry-bulb temperatures in deg F.
  - h. Water flow rate in gpm.
  - i. Water pressure differential in feet of head or psig.
  - j. Entering-water temperature in deg F.
  - k. Leaving-water temperature in deg F.
  - l. Refrigerant expansion valve and refrigerant types.
  - m. Refrigerant suction pressure in psig .
  - n. Refrigerant suction temperature in deg F.
  - o. Inlet steam pressure in psig .
  
- H. Electric-Coil Test Reports: For electric furnaces, duct coils, and electric coils installed in central-station air-handling units, include the following:
  1. Unit Data: Include the following:
    - a. System identification.
    - b. Location.
    - c. Coil identification.
    - d. Capacity in Btuh.
    - e. Number of stages.
    - f. Connected volts, phase, and hertz.
    - g. Rated amperage.
    - h. Airflow rate in cfm.
    - i. Face area in sq. ft.
    - j. Minimum face velocity in fpm.
  
  2. Test Data: Include design and actual values for the following:
    - a. Heat output in Btuh.
    - b. Airflow rate in cfm .

- c. Air velocity in fpm .
- d. Entering-air temperature in deg F.
- e. Leaving-air temperature in deg F.
- f. Voltage at each connection.
- g. Amperage for each phase.

I. Fan Test Reports: For supply, return, and exhaust fans, include the following:

- 1. Fan Data: Include the following:
  - a. System identification.
  - b. Location.
  - c. Make and type.
  - d. Model number and size.
  - e. Manufacturer's serial number.
  - f. Arrangement and class.
  - g. Sheave make, size in inches and bore.
  - h. Sheave dimensions, center-to-center and amount of adjustments in inches.
- 2. Motor Data: Include the following:
  - a. Make and frame type and size.
  - b. Horsepower and rpm.
  - c. Volts, phase, and hertz.
  - d. Full-load amperage and service factor.
  - e. Sheave make, size in inches and bore.
  - f. Sheave dimensions, center-to-center and amount of adjustments in inches.
  - g. Number of belts, make, and size.
- 3. Test Data: Include design and actual values for the following:
  - a. Total airflow rate in cfm.
  - b. Total system static pressure in inches wg .
  - c. Fan rpm.
  - d. Discharge static pressure in inches wg .
  - e. Suction static pressure in inches wg .

J. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:

- 1. Report Data: Include the following:
  - a. System and air-handling unit number.
  - b. Location and zone.
  - c. Traverse air temperature in deg F.
  - d. Duct static pressure in inches wg.
  - e. Duct size in inches.
  - f. Duct area in sq. ft.
  - g. Design airflow rate in cfm .
  - h. Design velocity in fpm.
  - i. Actual airflow rate in cfm.

- j. Actual average velocity in fpm.
- k. Barometric pressure in psig .

K. Air-Terminal-Device Reports: For terminal units, include the following:

1. Unit Data: Include the following:
  - a. System and air-handling unit identification.
  - b. Location and zone.
  - c. Test apparatus used.
  - d. Area served.
  - e. Air-terminal-device make.
  - f. Air-terminal-device number from system diagram.
  - g. Air-terminal-device type and model number.
  - h. Air-terminal-device size.
  - i. Air-terminal-device effective area in sq. ft.
2. Test Data: Include design and actual values for the following:
  - a. Airflow rate in cfm.
  - b. Air velocity in fpm.
  - c. Preliminary airflow rate as needed in cfm.
  - d. Preliminary velocity as needed in fpm.
  - e. Final airflow rate in cfm.
  - f. Final velocity in fpm.
  - g. Space temperature in deg F.

L. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:

1. Unit Data: Include the following:
  - a. System and air-handling unit identification.
  - b. Location and zone.
  - c. Room or riser served.
  - d. Coil make and size.
  - e. Flowmeter type.
2. Test Data: Include design and actual values for the following:
  - a. Airflow rate in cfm.
  - b. Entering-water temperature in deg F.
  - c. Leaving-water temperature in deg F.
  - d. Water pressure drop in feet of head or psig.
  - e. Entering-air temperature in deg F.
  - f. Leaving-air temperature in deg F.

M. Packaged Chiller Reports: For each chiller, include the following:

1. Unit Data: Include the following:
  - a. Unit identification.

- b. Make and model number.
  - c. Manufacturer's serial number.
  - d. Refrigerant type and capacity in gal..
  - e. Starter type and size.
  - f. Starter thermal protection size.
2. Condenser Test Data: Include design and actual values for the following:
- a. Refrigerant pressure in psig.
  - b. Refrigerant temperature in deg F.
  - c. Entering-water temperature in deg F.
  - d. Leaving-water temperature in deg F.
  - e. Entering-water pressure in feet of head or psig.
  - f. Water pressure differential in feet of head or psig.
3. Evaporator Test Reports: Include design and actual values for the following:
- a. Refrigerant pressure in psig.
  - b. Refrigerant temperature in deg F.
  - c. Entering-water temperature in deg F.
  - d. Leaving-water temperature in deg F.
  - e. Entering-water pressure in feet of head or psig.
  - f. Water pressure differential in feet of head or psig.
4. Compressor Test Data: Include design and actual values for the following:
- a. Make and model number.
  - b. Manufacturer's serial number.
  - c. Suction pressure in psig.
  - d. Suction temperature in deg F.
  - e. Discharge pressure in psig.
  - f. Discharge temperature in deg F.
  - g. Oil pressure in psig .
  - h. Oil temperature in deg F.
  - i. Voltage at each connection.
  - j. Amperage for each phase.
  - k. The kW input.
  - l. Crankcase heater kW.
  - m. Chilled water control set point in deg F.
  - n. Condenser water control set point in deg F.
  - o. Refrigerant low-pressure-cutoff set point in psig.
  - p. Refrigerant high-pressure-cutoff set point in psig.
5. Refrigerant Test Data: Include design and actual values for the following:
- a. Oil level.
  - b. Refrigerant level.
  - c. Relief valve setting in psig.
  - d. Unloader set points in psig.
  - e. Percentage of cylinders unloaded.
  - f. Bearing temperatures in deg F.

- g. Vane position.
  - h. Low-temperature-cutoff set point in deg F.
- N. Compressor and Condenser Reports: For refrigerant side of unitary systems, stand-alone refrigerant compressors, air-cooled condensing units, or water-cooled condensing units, include the following:
1. Unit Data: Include the following:
    - a. Unit identification.
    - b. Location.
    - c. Unit make and model number.
    - d. Manufacturer's compressor serial numbers.
    - e. Compressor make.
    - f. Compressor model and serial numbers.
    - g. Refrigerant weight in lb.
    - h. Low ambient temperature cutoff in deg F.
  2. Test Data: Include design and actual values for the following:
    - a. Inlet-duct static pressure in inches wg.
    - b. Outlet-duct static pressure in inches wg.
    - c. Entering-air, dry-bulb temperature in deg F.
    - d. Leaving-air, dry-bulb temperature in deg F.
    - e. Condenser entering-water temperature in deg F.
    - f. Condenser leaving-water temperature in deg F.
    - g. Condenser water temperature differential in deg F.
    - h. Condenser entering-water pressure in feet of head or psig.
    - i. Condenser leaving-water pressure in feet of head or psig.
    - j. Condenser water pressure differential in feet of head or psig.
    - k. Control settings.
    - l. Unloader set points.
    - m. Low-pressure-cutout set point in psig.
    - n. High-pressure-cutout set point in psig.
    - o. Suction pressure in psig.
    - p. Suction temperature in deg F.
    - q. Condenser refrigerant pressure in psig.
    - r. Condenser refrigerant temperature in deg F.
    - s. Oil pressure in psig.
    - t. Oil temperature in deg F.
    - u. Voltage at each connection.
    - v. Amperage for each phase.
    - w. The kW input.
    - x. Crankcase heater kW.
    - y. Number of fans.
    - z. Condenser fan rpm.
    - aa. Condenser fan airflow rate in cfm.
    - bb. Condenser fan motor make, frame size, rpm, and horsepower.
    - cc. Condenser fan motor voltage at each connection.
    - dd. Condenser fan motor amperage for each phase.

- O. Cooling Tower or Condenser Test Reports: For cooling towers or condensers, include the following:
1. Unit Data: Include the following:
    - a. Unit identification.
    - b. Make and type.
    - c. Model and serial numbers.
    - d. Nominal cooling capacity in tons.
    - e. Refrigerant type and weight in lb.
    - f. Water-treatment chemical feeder and chemical.
    - g. Number and type of fans.
    - h. Fan motor make, frame size, rpm, and horsepower.
    - i. Fan motor voltage at each connection.
    - j. Sheave make, size in inches and bore.
    - k. Sheave dimensions, center-to-center and amount of adjustments in inches.
    - l. Number of belts, make, and size.
  2. Pump Test Data: Include design and actual values for the following:
    - a. Make and model number.
    - b. Manufacturer's serial number.
    - c. Motor make and frame size.
    - d. Motor horsepower and rpm.
    - e. Voltage at each connection.
    - f. Amperage for each phase.
    - g. Water flow rate in gpm.
  3. Water Test Data: Include design and actual values for the following:
    - a. Entering-water temperature in deg F.
    - b. Leaving-water temperature in deg F.
    - c. Water temperature differential in deg F.
    - d. Entering-water pressure in feet of head or psig.
    - e. Leaving-water pressure in feet of head or psig.
    - f. Water pressure differential in feet of head or psig.
    - g. Water flow rate in gpm.
    - h. Bleed water flow rate in gpm.
  4. Air Data: Include design and actual values for the following:
    - a. Duct airflow rate in cfm.
    - b. Inlet-duct static pressure in inches wg.
    - c. Outlet-duct static pressure in inches wg.
    - d. Average entering-air, wet-bulb temperature in deg F.
    - e. Average leaving-air, wet-bulb temperature in deg F.
    - f. Ambient wet-bulb temperature in deg F.
- P. Heat-Exchanger/Converter Test Reports: For steam and hot-water heat exchangers, include the following:



1. Unit Data: Include the following:
  - a. Unit identification.
  - b. Location.
  - c. Service.
  - d. Make and type.
  - e. Model and serial numbers.
  - f. Ratings.
  
2. Steam Test Data: Include design and actual values for the following:
  - a. Inlet pressure in psig.
  - b. Condensate flow rate in lb/h.
  
3. Primary Water Test Data: Include design and actual values for the following:
  - a. Entering-water temperature in deg F.
  - b. Leaving-water temperature in deg F.
  - c. Entering-water pressure in feet of head or psig.
  - d. Water pressure differential in feet of head or psig.
  - e. Water flow rate in gpm.
  
4. Secondary Water Test Data: Include design and actual values for the following:
  - a. Entering-water temperature in deg F.
  - b. Leaving-water temperature in deg F.
  - c. Entering-water pressure in feet of head or psig.
  - d. Water pressure differential in feet of head or psig.
  - e. Water flow rate in gpm.
  
- Q. Pump Test Reports: For pumps, include the following data. Calculate impeller size by plotting the shutoff head on pump curves.
  1. Unit Data: Include the following:
    - a. Unit identification.
    - b. Location.
    - c. Service.
    - d. Make and size.
    - e. Model and serial numbers.
    - f. Water flow rate in gpm.
    - g. Water pressure differential in feet of head or psig.
    - h. Required net positive suction head in feet of head or psig.
    - i. Pump rpm.
    - j. Impeller diameter in inches.
    - k. Motor make and frame size.
    - l. Motor horsepower and rpm.
    - m. Voltage at each connection.
    - n. Amperage for each phase.
    - o. Full-load amperage and service factor.
    - p. Seal type.

2. Test Data: Include design and actual values for the following:

- a. Static head in feet of head or psig.
- b. Pump shutoff pressure in feet of head or psig.
- c. Actual impeller size in inches.
- d. Full-open flow rate in gpm.
- e. Full-open pressure in feet of head or psig.
- f. Final discharge pressure in feet of head or psig.
- g. Final suction pressure in feet of head or psig.
- h. Final total pressure in feet of head or psig .
- i. Final water flow rate in gpm.
- j. Voltage at each connection.
- k. Amperage for each phase.

R. Instrument Calibration Reports: For instrument calibration, include the following:

1. Report Data: Include the following:

- a. Instrument type and make.
- b. Serial number.
- c. Application.
- d. Dates of use.
- e. Dates of calibration.

3.25 ADDITIONAL TESTS

- A. Within 90 days of completing testing, adjusting, and balancing, perform additional testing and balancing to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
- B. Seasonal Periods: If initial testing, adjusting, and balancing procedures were not performed during near-peak summer conditions, perform additional inspections, testing, and adjusting during near-peak summer conditions.

END OF SECTION 15990



## SECTION 16050 - BASIC ELECTRICAL 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.

#### 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Raceways.
  - 2. Building wire and connectors.
  - 3. Supporting devices for electrical components.
  - 4. Electrical identification.
  - 5. Electricity-metering components.
  - 6. Concrete equipment bases.
  - 7. Cutting and patching for electrical construction.
  - 8. Touchup painting.

#### 1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. FMC: Flexible metal conduit.
- C. IMC: Intermediate metal conduit.
- D. LFMC: Liquidtight flexible metal conduit.
- E. RNC: Rigid nonmetallic conduit.
- F. RMC: Rigid Metallic Conduit

#### 1.4 SUBMITTALS

- A. Product Data: For electricity-metering equipment.
- B. Shop Drawings: Dimensioned plans and sections or elevation layouts of electricity-metering equipment.
- C. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

## 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. Comply with NFPA 70.

## 1.6 COORDINATION

- A. Coordinate chases, slots, inserts, sleeves, and openings with general construction work and arrange in building structure during progress of construction to facilitate the electrical installations that follow.
  - 1. Set inserts and sleeves in poured-in-place concrete, masonry work, and other structural components as they are constructed.
- B. Sequence, coordinate, and integrate installing electrical materials and equipment for efficient flow of the Work. Coordinate installing large equipment requiring positioning before closing in the building.
- C. Coordinate electrical service connections to components furnished by utility companies.
  - 1. Coordinate installation and connection of exterior underground and overhead utilities and services, including provision for electricity-metering components.
  - 2. Comply with requirements of authorities having jurisdiction and of utility company providing electrical power and other services.
- D. Coordinate location of access panels and doors for electrical items that are concealed by finished surfaces. Access doors and panels are specified in Division 8 Section "Access Doors."
- E. Where electrical identification devices are applied to field-finished surfaces, coordinate installation of identification devices with completion of finished surface.
- F. Where electrical identification markings and devices will be concealed by acoustical ceilings and similar finishes, coordinate installation of these items before ceiling installation.

## PART 2 - PRODUCTS

### 2.1 RACEWAYS

- A. EMT: ANSI C80.3, zinc-coated steel, with set-screw or compression fittings.
- B. FMC: Zinc-coated steel.
- C. IMC: ANSI C80.6, zinc-coated steel, with threaded fittings.
- D. LFMC: Zinc-coated steel with sunlight-resistant and mineral-oil-resistant plastic jacket.
- E. RNC: NEMA TC 2, Schedule 40 PVC, with NEMA TC3 fittings.
- F. RMC: Rigid Metallic Conduit
- G. Raceway Fittings: Specifically designed for the raceway type with which used.

## 2.2 CONDUCTORS

- A. Conductors, No. 10 AWG and Smaller: Solid or stranded copper.
- B. Conductors, Larger Than No. 10 AWG: Stranded copper.
- C. Insulation: Thermoplastic, rated at 90 deg C minimum.
- D. Wire Connectors and Splices: Units of size, ampacity rating, material, type, and class suitable for service indicated.

## 2.3 SUPPORTING DEVICES

- A. Material: Structural Aluminum acceptable to authorities having jurisdiction.
- B. Metal Items for Use Outdoors or in Damp Locations.
- C. Slotted Galvanized Steel Channel Supports: Flange edges turned toward web, and 9/16-inch- diameter slotted holes at a maximum of 2 inches o.c., in webs.
- D. Slotted-Steel Channel Supports.
  - 1. Channel Thickness: Selected to suit structural loading.
  - 2. Fittings and Accessories: Products of the same manufacturer as channel supports.
- E. Nonmetallic Channel and Angle Systems: Structural-grade, factory-formed, glass-fiber-resin channels and angles with 9/16-inch- diameter holes at a maximum of 8 inches o.c., in at least one surface.
  - 1. Fittings and Accessories: Products of the same manufacturer as channels and angles.
  - 2. Fittings and Accessory Materials: Same as channels and angles, except metal items may be stainless steel.
- F. Raceway and Cable Supports: Manufactured clevis hangers, riser clamps, straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and spring-steel clamps or click-type hangers.
- G. Cable Supports for Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug for nonarmored electrical cables in riser conduits. Plugs have number and size of conductor gripping holes as required to suit individual risers. Body constructed of malleable-iron casting with hot-dip galvanized finish.
- H. Expansion Anchors: Carbon-steel wedge or sleeve type.
- I. Toggle Bolts: Stainless Steel springhead type.
- J. Powder-Driven Threaded Studs: Heat-treated steel.

## 2.4 ELECTRICAL IDENTIFICATION

- A. Identification Devices: A single type of identification product for each application category. Use colors prescribed by ANSI A13.1, NFPA 70, and these Specifications.
- B. Raceway and Cable Labels: Comply with ANSI A13.1, Table 3, for minimum size of letters for legend and minimum length of color field for each raceway and cable size.

1. Type: Pretensioned, wraparound plastic sleeves. Flexible, preprinted, color-coded, acrylic band sized to suit the diameter of the item it identifies.
  2. Type: Preprinted, flexible, self-adhesive, vinyl. Legend is overlaminated with a clear, weather- and chemical-resistant coating.
  3. Color: Black letters on orange background.
  4. Legend: Indicates voltage.
- C. Colored Adhesive Marking Tape for Raceways, Wires, and Cables: Self-adhesive vinyl tape, not less than **1 inch wide by 3 mils thick** .
- D. Underground Warning Tape: Permanent, bright-colored, continuous-printed, vinyl tape with the following features:
1. Not less than **6 inches wide by 4 mils thick** .
  2. Compounded for permanent direct-burial service.
  3. Embedded continuous metallic strip or core.
  4. Printed legend that indicates type of underground line.
- E. Tape Markers for Wire: Vinyl or vinyl-cloth, self-adhesive, wraparound type with preprinted numbers and letters.
- F. Color-Coding Cable Ties: Type 6/6 nylon, self-locking type. Colors to suit coding scheme.
- G. Engraved-Plastic Labels, Signs, and Instruction Plates: Engraving stock, melamine plastic laminate punched or drilled for mechanical fasteners **1/16-inch** minimum thickness for signs up to **20 sq. in.** and **1/8-inch** minimum thickness for larger sizes. Engraved legend in black letters on white background.
- H. Interior Warning and Caution Signs: Comply with 29 CFR, Chapter XVII, Part 1910.145. Preprinted, aluminum, baked-enamel-finish signs, punched or drilled for mechanical fasteners, with colors, legend, and size appropriate to the application.
- I. Exterior Warning and Caution Signs: Comply with 29 CFR, Chapter XVII, Part 1910.145. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with **0.0396-inch**, galvanized-steel backing, with colors, legend, and size appropriate to the application. **1/4-inch** grommets in corners for mounting.
- J. Fasteners for Nameplates and Signs: Self-tapping, stainless-steel screws or No. 10/32 stainless-steel machine screws with nuts and flat and lock washers.
- 2.5 CONCRETE BASES
- A. Concrete Forms and Reinforcement Materials: As specified in Section "Cast-in-Place Concrete."
  - B. Concrete: **3000-psi** , 28-day compressive strength as specified in Section "Cast-in-Place Concrete."
- 2.6 TOUCHUP PAINT
- A. For Equipment: Equipment manufacturer's paint selected to match installed equipment finish.

## PART 3 - EXECUTION

### 3.1 ELECTRICAL EQUIPMENT INSTALLATION

- A. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide the maximum possible headroom.
- B. Materials and Components: Install level, plumb, and parallel and perpendicular to other building systems and components, unless otherwise indicated.
- C. Equipment: Install to facilitate service, maintenance, and repair or replacement of components. Connect for ease of disconnecting, with minimum interference with other installations.
- D. Right of Way: Give to raceways and piping systems installed at a required slope.

### 3.2 RACEWAY APPLICATION

- A. Use the following raceways for outdoor installations:
  - 1. Exposed: RMC
  - 2. Concealed: RNC.
  - 3. Underground, Single Run: RNC.
  - 4. Underground, Grouped: RNC.
  - 5. Connection to Vibrating Equipment: LFMC.
  - 6. Boxes and Enclosures: NEMA 250 or Type 4x.
- B. Use the following raceways for indoor installations:
  - 1. Exposed: RMC
  - 2. Concealed: EMT .
  - 3. Connection to Vibrating Equipment: LFMC.
  - 4. Damp or Wet Locations: RMC.
  - 5. Boxes and Enclosures: NEMA 250, Type 1, unless otherwise indicated.

### 3.3 RACEWAY AND CABLE INSTALLATION

- A. Conceal raceways and cables, unless otherwise indicated, within finished walls, ceilings, and floors.
- B. Install raceways and cables at least **6 inches** away from parallel runs of flues and steam or hot-water pipes. Locate horizontal raceway runs above water and steam piping.
- C. Use temporary raceway caps to prevent foreign matter from entering.
- D. Make conduit bends and offsets so ID is not reduced. Keep legs of bends in the same plane and straight legs of offsets parallel, unless otherwise indicated.
- E. Use raceway and cable fittings compatible with raceways and cables and suitable for use and location.
- F. Install raceways embedded in slabs in middle third of slab thickness where practical, and leave at least **1-inch** concrete cover.



1. Secure raceways to reinforcing rods to prevent sagging or shifting during concrete placement.
  2. Space raceways laterally to prevent voids in concrete.
  3. Install conduit larger than **1-inch trade size (DN27)** parallel to or at right angles to main reinforcement. Where conduit is at right angles to reinforcement, place conduit close to slab support.
  4. Make bends in exposed parallel or banked runs from same centerline to make bends parallel. Use factory elbows only where elbows can be installed parallel; otherwise, provide field bends for exposed parallel raceways.
- G. Install pull wires in empty raceways. Use No. 14 AWG zinc-coated steel or monofilament plastic line with not less than **200-lb** tensile strength. Leave at least **12 inches** of slack at each end of the pull wire.
- H. Install telephone and signal system raceways, **2-inch trade size** and smaller, in maximum lengths of **150 feet** and with a maximum of two 90-degree bends or equivalent. Separate lengths with pull or junction boxes where necessary to comply with these requirements, in addition to requirements above.
- I. Connect motors and equipment subject to vibration, noise transmission, or movement with a maximum of **72-inch** flexible conduit. Install LFMC in wet or damp locations. Install separate ground conductor across flexible connections.
- J. Set floor boxes level and trim after installation to fit flush to finished floor surface.

#### 3.4 WIRING METHODS FOR POWER, LIGHTING, AND CONTROL CIRCUITS

- A. Feeders: Type THHN insulated conductors in raceway .
- B. Underground Feeders and Branch Circuits: Type THWN single-wire.
- C. Branch Circuits: Type THHN insulated conductors in raceway.
- D. Remote-Control Signaling and Power-Limited Circuits: Type THWN insulated conductors in raceway for Classes 1, 2, and 3, unless otherwise indicated.

#### 3.5 WIRING INSTALLATION

- A. Install splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
- B. Install wiring at outlets with at least **12 inches** of slack conductor at each outlet.
- C. Connect outlet and component connections to wiring systems and to ground. 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.

#### 3.6 ELECTRICAL SUPPORTING DEVICE APPLICATION

- A. Damp Locations and Outdoors: Structural Aluminum materials or nonmetallic, U-channel system components.
- B. Dry Locations: Structural Aluminum materials.
- C. Support Clamps for PVC Raceways: Click-type clamp system.

- D. Selection of Supports: Comply with manufacturer's written instructions.
- E. Strength of Supports: Adequate to carry present and future loads, times a safety factor of at least four; minimum of 200-lb design load.

### 3.7 SUPPORT INSTALLATION

- A. Install support devices to securely and permanently fasten and support electrical components.
- B. Install individual and multiple raceway hangers and riser clamps to support raceways. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assemblies and for securing hanger rods and conduits.
- C. Support parallel runs of horizontal raceways together on trapeze- or bracket-type hangers.
- D. Size supports for multiple raceway installations so capacity can be increased by a 25 percent minimum in the future.
- E. Support individual horizontal raceways with separate, malleable-iron pipe hangers or clamps.
- F. Install 1/4-inch- diameter or larger threaded steel hanger rods, unless otherwise indicated.
- G. Spring-steel fasteners specifically designed for supporting single conduits or tubing may be used instead of malleable-iron hangers for 1-1/2-inch and smaller raceways serving lighting and receptacle branch circuits above suspended ceilings and for fastening raceways to slotted channel and angle supports.
- H. Arrange supports in vertical runs so the weight of raceways and enclosed conductors is carried entirely by raceway supports, with no weight load on raceway terminals.
- I. Simultaneously install vertical conductor supports with conductors.
- J. Separately support cast boxes that are threaded to raceways and used for fixture support. Support sheet-metal boxes directly from the building structure or by bar hangers. If bar hangers are used, attach bar to raceways on opposite sides of the box and support the raceway with an approved fastener not more than 24 inches from the box.
- K. Install metal channel racks for mounting cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices unless components are mounted directly to structural elements of adequate strength.
- L. Install sleeves for cable and raceway penetrations of concrete slabs and walls unless core-drilled holes are used. Install sleeves for cable and raceway penetrations of masonry and fire-rated gypsum walls and of all other fire-rated floor and wall assemblies. Install sleeves during erection of concrete and masonry walls.
- M. Securely fasten electrical items and their supports to the building structure, unless otherwise indicated. Perform fastening according to the following unless other fastening methods are indicated:
  - 1. Wood: Fasten with wood screws or screw-type nails.
  - 2. Masonry: Toggle bolts on hollow masonry units and expansion bolts on solid masonry units.
  - 3. New Concrete: Concrete inserts with machine screws and bolts.
  - 4. Existing Concrete: Expansion bolts.
  - 5. Instead of expansion bolts, threaded studs driven by a powder charge and provided with lock washers may be used in existing concrete.

6. Steel: Welded threaded studs or spring-tension clamps on steel.
  - a. Field Welding: Comply with AWS D1.1.
7. Welding to steel structure may be used only for threaded studs, not for conduits, pipe straps, or other items.
8. Light Steel: Sheet-metal screws.
9. Fasteners: Select so the load applied to each fastener does not exceed 25 percent of its proof-test load.

### 3.8 IDENTIFICATION MATERIALS AND DEVICES

- A. Install at locations for most convenient viewing without interference with operation and maintenance of equipment.
- B. Coordinate names, abbreviations, colors, and other designations used for electrical identification with corresponding designations indicated in the Contract Documents or required by codes and standards. Use consistent designations throughout Project.
- C. Self-Adhesive Identification Products: Clean surfaces before applying.
- D. Identify raceways and cables with color banding as follows:
  1. Bands: Pretensioned, snap-around, colored plastic sleeves or colored adhesive marking tape. Make each color band **2 inches** wide, completely encircling conduit, and place adjacent bands of two-color markings in contact, side by side.
  2. Band Locations: At changes in direction, at penetrations of walls and floors, at **50-foot** maximum intervals in straight runs, and at **25-foot** maximum intervals in congested areas.
  3. Colors: As follows:
    - a. Fire Alarm System: Red.
    - b. Security System: Blue and yellow.
    - c. Telecommunication System: Green and yellow.
- E. Tag and label circuits designated to be extended in the future. Identify source and circuit numbers in each cabinet, pull and junction box, and outlet box. Color-coding may be used for voltage and phase identification.
- F. Install continuous underground plastic markers during trench backfilling, for exterior underground power, control, signal, and communication lines located directly above power and communication lines. Locate **6 to 8 inches** below finished grade. If width of multiple lines installed in a common trench or concrete envelope does not exceed **16 inches**, overall, use a single line marker.
- G. Color-code 208/120-V system secondary service, feeder, and branch-circuit conductors throughout the secondary electrical system as follows:
  1. Phase A: Black.
  2. Phase B: Red.
  3. Phase C: Blue.
  4. Neutral: White.
  5. Ground: Green.

- H. Color-code 480/277-V system secondary service, feeder, and branch-circuit conductors throughout the secondary electrical system as follows:
  - 1. Phase A: Yellow.
  - 2. Phase B: Brown.
  - 3. Phase C: Orange.
  - 4. Neutral: White with a colored stripe or gray.
  - 5. Ground: Green.

### 3.9 UTILITY COMPANY ELECTRICITY-METERING EQUIPMENT

- A. Install equipment according to P.R.E.P.A.'s Standards. Provide grounding and empty conduits as required .

### 3.10 FIRESTOPPING

- A. Apply firestopping to cable and raceway penetrations of fire-rated floor and wall assemblies to achieve fire-resistance rating of the assembly. Firestopping materials and installation requirements are specified in Division 7 Section "Firestopping."

### 3.11 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated, but not less than **4 inches** larger, in both directions, than supported unit. Follow supported equipment manufacturer's anchorage recommendations and setting templates for anchor-bolt and tie locations, unless otherwise indicated. Use **3000-psi** , 28-day compressive-strength concrete and reinforcement as specified in Division 3 Section "Cast-in-Place Concrete."

### 3.12 FIELD QUALITY CONTROL

- A. Inspect installed components for damage and faulty work, including the following:
  - 1. Raceways.
  - 2. Building wire and connectors.
  - 3. Supporting devices for electrical components.
  - 4. Electrical identification.
  - 5. Electricity-metering components.
  - 6. Concrete bases.
  - 7. Electrical demolition.
  - 8. Cutting and patching for electrical construction.
  - 9. Touchup painting.

### 3.13 REFINISHING AND TOUCHUP PAINTING

- A. Refinish and touch up paint. Paint materials and application requirements are specified in Division 9 Section "Painting."

1. Clean damaged and disturbed areas and apply primer, intermediate, and finish coats to suit the degree of damage at each location.
2. Follow paint manufacturer's written instructions for surface preparation and for timing and application of successive coats.
3. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
4. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

3.14 CLEANING AND PROTECTION

- A. On completion of installation, including outlets, fittings, and devices, inspect exposed finish. Remove burrs, dirt, paint spots, and construction debris.
- B. Protect equipment and installations and maintain conditions to ensure that coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

END OF SECTION 16050

## SECTION 16120 - CONDUCTORS AND CABLES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes building wires and cables and associated connectors, splices, and terminations for wiring systems rated 600 V and less.

#### 1.3 SUBMITTALS

- A. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

#### 1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver wires and cables according to NEMA WC 26.

#### 1.5 COORDINATION

- A. Coordinate layout and installation of cables with other installations.
- B. Revise locations and elevations from those indicated, as required to suit field conditions and as approved by Architect.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Wires and Cables:
    - a. American Insulated Wire Corp.; Leviton Manufacturing Co.
    - b. BICC Brand-Rex Company.
    - c. Carol Cable Co., Inc.
    - d. Senator Wire & Cable Company.
    - e. Southwire Company.
  - 2. Connectors for Wires and Cables:

- a. AMP Incorporated.
- b. General Signal; O-Z/Gedney Unit.
- c. Monogram Co.; AFC.
- d. Square D Co.; Anderson.
- e. 3M Company; Electrical Products Division.

## 2.2 BUILDING WIRES AND CABLES

- A. UL-listed building wires and cables with conductor material, insulation type, cable construction, and rating as specified in Part 3 "Wire and Insulation Applications" Article.
- B. Rubber Insulation Material: Comply with NEMA WC 3.
- C. Thermoplastic Insulation Material: Comply with NEMA WC 5.
- D. Cross-Linked Polyethylene Insulation Material: Comply with NEMA WC 7.
- E. Ethylene Propylene Rubber Insulation Material: Comply with NEMA WC 8.
- F. Conductor Material: Copper.
- G. Conductor Material: Copper.
- H. Stranding: Solid conductor for No. 10 AWG and smaller; stranded conductor for larger than No. 10 AWG.

## 2.3 CONNECTORS AND SPLICES

- A. UL-listed, factory-fabricated wiring connectors of size, ampacity rating, material, type, and class for application and service indicated. Comply with Project's installation requirements and as specified in Part 3 "Wire and Insulation Applications" Article.

# PART 3 - EXECUTION

## 3.1 EXAMINATION

- A. Examine raceways and building finishes to receive wires and cables for compliance with requirements for installation tolerances and other conditions affecting performance of wires and cables. Do not proceed with installation until unsatisfactory conditions have been corrected.

## 3.2 WIRE AND INSULATION APPLICATIONS

- A. Feeders: Type THHN in raceway.
- B. Fire-Pump Panel: THHN in raceway.
- C. Branch Circuits: Type THHN, in raceway.
- D. Fire Alarm Circuits: Type THWN, in raceway.

### 3.3 INSTALLATION

- A. Install wires and cables as indicated, according to manufacturer's written instructions and NECA's "Standard of Installation."
- B. Not Used.
- C. Pull Conductors: Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- E. Install exposed cables, parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- F. Support cables according to Division 16 Section "Basic Electrical Materials and Methods."
- G. Seal around cables penetrating fire-rated elements according to Division 7 Section "Firestopping."
- H. Identify wires and cables according to Division 16 Section "Basic Electrical Materials and Methods."
- I. Identify wires and cables according to Division 16 Section "Electrical Identification."

### 3.4 CONNECTIONS

- A. Conductor Splices: Keep to minimum.
- B. Install splices and tapes that possess equivalent or better mechanical strength and insulation ratings than conductors being spliced.
- C. Use splice and tap connectors compatible with conductor material.
- D. Use oxide inhibitor in each splice and tap connector for aluminum conductors.
- E. Wiring at Outlets: Install conductor at each outlet, with at least **12 inches** of slack.
- F. Connect outlets and components to wiring and to ground as indicated and instructed by manufacturer.
- G. 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.

### 3.5 FIELD QUALITY CONTROL

- A. Testing: On installation of wires and cables and before electrical circuitry has been energized, demonstrate product capability and compliance with requirements.
  - 1. Procedures: Perform each visual and mechanical inspection and electrical test stated in NETA ATS, Section 7.3.1. Certify compliance with test parameters.



- B. Correct malfunctioning conductors and cables at Project site, where possible, and retest to demonstrate compliance; otherwise, remove and replace with new units and retest.

END OF SECTION 16120

## SECTION 16130 - RACEWAYS AND BOXES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

- 1. Raceways include the following:

- a. RMC.
    - b. IMC.
    - c. PVC externally coated, rigid steel conduits.
    - d. PVC externally coated, IMC.
    - e. EMT.
    - f. FMC.
    - g. LFMC.
    - h. LFNC.
    - i. RNC.
    - j. Wireways.
    - k. Surface raceways.

- 2. Boxes, enclosures, and cabinets include the following:

- a. Device boxes.
    - b. Floor boxes.
    - c. Outlet boxes.
    - d. Pull and junction boxes.
    - e. Cabinets and hinged-cover enclosures.

- B. Related Sections include the following:

- 1. Division 7 Section "Firestopping."
  - 2. Division 16 Section "Basic Electrical Materials and Methods" for raceways and box supports.
  - 3. Division 16 Section "Wiring Devices" for devices installed in boxes and for floor-box service fittings.

#### 1.3 DEFINITION

- A. EMT: Electrical metallic tubing.
- B. FMC: Flexible metal conduit.
- C. IMC: Intermediate metal conduit.

- D. LFMC: Liquidtight flexible metal conduit.
- E. LFNC: Liquidtight flexible nonmetallic conduit.
- F. RMC: Rigid metal conduit.
- G. RNC: Rigid nonmetallic conduit.

#### 1.4 SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
- B. Shop Drawings: Include layout drawings showing components and wiring for nonstandard boxes, enclosures, and cabinets.

#### 1.5 QUALITY ASSURANCE

- A. Listing and Labeling: Provide raceways and boxes specified in this Section that are listed and labeled.
  - 1. The Terms "Listed" and "Labeled": As defined in NFPA 70, Article 100.
  - 2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" as defined in OSHA Regulation 1910.7.
- B. Comply with NECA's "Standard of Installation."
- C. Comply with NFPA 70.

#### 1.6 COORDINATION

- A. Coordinate layout and installation of raceways and boxes with other construction elements to ensure adequate headroom, working clearance, and access.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Metal Conduit and Tubing:
    - a. Alflex Corp.
    - b. Anamet, Inc.; Anaconda Metal Hose.
    - c. Anixter Brothers, Inc.
    - d. Carol Cable Co., Inc.
    - e. Cole-Flex Corp.
    - f. Electri-Flex Co.

- g. Flexcon, Inc.; Coleman Cable Systems, Inc.
  - h. Grinnell Co.; Allied Tube and Conduit Div.
  - i. Monogram Co.; AFC.
  - j. Spiraduct, Inc.
  - k. Triangle PWC, Inc.
  - l. Wheatland Tube Co.
2. Nonmetallic Conduit and Tubing:
- a. Anamet, Inc.; Anaconda Metal Hose.
  - b. Arnco Corp.
  - c. Breeze-Illinois, Inc.
  - d. Cantex Industries; Harsco Corp.
  - e. Certainteed Corp.; Pipe & Plastics Group.
  - f. Cole-Flex Corp.
  - g. Condux International; Electrical Products.
  - h. Electri-Flex Co.
  - i. George-Ingraham Corp.
  - j. Hubbell, Inc.; Raco, Inc.
  - k. Lamson & Sessions; Carlon Electrical Products.
  - l. R&G Sloan Manufacturing Co., Inc.
  - m. Spiraduct, Inc.
  - n. Thomas & Betts Corp.
  - o. Industrias Vasallo
3. Conduit Bodies and Fittings:
- a. American Electric; Construction Materials Group.
  - b. Crouse-Hinds; Div. of Cooper Industries.
  - c. Emerson Electric Co.; Appleton Electric Co.
  - d. Hubbell, Inc.; Killark Electric Manufacturing Co.
  - e. Lamson & Sessions; Carlon Electrical Products.
  - f. O-Z/Gedney; Unit of General Signal.
  - g. Scott Fetzer Co.; Adalet-PLM.
  - h. Spring City Electrical Manufacturing Co.
4. Metal Wireways:
- a. Hoffman Engineering Co.
  - b. Keystone/Rees, Inc.
  - c. Square D Co.
5. Nonmetallic Wireways:
- a. Hoffman Engineering Co.
  - b. Lamson & Sessions; Carlon Electrical Products.
6. Surface Metal Raceways:
- a. Airey-Thompson Co., Inc.; A-T Power Systems.
  - b. American Electric; Construction Materials Group.
  - c. Butler Manufacturing Co.; Walker Division.
  - d. Wiremold Co. .
7. Surface Nonmetallic Raceways:

- a. Anixter Brothers, Inc.
  - b. Butler Manufacturing Co.; Walker Division.
  - c. Hubbell, Inc.; Wiring Device Division.
  - d. JBC Enterprises, Inc.; Enduro Fiberglass Systems.
  - e. Lamson & Sessions; Carlon Electrical Products.
  - f. Panduit Corp.
  - g. Thermotools Co.
  - h. United Telecom; Premier Telecom Products, Inc.
  - i. Wiremold Co. (The); Electrical Sales Division.
8. Boxes, Enclosures, and Cabinets:
- a. American Electric; FL Industries.
  - b. Butler Manufacturing Co.; Walker Division.
  - c. Crouse-Hinds; Div. of Cooper Industries.
  - d. Electric Panelboard Co., Inc.
  - e. Erickson Electrical Equipment Co.
  - f. Hoffman Engineering Co.; Federal-Hoffman, Inc.
  - g. Hubbell Inc.; Killark Electric Manufacturing Co.
  - h. Hubbell Inc.; Raco, Inc.
  - i. Lamson & Sessions; Carlon Electrical Products.
  - j. O-Z/Gedney; Unit of General Signal.
  - k. Parker Electrical Manufacturing Co.
  - l. Robroy Industries, Inc.; Electrical Division.
  - m. Scott Fetzer Co.; Adalet-PLM.
  - n. Spring City Electrical Manufacturing Co.
  - o. Thomas & Betts Corp.
  - p. Woodhead Industries, Inc.; Daniel Woodhead Co.

## 2.2 METAL CONDUIT AND TUBING

- A. Rigid Steel Conduit: ANSI C80.1.
- B. Rigid Aluminum Conduit: ANSI C80.5.
- C. IMC: ANSI C80.6.
- D. Plastic-Coated Steel Conduit and Fittings: NEMA RN 1.
- E. Plastic-Coated IMC and Fittings: NEMA RN 1.
- F. EMT and Fittings: ANSI C80.3.
  - 1. Fittings: compression type.
- G. FMC: Aluminum.
- H. FMC: Zinc-coated steel.
- I. LFMC: Flexible steel conduit with PVC jacket.
- J. Fittings: NEMA FB 1; compatible with conduit/tubing materials.

### 2.3 NONMETALLIC CONDUIT AND TUBING

- A. RNC: NEMA TC 2, Schedule 40 or 80 PVC.
- B. LFNC: UL 1660.

### 2.4 METAL WIREWAYS

- A. Material: Sheet metal sized and shaped as indicated.
- B. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- C. Select features, unless otherwise indicated, as required to complete wiring system and to comply with NFPA 70.
- D. Wireway Covers: As indicated
- E. Wireway Covers: Hinged type.
- F. Wireway Covers: Screw-cover type.
- G. Wireway Covers: Flanged-and-gasketed type.
- H. Finish: Manufacturer's standard enamel finish.

### 2.5 NONMETALLIC WIREWAYS

- A. Description: Fiberglass polyester, extruded and fabricated to size and shape indicated, with no holes or knockouts. Cover is gasketed with oil-resistant gasket material and fastened with captivated screws treated for corrosion resistance. Connections are flanged, with stainless-steel screws and oil-resistant gaskets.
- B. Description: PVC plastic, extruded and fabricated to size and shape indicated, with snap-on cover and mechanically coupled connections using plastic fasteners.
- C. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- D. Select features, unless otherwise indicated, as required to complete wiring system and to comply with NFPA 70.

### 2.6 SURFACE RACEWAYS

- A. Surface Metal Raceways: Galvanized steel with snap-on covers. Finish with manufacturer's standard prime coating.
- B. Surface Nonmetallic Raceways: 2-piece construction, manufactured of rigid PVC compound with matte texture and manufacturer's standard color.
- C. Types, sizes, and channels as indicated and required for each application, with fittings that match and mate with raceways.

## 2.7 OUTLET AND DEVICE BOXES

- A. Sheet Metal Boxes: NEMA OS 1.
- B. Cast-Metal Boxes: NEMA FB 1, Type FD, cast box with gasketed cover.

## 2.8 FLOOR BOXES

- A. Floor Boxes: Cast metal, fully adjustable, rectangular.
- B. Floor Boxes: Nonmetallic, nonadjustable, round.

## 2.9 PULL AND JUNCTION BOXES

- A. Small Sheet Metal Boxes: NEMA OS 1.
- B. Cast-Metal Boxes: NEMA FB 1, cast aluminum with gasketed cover.

## 2.10 ENCLOSURES AND CABINETS

- A. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous hinge cover and flush latch.
  - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
  - 2. Nonmetallic Enclosures: Plastic, finished inside with radio-frequency-resistant paint.
- B. Cabinets: NEMA 250, Type 1, galvanized steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel. Hinged door in front cover with flush latch and concealed hinge. Key latch to match panelboards. Include metal barriers to separate wiring of different systems and voltage, and include accessory feet where required for freestanding equipment.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine surfaces to receive raceways, boxes, enclosures, and cabinets for compliance with installation tolerances and other conditions affecting performance of raceway installation. Do not proceed with installation until unsatisfactory conditions have been corrected.

### 3.2 WIRING METHODS

- A. Outdoors: Use the following wiring methods:
  - 1. Exposed: RMC
  - 2. Concealed: RNC.
  - 3. Underground, Single Run: RNC.
  - 4. Underground, Grouped: RNC.
  - 5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
  - 6. Boxes and Enclosures: NEMA 250, Type 4X.

- B. Indoors: Use the following wiring methods:
1. Exposed: RMC.
  2. Concealed: EMT.
  3. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC; except in wet or damp locations, use LFMC.
  4. Damp or Wet Locations: RMC.
  5. Boxes and Enclosures: NEMA 250, Type 1, except as follows:
    - a. Damp or Wet Locations: NEMA 250, Type 4, stainless steel.
    - b. Damp or Wet Locations: NEMA 250, Type 4, nonmetallic.

### 3.3 INSTALLATION

- A. Install raceways, boxes, enclosures, and cabinets as indicated, according to manufacturer's written instructions.
- B. Minimum Raceway Size: **3/4-inch trade size**.
- C. Conceal conduit unless otherwise indicated, within finished walls, ceilings, and floors.
- D. Keep raceways at least **6 inches** away from parallel runs of hot-water pipes. Install horizontal raceway runs above water piping.
- E. Install raceways level and square and at proper elevations. Provide adequate headroom.
- F. Complete raceway installation before starting conductor installation.
- G. Support raceways as specified in Division 16 Section "Basic Electrical Materials and Methods."
- H. Use temporary closures to prevent foreign matter from entering raceways.
- I. Protect stub-ups from damage where conduits rise through floor slabs. Arrange so curved portion of bends is not visible above the finished slab.
- J. Make bends and offsets so ID is not reduced. Keep legs of bends in the same plane and straight legs of offsets parallel, unless otherwise indicated.
- K. Use raceway fittings compatible with raceways and suitable for use and location. For intermediate steel conduit, use threaded rigid steel conduit fittings, unless otherwise indicated.
- L. Run concealed raceways, with a minimum of bends, in the shortest practical distance considering the type of building construction and obstructions, unless otherwise indicated.
- M. Raceways Embedded in Slabs: Install in middle third of slab thickness where practical, and leave at least **1-inch** concrete cover.
  1. Secure raceways to reinforcing rods to prevent sagging or shifting during concrete placement.
  2. Space raceways laterally to prevent voids in concrete.
  3. Run conduit larger than **1-inch trade size** parallel to or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
  4. Transition from nonmetallic tubing to Schedule 80 nonmetallic conduit, rigid steel conduit, or IMC before rising above floor.



- N. Install exposed raceways parallel to or at right angles to nearby surfaces or structural members, and follow the surface contours as much as practical.
1. Run parallel or banked raceways together, on common supports where practical.
  2. Make bends in parallel or banked runs from same centerline to make bends parallel. Use factory elbows only where elbows can be installed parallel; otherwise, provide field bends for parallel raceways.
- O. Join raceways with fittings designed and approved for the purpose and make joints tight.
1. Make raceway terminations tight. Use bonding bushings or wedges at connections subject to vibration. Use bonding jumpers where joints cannot be made tight.
  2. Use insulating bushings to protect conductors.
- P. Tighten set screws of threadless fittings with suitable tools.
- Q. Terminations: Where raceways are terminated with locknuts and bushings, align raceways to enter squarely and install locknuts with dished part against the box. Where terminations are not secure with 1 locknut, use 2 locknuts: 1 inside and 1 outside the box.
- R. Where raceways are terminated with threaded hubs, screw raceways or fittings tightly into the hub so the end bears against the wire protection shoulder. Where chase nipples are used, align raceways so the coupling is square to the box and tighten the chase nipple so no threads are exposed.
- S. Install pull wires in empty raceways. Use No. 14 AWG zinc-coated steel or monofilament plastic line with not less than **200-lb** tensile strength. Leave at least **12 inches** of slack at each end of the pull wire.
- T. Telephone and Signal System Raceways, **2-Inch Trade Size** and Smaller: In addition to the above requirements, install raceways in maximum lengths of **150 feet** and with a maximum of two 90-degree bends or equivalent. Separate lengths with pull or junction boxes where necessary to comply with these requirements.
- U. Install raceway sealing fittings according to manufacturer's written instructions. Locate fittings at suitable, approved, and accessible locations and fill them with UL-listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:
1. Where conduits pass from warm to cold locations, such as the boundaries of refrigerated spaces.
  2. Where otherwise required by NFPA 70.
- V. Stub-up Connections: Extend conduits through concrete floor for connection to freestanding equipment. Install with an adjustable top or coupling threaded inside for plugs set flush with the finished floor. Extend conductors to equipment with rigid steel conduit; FMC may be used **6 inches** above the floor. Install screwdriver-operated, threaded flush plugs flush with floor for future equipment connections.
- W. Flexible Connections: Use maximum of **6 feet** of flexible conduit for recessed and semirecessed lighting fixtures; for equipment subject to vibration, noise transmission, or movement; and for all motors. Use liquidtight flexible conduit in wet or damp locations. Install separate ground conductor across flexible connections.
- X. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in a nonmetallic sleeve.
- Y. Do not install aluminum conduits embedded in or in contact with concrete.

- Z. PVC Externally Coated, Rigid Steel Conduits: Use only fittings approved for use with that material. Patch all nicks and scrapes in PVC coating after installing conduits.
  
- AA. Surface Raceways: Install a separate, green, ground conductor in raceways from junction box supplying the raceways to receptacle or fixture ground terminals.
  - 1. Select each surface raceway outlet box, to which a lighting fixture is attached, of sufficient diameter to provide a seat for the fixture canopy.
  - 2. Where a surface raceway is used to supply a fluorescent lighting fixture having central-stem suspension with a backplate and a canopy (with or without extension ring), no separate outlet box is required.
  - 3. Provide surface metal raceway outlet box, and the backplate and canopy, at the feed-in location of each fluorescent lighting fixture having end-stem suspension.
  - 4. Where a surface metal raceway extension is made from an existing outlet box on which a lighting fixture is installed, no additional surface-mounted outlet box is required. Provide a backplate slightly smaller than the fixture canopy.
  
- BB. Set floor boxes level and adjust to finished floor surface.
  
- CC. Set floor boxes level and trim after installation to fit flush to finished floor surface.
  
- DD. Install hinged-cover enclosures and cabinets plumb. Support at each corner.

### 3.4 PROTECTION

- A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure coatings, finishes, and cabinets are without damage or deterioration at the time of Substantial Completion.
  - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
  - 2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

### 3.5 CLEANING

- A. On completion of installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finish, including chips, scratches, and abrasions.

END OF SECTION 16130



## SECTION 16140 - WIRING DEVICES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes receptacles, connectors, switches, and finish plates.

#### 1.3 DEFINITIONS

- A. GFCI: Ground-fault circuit interrupter.

#### 1.4 SUBMITTALS

- A. Product Data: For each product specified.
- B. Shop Drawings: Legends for receptacles and switch plates.
- C. Samples: For devices and device plates for color selection and evaluation of technical features.
- D. Maintenance Data: For materials and products to include in maintenance manuals specified in Division 1.

#### 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.
- B. Comply with NEMA WD 1.
- C. Comply with NFPA 70.

#### 1.6 COORDINATION

- A. Receptacles for Owner-Furnished Equipment: Match plug configurations.
  - 1. Cord and Plug Sets: Match equipment requirements.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Wiring Devices:
    - a. Bryant Electric, Inc.
    - b. GE Company; GE Wiring Devices.
    - c. Hubbell, Inc.; Wiring Devices Div.
    - d. Leviton Manufacturing Co., Inc.
  - 2. Wiring Devices for Hazardous (Classified) Locations:
    - a. Crouse-Hinds Electrical Co.; Distribution Equipment Div.
    - b. Appleton Electric Co.
  - 3. Multioutlet Assemblies:
    - a. Airey-Thompson Co.
    - b. Wiremold.
  - 4. Poke-through, Floor Service Outlets and Telephone/Power Poles:
    - a. Hubbell, Inc.; Wiring Devices Div.
    - b. Pass & Seymour/Legrand; Wiring Devices Div.
    - c. Square D Co.
    - d. Wiremold.

### 2.2 RECEPTACLES

- A. Straight-Blade and Locking Receptacles: Heavy-Duty, Hospital Grade.
- B. GFCI Receptacles: Feed-through type, with integral NEMA WD 6, Configuration 5-20R duplex receptacle. Design units for installation in a ~~2-3/4-inch~~ deep outlet box without an adapter.
- C. Isolated-Ground Receptacles: Equipment grounding contacts connected only to the green grounding screw terminal of the device with inherent electrical isolation from mounting strap.
  - 1. Devices: Listed and labeled as isolated-ground receptacles.
  - 2. Isolation Method: Integral to receptacle construction and not dependent on removable parts.

### 2.3 PENDANT CORD/CONNECTOR DEVICES

- A. Description: Matching, locking type, plug and receptacle body connector, NEMA WD 6, Configurations L5-20P and L5-20R, Heavy-Duty grade.

1. Body: Nylon with screw-open cable-gripping jaws and provision for attaching external cable grip.
2. External Cable Grip: Woven wire-mesh type made of high-strength galvanized-steel wire strand, matched to cable diameter, and with attachment provision designed for corresponding connector.

## 2.4 CORD AND PLUG SETS

- A. Description: Match voltage and current ratings and number of conductors to requirements of equipment being connected.
1. Cord: Rubber-insulated, stranded-copper conductors, with type SOW-A jacket. Green-insulated grounding conductor, and equipment-rating ampacity plus a minimum of 30 percent.
  2. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

## 2.5 SWITCHES

- A. Snap Switches: Heavy-duty, quiet type, Hospital Grade.
- B. Combination Switch and Receptacle: Both devices in a single gang unit with plaster ears and removable tab connector that permit separate or common feed connection.
1. Switch: 20 A, 120/277-V ac.
  2. Receptacle: NEMA WD 6, Configuration 5-15R.
- C. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on/off switches and audible and electromagnetic noise filters.
1. Control: Continuously adjustable slide or, toggle, or rotary knob. Single-pole or three-way switch to suit connections.
  2. Incandescent Lamp Dimmers: Modular, 120 V, 60 Hz with continuously adjustable, toggle, or slide; single pole with soft tap or other quiet switch; electromagnetic filter to eliminate noise, RF, and TV interference; and 5-inch wire connecting leads.
  3. Fluorescent Lamp Dimmers: Modular; compatible with dimmer ballasts; trim potentiometer to adjust low-end dimming; dimmer-ballast combination capable of consistent dimming to a maximum of 1 percent of full brightness.

## 2.6 WALL PLATES

- A. Single and combination types match corresponding wiring devices.
1. Plate-Securing Screws: Metal with head color to match plate finish.
  2. Material for Finished Spaces: As selected by architect.
  3. Material for Unfinished Spaces: Galvanized steel.

## 2.7 FLOOR SERVICE FITTINGS

- A. Type: Modular, flush-type, dual-service units suitable for wiring method used Bronze Trim.

## 2.8 POKE-THROUGH ASSEMBLIES

- A. Description: Factory-fabricated and -wired assembly of below-floor junction box unit with multichanneled, through-floor raceway/firestop unit and detachable matching floor service-outlet assembly.
1. Size: Selected to fit nominal **3-inch** cored holes in floor and matched to floor thickness.
  2. Fire Rating: Unit is listed and labeled for fire rating of floor-ceiling assembly.
  3. Closure Plug: Arranged to close unused **3-inch** cored openings and reestablish fire rating of floor.
  4. Wiring: Three No. 12 AWG power and ground conductors; one 75-ohm coaxial telephone/data cable; and one four-pair, 75-ohm telephone/data cable.

## 2.9 FINISHES

- A. Color: To be selected by architect.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install devices and assemblies plumb and secure.
- B. Install wall plates when painting is complete.
- C. Install wall dimmers to achieve indicated rating after derating for ganging as instructed by manufacturer.
- D. Do not share neutral conductor on load side of dimmers.
- E. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical, and grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.
- F. Protect devices and assemblies during painting.
- G. Adjust locations at which floor service outlets and telephone/power service poles are installed to suit arrangement of partitions and furnishings.

### 3.2 IDENTIFICATION

- A. Comply with Division 16 Section "Basic Electrical Materials and Methods."
1. Switches: Where two or more switches of different phase are ganged, provide box barriers.
  2. Receptacles: Identify panelboard and circuit number from which served. Use durable wire markers or tags within outlet boxes.

### 3.3 CONNECTIONS

- A. Connect wiring device grounding terminal to outlet box with bonding jumper.
- B. Connect wiring device grounding terminal to branch-circuit equipment grounding conductor.

- C. Isolated-Ground Receptacles: Connect to isolated-ground conductor routed to designated isolated equipment ground terminal of electrical system.
- D. Tighten electrical connectors and terminals according to manufacturers published torque-tightening values. If manufacturers torque values are not indicated, use those specified in UL 486A and UL 486B.

#### 3.4 FIELD QUALITY CONTROL

- A. Test wiring devices for proper polarity and ground continuity. Operate each device at least six times.
- B. Check TVSS receptacle indicating lights for normal indication.
- C. Test GFCI operation with both local and remote fault simulations according to manufacturer's written instructions.
- D. Replace damaged or defective components.

#### 3.5 CLEANING

- A. Internally clean devices, device outlet boxes, and enclosures. Replace stained or improperly painted wall plates or devices.

END OF SECTION 16140





## SECTION 16415 - TRANSFER SWITCHES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes transfer switches rated 600 V and less, including the following:
  - 1. Automatic transfer switch.
  - 2. Automatic closed-transition transfer switch.
  - 3. Bypass/isolation switch.
  - 4. Nonautomatic transfer switch.
  - 5. Remote annunciation system.
  - 6. Remote annunciation and control system.
- B. Related Sections include the following:
  - 1. Division 13 Section "Electric-Drive, Horizontal Fire Pumps" for automatic transfer switches for fire pumps.
  - 2. Division 13 Section "Electric-Drive, Vertical-Turbine Fire Pumps" for automatic transfer switches for fire pumps.

#### 1.3 SUBMITTALS

- A. Product Data: Include ratings and dimensioned plans, sections, and elevations showing minimum clearances, conductor entry provisions, gutter space, installed features and devices, and material lists for each switch specified.
- B. Wiring Diagrams: Detail wiring for transfer switches and differentiate between manufacturer-installed and field-installed wiring. Show both power and control wiring.
- C. Single-Line Diagram: Show connections between transfer switch, bypass/isolation switch, power sources, and load; and show interlocking provisions for each combined transfer switch and bypass/isolation switch.
- D. Product Certificates: Signed by manufacturer certifying that products furnished comply with requirements and that switches have been tested for load ratings and short-circuit closing and withstand ratings applicable to units for Project.
- E. Qualification Data: For firms and persons specified in "Quality Assurance" Article.
- F. Field Test Reports: Indicate and interpret test and inspection results for compliance with performance requirements.

- G. Maintenance Data: For each type of product to include in maintenance manuals specified in Division 1. Include all features and operating sequences, both automatic and manual. List all factory settings of relays and provide relay-setting and calibration instructions, including software, where applicable.

#### 1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Maintain a service center capable of providing emergency maintenance and repairs at Project site with an eight-hour maximum response time.
- B. Testing Agency Qualifications: Testing agency as defined by OSHA in 29 CFR 1910.7 or a member company of the InterNational Electrical Testing Association and that is acceptable to authorities having jurisdiction.
  - 1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies (Level 3 or higher), to supervise on-site testing specified in Part 3.
- C. Source Limitations: Obtain automatic transfer switch, bypass/isolation switch, nonautomatic transfer switch, remote annunciators, and remote annunciator and control panels through one source from a single manufacturer.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, for emergency service under UL 1008, by a testing agency acceptable to authorities having jurisdiction.
- E. Comply with NEMA ICS 1.
- F. Comply with NFPA 70.
- G. Comply with NFPA 99.
- H. Comply with NFPA 110.
- I. Comply with UL 1008, unless requirements of these Specifications are stricter.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Conventional Transfer Switches:
    - a. Cutler Hammer
    - b. Automatic Switch Co.
    - c. Onan Corp.; Electrical Products Division.
    - d. Russelectric, Inc.

## 2.2 GENERAL TRANSFER-SWITCH PRODUCT REQUIREMENTS

- A. Indicated Current Ratings: Apply as defined in UL 1008 for continuous loading and total system transfer, including tungsten filament lamp loads not exceeding 30 percent of switch ampere rating, unless otherwise indicated.
- B. Tested Fault-Current Closing and Withstand Ratings: Adequate for duty imposed by protective devices at installation locations in Project under the fault conditions indicated, based on testing according to UL 1008.
  - 1. Where Transfer Switch Includes Internal Fault-Current Protection: Rating of switch and trip unit combination exceeds indicated fault-current value at installation location.
- C. Annunciation, Control, and Programming Interface Components: Devices at transfer switches for communicating with remote programming devices, annunciators, or annunciator and control panels have communications capability matched with remote device.
- D. Solid-State Controls: Repetitive accuracy of all settings is plus or minus 2 percent or better over an operating temperature range of minus 20 to plus 70 deg C.
- E. Resistance to Damage by Voltage Transients: Components meet or exceed voltage-surge withstand capability requirements when tested according to IEEE C62.41. Components meet or exceed voltage-impulse withstand test of NEMA ICS 1.
- F. Neutral: As shown on drawings.
- G. Oversize Neutral: Ampacity and switch rating of neutral path through units indicated for oversize neutral are double nominal rating of circuit in which switch is installed.
- H. Enclosures: General-purpose NEMA 250, Type 1, complying with NEMA ICS 6; UL 508, unless otherwise indicated.
- I. Heater: Equip switches exposed to outdoor temperature and humidity conditions, and other units indicated, with an internal heater. Provide thermostat within enclosure to control heater.
- J. Factory Wiring: Train and bundle factory wiring and label consistent with Shop Drawings, either by color code or by numbered or lettered wire and cable tape markers at terminations.
  - 1. Designated Terminals: Pressure type suitable for types and sizes of field wiring indicated.
  - 2. Power-Terminal Arrangement and Field-Wiring Space: Suitable for top, side, or bottom entrance of feeder conductors as indicated.
  - 3. Control Wiring: Equipped with lugs suitable for connection to terminal strips.
- K. Electrical Operation: Accomplish by a nonfused, momentarily energized solenoid or electric-motor-operated mechanism, mechanically and electrically interlocked in both directions.
- L. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.
  - 1. Limitation: Switches using molded-case switches or circuit breakers or insulated-case circuit-breaker components are not acceptable.
  - 2. Switch Action: Double throw; mechanically held in both directions.
  - 3. Contacts: Silver composition or silver alloy for load-current switching. Conventional automatic transfer-switch units rated 225 A and greater have separate arcing contacts.

## 2.3 AUTOMATIC TRANSFER SWITCHES

- A. Comply with Level 1 equipment according to NFPA 110.
- B. Switching Arrangement: Double-throw type, incapable of pauses or intermediate position stops during normal functioning, unless otherwise indicated.
- C. Manual Switch Operation: Under load, with door closed and with either or both sources energized. Transfer time is the same as for electrical operation. Control circuit automatically disconnects from electrical operator during manual operation.
- D. Manual Switch Operation: Unloaded. Control circuit automatically disconnects from electrical operator during manual operation.
- E. Signal-before-Transfer Contacts: A set of normally open/normally closed dry contacts operates in advance of retransfer to normal source. Interval is adjustable from 1 to 30 seconds.
- F. Digital Communications Interface: Matched to capability of remote annunciator or annunciator and control panel.
- G. Motor Disconnect and Timing Relay: Controls designate starters so they disconnect motors before transfer and reconnect them selectively at an adjustable time interval after transfer. Control connection to motor starters is through wiring external to automatic transfer switch. Time delay for reconnecting individual motor loads is adjustable between 1 and 60 seconds, and settings are as indicated. Relay contacts handling motor-control circuit inrush and seal currents are rated for actual currents to be encountered.
- H. Programmed Neutral Switch Position: Switch operator has a programmed neutral position arranged to provide a midpoint between the two working switch positions, with an intentional, time-controlled pause at midpoint during transfer. Pause is adjustable from 0.5 to 10 seconds factory set for 0.5 second, unless otherwise indicated. Time delay occurs for both transfer directions. Pause is disabled, unless both sources are live.

## 2.4 AUTOMATIC TRANSFER-SWITCH FEATURES

- A. Undervoltage Sensing for Each Phase of Normal Source: Senses low phase-to-ground voltage on each phase. Pickup voltage is adjustable from 85 to 100 percent of nominal, and dropout voltage is adjustable from 75 to 98 percent of pickup value. Factory set for pickup at 90 percent and dropout at 85 percent.
- B. Time delay for override of normal-source voltage sensing delays transfer and engine start signals. Adjustable from zero to six seconds, and factory set for one second.
- C. Voltage/Frequency Lockout Relay: Prevents premature transfer to generator set. Pickup voltage is adjustable from 85 to 100 percent of nominal. Factory set for pickup at 90 percent. Pickup frequency is adjustable from 90 to 100 percent of nominal. Factory set for pickup at 95 percent.
- D. Time Delay for Retransfer to Normal Source: Adjustable from 0 to 30 minutes; factory set for 10 minutes. Provides automatic defeat of delay on loss of voltage or sustained undervoltage of emergency source, provided normal supply has been restored.
- E. Test Switch: Simulates normal-source failure.
- F. Switch-Position Pilot Lights: Indicate source to which load is connected.

- G. Source-Available Indicating Lights: Supervise sources via transfer-switch, normal- and emergency-source sensing circuits.
  - 1. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."
  - 2. Emergency Power Supervision: Red light with nameplate engraved "Emergency Source Available."
- H. Unassigned Auxiliary Contacts: Two normally open single-pole, double-throw contacts for each switch position, rated 10 A at 240-V ac.
- I. Transfer Override Switch: Overrides automatic retransfer control so automatic transfer switch will remain connected to emergency power source regardless of condition of normal source. Pilot light indicates override status.
- J. Engine Starting Contacts: One isolated, normally closed and one isolated, normally open, rated 10 A at 32-V dc minimum.
- K. Engine Shutdown Contacts: Time delay adjustable from zero to five minutes; factory set for five minutes. Initiates shutdown at remote engine-generator controls after retransfer of load to normal source.
- L. Engine-Generator Exerciser: Solid-state, programmable-time switch starts engine-generator set and transfers load to it from normal source for a preset time, then retransfers and shuts down engine after a preset cool-down period. Initiates exercise cycle at preset intervals adjustable from 7 to 30 days. Running periods are adjustable from 10 to 30 minutes. Factory settings are for 7-day exercise cycle, 20-minute running period, and 5-minute cool-down period. Exerciser features include the following:
  - 1. Exerciser Transfer Selector Switch: Permits selection of exercise with and without load transfer.
  - 2. Push-button programming control with digital display of settings.
  - 3. Integral battery operation of time switch when normal control power is not available.

## 2.5 BYPASS/ISOLATION SWITCHES

- A. Comply with requirements for Level 1 equipment per NFPA 110.
- B. Description: Manual type, arranged to select and connect either source of power directly to load, isolating transfer switch from load and from both power sources. Include the following features for each combined automatic transfer switch and bypass/isolation switch:
  - 1. Means to lock bypass/isolation in the position that isolates transfer switch, with an arrangement that permits complete electrical testing of transfer switch while isolated. While isolated, interlocks prevent transfer-switch operation, except for testing or maintenance.
  - 2. Drawout Arrangement for Transfer Switch: Provides physical separation from live parts and accessibility for testing and maintenance operations.
  - 3. Bypass/Isolation Switch Current, Voltage, Closing, and Short-Circuit Withstand Ratings: Equal to or greater than those of associated automatic transfer switch, and with the same phase arrangement and number of poles.
  - 4. Contact temperatures of bypass/isolation switches do not exceed those of automatic transfer-switch contacts when they are carrying rated load.
  - 5. Operability: Constructed so load bypass and transfer-switch isolation can be performed by one person in no more than two operations in 15 seconds or less.
  - 6. Legend: Manufacturer's standard legend for control labels and instruction signs give detailed operating instructions.
  - 7. Maintainability: Fabricate to allow convenient removal of major components from the front without removing other parts or main power conductors.

- C. Interconnection of Bypass/Isolation Switches with Automatic Transfer Switches: Factory-installed copper bus bars, plated at connection points and braced for the indicated available short-circuit current.

## 2.6 REMOTE ANNUNCIATOR SYSTEM

- A. Functional Description: Remote annunciator panel annunciates conditions for indicated transfer switches. Annunciation includes the following:
  - 1. Sources available, as defined by actual pickup and dropout settings of transfer-switch controls.
  - 2. Switch position.
  - 3. Switch in test mode.
  - 4. Failure of communications link.
- B. Annunciator Panel: LED-lamp type with audible signal and silencing switch.
  - 1. Indicating Lights: Grouped for each transfer switch monitored.
  - 2. Label each group indicating transfer switch it monitors, location of switch, and identity of load it serves.
  - 3. Mounting: Flush, modular, steel cabinet, unless otherwise indicated.
  - 4. Lamp Test: Push-to-test or lamp-test switch on front panel.

## 2.7 REMOTE ANNUNCIATOR AND CONTROL SYSTEM

- A. Functional Description: Include the following functions for indicated transfer switches:
  - 1. Indication of sources available, as defined by actual pickup and dropout settings of transfer-switch controls.
  - 2. Indication of switch position.
  - 3. Indication of switch in test mode.
  - 4. Indication of failure of digital communications link.
  - 5. Key-switch or user-code access to control functions of panel.
  - 6. Control of switch-test initiation.
  - 7. Control of switch operation in either direction.
  - 8. Control of time-delay bypass for transfer to normal source.
- B. Malfunction of annunciator, annunciation and control panel, or communications link shall not affect functions of automatic transfer switch. In the event of failure of the communications link, automatic transfer switch automatically reverts to standalone, self-contained operation. Automatic transfer-switch sensing, controlling, or operating function shall not depend on remote panel for proper operation.
- C. Remote Annunciation and Control Panel: Solid-state components. Include the following features:
  - 1. Controls and indicating lights grouped together for each transfer switch.
  - 2. Label each indicating light control group. Indicate the transfer switch it controls, location of the switch, and the load it serves.
  - 3. Digital Communications Capability: Matched to that of transfer switches supervised.
  - 4. Mounting: Flush, modular, steel cabinet, unless otherwise indicated.

## 2.8 FINISHES

- A. Enclosures: Manufacturer's standard enamel over corrosion-resistant pretreatment and primer.

## 2.9 SOURCE QUALITY CONTROL

- A. Factory Test Components, Assembled Switches, and Associated Equipment: Ensure proper operation. Check transfer time and voltage, frequency, and time-delay settings for compliance with specified requirements. Perform dielectric strength test complying with NEMA ICS 1.

## PART 3 - EXECUTION

### 3.1 APPLICATION

- A. Four-Pole Switches: Where four-pole switches are indicated, install neutral switching.

### 3.2 INSTALLATION

- A. Floor-Mounted Switch: Level and anchor unit to floor.
- B. Annunciator and Control Panel Mounting: Flush in wall, unless otherwise indicated.
- C. Identify components according to Division 16 Section "Basic Electrical Materials and Methods."
- D. Identify components according to Division 16 Section "Electrical Identification."

### 3.3 WIRING TO REMOTE COMPONENTS

- A. Match type and number of cables and conductors to control and communications requirements of transfer switches as recommended by manufacturer. Increase raceway sizes at no additional cost to Owner if necessary to accommodate required wiring.

### 3.4 CONNECTIONS

- A. Ground equipment as indicated and as required by NFPA 70.

### 3.5 FIELD QUALITY CONTROL

- A. Testing: Test transfer-switch products by operating them in all modes. Perform tests recommended by manufacturer under the supervision of manufacturer's factory-authorized service representative. Correct deficiencies and report results in writing. Record adjustable relay settings.
- B. Testing: Perform the following field quality-control testing under the supervision of the manufacturer's factory-authorized service representative in addition to tests recommended by the manufacturer:
  - 1. Before energizing equipment, after transfer-switch products have been installed:
    - a. Measure insulation resistance phase-to phase and phase-to-ground with insulation-resistance tester. Include external annunciation and control circuits. Use test voltages and procedure recommended by manufacturer. Meet manufacturer's specified minimum resistance.
    - b. Check for electrical continuity of circuits and for short circuits.



- c. Inspect for physical damage; proper installation and connection; and integrity of barriers, covers, and safety features.
  - d. Verify that manual transfer warnings are properly placed.
  - e. Perform manual transfer operation.
2. After energizing circuits, demonstrate interlocking sequence and operational function for each switch at least three times.
- a. Simulate power failures of normal source to automatic transfer switches and of emergency source with normal source available.
  - b. Simulate loss of phase-to-ground voltage for each phase of normal source.
  - c. Verify time-delay settings.
  - d. Verify pickup and dropout voltages by data readout or inspection of control settings.
  - e. Test bypass/isolation unit functional modes and related automatic transfer-switch operations.
  - f. Perform contact-resistance test across main contacts and correct values exceeding 500 microhms and values for one pole deviating by more than 50 percent from other poles.
  - g. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown sequence.
- C. Ground-Fault Tests: Coordinate with testing of ground-fault protective devices for power delivery from both sources.
- 1. Assist in verifying grounding connections and locations and ratings of sensors.
  - 2. Assist in observing reaction of circuit-interrupting devices when simulated fault current is applied at sensors.
- D. Coordinate tests with tests of generator plant and run them concurrently.
- E. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation and contact resistances and time delays. Attach a label or tag to each tested component indicating satisfactory completion of tests.

### 3.6 CLEANING

- A. After completing equipment installation, inspect unit components. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.
- B. Clean equipment internally, on completion of installation, according to manufacturer's written instructions.

### 3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's personnel to adjust, operate, and maintain transfer switches and related equipment as specified below:
  - 1. Coordinate this training with that for generator equipment.
  - 2. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining equipment.
  - 3. Review data in maintenance manuals. Refer to Division 1 Section "Contract Closeout."
  - 4. Review data in maintenance manuals. Refer to Division 1 Section "Operation and Maintenance Data."

5. Schedule training with Owner, through Architect, with at least seven days' advance notice.
6. Provide a minimum of four hours of instruction.

END OF SECTION 16415



## SECTION 16420 - ENCLOSED CONTROLLERS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes ac general-purpose controllers rated 600 V and less that are supplied as enclosed units.
- B. Related Sections include the following:
  - 1. Division 16 Section "Electrical Power Monitoring and Control" for monitoring and control of motor circuits.
  - 2. Division 16 Section "Transient Voltage Suppression" for low-voltage power, control, and communication surge suppressors.
  - 3. Division 16 Section "Fuses" for fuses in fusible switches.

#### 1.3 SUBMITTALS

- A. Product Data: For each type of enclosed controller. Include dimensions and manufacturer's technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each enclosed controller.
  - 1. Dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings. Include the following:
    - a. Enclosure types and details.
    - b. Nameplate legends.
    - c. Short-circuit current rating of integrated unit.
    - d. UL listing for series rating of overcurrent protective devices in combination controllers.
    - e. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices in combination controllers.
  - 2. Wiring Diagrams: Power, signal, and control wiring. Differentiate between manufacturer-installed and field-installed wiring.
- C. Coordination Drawings: Floor plans showing dimensioned layout, required working clearances, and required area above and around enclosed controllers where pipe and ducts are prohibited. Show enclosed controller layout and relationships between electrical components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate field measurements.

- D. **Manufacturer Seismic Qualification Certification:** Submit certification that enclosed controllers, accessories, and components will withstand seismic forces defined in Division 16 Section "Seismic Controls for Electrical Work." Include the following:
1. **Basis for Certification:** Indicate whether withstand certification is based on actual test of assembled components or on calculation.
    - a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
    - b. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
  2. **Dimensioned Outline Drawings of Equipment Unit:** Identify center of gravity and locate and describe mounting and anchorage provisions.
  3. **Detailed description of equipment anchorage devices** on which the certification is based and their installation requirements.
- E. **Qualification Data:** For firms and persons specified in "Quality Assurance" Article.
- F. **Field Test Reports:** Written reports specified in Part 3.
- G. **Manufacturer's field service report.**
- H. **Maintenance Data:** For enclosed controllers and components to include in maintenance manuals specified in Division 1. In addition to requirements specified in Division 1 Section "Closeout Procedures," include the following:
1. Routine maintenance requirements for enclosed controllers and all installed components.
  2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
- I. **Load-Current and Overload-Relay Heater List:** Compile after motors have been installed and arrange to demonstrate that selection of heaters suits actual motor nameplate full-load currents.
- J. **Load-Current and List of Settings of Adjustable Overload Relays:** Compile after motors have been installed and arrange to demonstrate that dip switch settings for motor running overload protection suit actual motor to be protected.

#### 1.4 QUALITY ASSURANCE

- A. **Manufacturer Qualifications:** Maintain, within 100 miles (160 km) of Project site, a service center capable of providing training, parts, and emergency maintenance and repairs.
- B. **Testing Agency Qualifications:** An independent testing agency with the experience and capability to satisfactorily conduct the testing indicated, as documented according to ASTM E 548.
- C. **Source Limitations:** Obtain enclosed controllers of a single type through one source from a single manufacturer.
- D. **Electrical Components, Devices, and Accessories:** Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

- E. Comply with NFPA 70.
- F. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed controllers, including clearances between enclosed controllers, and for adjacent surfaces and other items. Comply with indicated maximum dimensions.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store enclosed controllers indoors in clean, dry space with uniform temperature to prevent condensation. Protect enclosed controllers from exposure to dirt, fumes, water, corrosive substances, and physical damage.
- B. If stored in areas subjected to weather, cover enclosed controllers to protect from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside controllers; install electric heating of sufficient wattage to prevent condensation.

#### 1.6 PROJECT CONDITIONS

- A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
  - 1. Notify Architect at least two days in advance of proposed utility interruptions. Identify extent and duration of utility interruptions.
  - 2. Indicate method of providing temporary utilities.
  - 3. Do not proceed with utility interruptions without Architect's written permission.

#### 1.7 COORDINATION

- A. Coordinate layout and installation of enclosed controllers with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3 Section "Cast-in-Place Concrete."
- C. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 7 Section "Roof Accessories."
- D. Coordinate features of enclosed controllers and accessory devices with pilot devices and control circuits to which they connect.
- E. Coordinate features, accessories, and functions of each enclosed controller with ratings and characteristics of supply circuit, motor, required control sequence, and duty cycle of motor and load.

#### 1.8 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. Spare Fuses: Furnish one spare for every five installed, but not less than one set of three of each type and rating.
2. Indicating Lights: Two of each type installed.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Manual and Magnetic Enclosed Controllers:
    - a. ABB Power Distribution, Inc.; ABB Control, Inc. Subsidiary.
    - b. General Electrical Distribution & Control.
    - c. Siemens Controls.
    - d. Square D Co.
    - e. Cutler Hammer

### 2.2 MANUAL ENCLOSED CONTROLLERS

- A. Description: NEMA ICS 2, general purpose, Class A, with toggle action and overload element.

### 2.3 MAGNETIC ENCLOSED CONTROLLERS

- A. Description: NEMA ICS 2, Class A, full voltage, nonreversing, across the line, unless otherwise indicated.
- B. Control Circuit: 120 V; obtained from integral control power transformer of sufficient capacity to operate connected pilot, indicating and control devices, plus 100 percent spare capacity.
- C. Combination Controller: Factory-assembled combination controller and disconnect switch.
  1. Fusible Disconnecting Means: NEMA KS 1, heavy-duty, fusible switch with rejection-type fuse clips rated for fuses. Select and size fuses to provide Type 2 protection according to IEC 947-4-1, as certified by a nationally recognized testing laboratory.
  2. Nonfusible Disconnecting Means: NEMA KS 1, heavy-duty, nonfusible switch.
  3. Circuit-Breaker Disconnecting Means: NEMA AB 1, motor-circuit protector with field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.
- D. Overload Relay: Ambient-compensated type with inverse-time-current characteristic. Provide with heaters or sensors in each phase matched to nameplate full-load current of specific motor to which they connect and with appropriate adjustment for duty cycle.
- E. Adjustable Overload Relay: Dip switch selectable for motor running overload protection, and selected to protect motor against voltage and current unbalance and single phasing. Provide relay with Class II ground-fault protection, with start and run delays to prevent nuisance trip on starting.

- F. Solid-State, Reduced-Voltage Controller: NEMA ICS 2, suitable for use with NEMA MG 1, Design B, polyphase, medium induction motors.
1. Adjustable acceleration rate control utilizing voltage or current ramp, and adjustable starting torque control with up to 500 percent current limitation for 20 seconds.
  2. Surge suppressor in solid-state power circuits providing 3-phase protection against damage from supply voltage surges 10 percent or more above nominal line voltage.
  3. LED indicators showing motor and control status, including the following conditions:
    - a. Control power available.
    - b. Controller on.
    - c. Overload trip.
    - d. Loss of phase.
    - e. Shorted silicon-controlled rectifier.
  4. Automatic voltage-reduction controls to reduce voltage when motor is running at light load.
  5. Motor running contactor operating automatically when full voltage is applied to motor.

## 2.4 ENCLOSURES

- A. Description: Flush- or surface-mounted cabinets as indicated. NEMA 250, Type 1, unless otherwise indicated to comply with environmental conditions at installed location.
1. Outdoor Locations: NEMA 250, Type 4X Stainless Steel.
  2. Kitchen Areas: NEMA 250, Type 4X, stainless steel.
  3. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
  4. Hazardous Areas Indicated on Drawings: NEMA 250, Type 7C.

## 2.5 ACCESSORIES

- A. Devices shall be factory installed in controller enclosure, unless otherwise indicated.
- B. Push-Button Stations, Pilot Lights, and Selector Switches: NEMA ICS 2, heavy-duty type.
- C. Stop and Lockout Push-Button Station: Momentary-break, push-button station with a factory-applied hasp arranged so padlock can be used to lock push button in depressed position with control circuit open.
- D. Control Relays: Auxiliary and adjustable time-delay relays.
- E. Elapsed Time Meters: Heavy duty with digital readout in hours.
- F. Meters: Panel type, 2-1/2-inch (64-mm) minimum size with 90- or 120-degree scale and plus or minus 2 percent accuracy. Where indicated, provide transfer device with an off position. Meters shall indicate the following:
1. Ammeter: Output current, with current sensors rated to suit application.
  2. Voltmeter: Output voltage.
  3. Frequency Meter: Output frequency.
- G. Multifunction Digital-Metering Monitor: UL-listed or -recognized, microprocessor-based unit suitable for three- or four-wire systems and with the following features:



1. Inputs from sensors or 5-A current-transformer secondaries, and potential terminals rated to 600 V.
  2. Switch-selectable digital display of the following:
    - a. Phase Currents, Each Phase: Plus or minus 1 percent.
    - b. Phase-to-Phase Voltages, Three Phase: Plus or minus 1 percent.
    - c. Phase-to-Neutral Voltages, Three Phase: Plus or minus 1 percent.
    - d. Three-Phase Real Power: Plus or minus 2 percent.
    - e. Three-Phase Reactive Power: Plus or minus 2 percent.
    - f. Power Factor: Plus or minus 2 percent.
    - g. Frequency: Plus or minus 0.5 percent.
    - h. Integrated Demand with Demand Interval Selectable from 5 to 60 Minutes: Plus or minus 2 percent.
    - i. Accumulated energy, in megawatt hours (joules), plus or minus 2 percent; stored values unaffected by power outages for up to 72 hours.
  3. Mounting: Display and control unit flush or semiflush mounted in instrument compartment door.
- H. Phase-Failure and Undervoltage Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connection. Provide adjustable undervoltage setting.
- I. Current-Sensing, Phase-Failure Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connection; arranged to operate on phase failure, phase reversal, current unbalance of from 30 to 40 percent, or loss of supply voltage; with adjustable response delay.

## 2.6 FACTORY FINISHES

- A. Manufacturer's standard prime-coat finish ready for field painting.
- B. Finish: Manufacturer's standard paint applied to factory-assembled and -tested enclosed controllers before shipping.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas and surfaces to receive enclosed controllers for compliance with requirements, installation tolerances, and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 APPLICATIONS

- A. Select features of each enclosed controller to coordinate with ratings and characteristics of supply circuit and motor; required control sequence; duty cycle of motor, drive, and load; and configuration of pilot device and control circuit affecting controller functions.
- B. Select horsepower rating of controllers to suit motor controlled.

### 3.3 INSTALLATION

- A. See Division 16 Section "Basic Electrical Materials and Methods" for general installation requirements.
- B. For control equipment at walls, bolt units to wall or mount on lightweight structural-steel channels bolted to wall. For controllers not at walls, provide freestanding racks complying with Division 16 Section "Basic Electrical Materials and Methods."
- C. Install freestanding equipment on concrete bases complying with Division 3 Section "Cast-in-Place Concrete."
- D. Comply with mounting and anchoring requirements specified in Division 16 Section "Seismic Controls for Electrical Work."
- E. Enclosed Controller Fuses: Install fuses in each fusible switch. Comply with requirements in Division 16 Section "Fuses."

### 3.4 IDENTIFICATION

- A. Identify enclosed controller components and control wiring according to Division 16 Section "Basic Electrical Materials and Methods."

### 3.5 CONTROL WIRING INSTALLATION

- A. Install wiring between enclosed controllers according to Division 16 Section "Conductors and Cables."
- B. Bundle, train, and support wiring in enclosures.
- C. Connect hand-off-automatic switch and other automatic-control devices where applicable.
  1. Connect selector switches to bypass only manual- and automatic-control devices that have no safety functions when switch is in hand position.
  2. Connect selector switches with enclosed controller circuit in both hand and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

### 3.6 CONNECTIONS

- A. Conduit installation requirements are specified in other Division 16 Sections. Drawings indicate general arrangement of conduit, fittings, and specialties.
- B. Ground equipment.
- C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

### 3.7 FIELD QUALITY CONTROL

- A. Prepare for acceptance tests as follows:
  1. Test insulation resistance for each enclosed controller bus, component, connecting supply, feeder, and control circuit.
  2. Test continuity of each circuit.

- B. Testing: Owner will engage a qualified testing agency to perform the following field quality-control testing:
- C. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including pretesting and adjusting solid-state controllers.
- D. Test Reports: Prepare a written report to record the following:
  - 1. Test procedures used.
  - 2. Test results that comply with requirements.
  - 3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

### 3.8 ADJUSTING

- A. Set field-adjustable switches and circuit-breaker trip ranges.

### 3.9 CLEANING

- A. Clean enclosed controllers internally, on completion of installation, according to manufacturer's written instructions. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

### 3.10 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
- B. Verify that enclosed controllers are installed and connected according to the Contract Documents.
- C. Verify that electrical wiring installation complies with manufacturer's submittal and installation requirements in Division 16 Sections.
- D. Complete installation and startup checks according to manufacturer's written instructions.

### 3.11 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain enclosed controllers and variable-frequency drives.
  - 1. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining equipment and schedules.
  - 2. Review data in maintenance manuals. Refer to Division 1 Section "Closeout Procedures."
  - 3. Review data in maintenance manuals. Refer to Division 1 Section "Operation and Maintenance Data."
  - 4. Schedule training with Owner, through Architect, with at least seven days' advance notice.

END OF SECTION 16420

## SECTION 16442 - PANELBOARDS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes load centers and panelboards, overcurrent protective devices, and associated auxiliary equipment rated 600 V and less for the following types:
  - 1. Lighting and appliance branch-circuit panelboards.
  - 2. Distribution panelboards.
  - 3. Transient voltage surge suppressor panelboards.
- B. Related Sections include the following:
  - 1. Division 16 Section "Fuses."
  - 2. Division 16 Section "Seismic Controls for Electrical Work."
  - 3. Division 16 Section "Electrical Power Monitoring and Control."

#### 1.3 DEFINITIONS

- A. EMI: Electromagnetic interference.
- B. GFCI: Ground-fault circuit interrupter.
- C. RFI: Radio-frequency interference.
- D. RMS: Root mean square.
- E. SPDT: Single pole, double throw.
- F. TVSS: Transient voltage surge suppressor.

#### 1.4 SUBMITTALS

- A. Product Data: For each type of panelboard, overcurrent protective device, TVSS device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each panelboard and related equipment.
  - 1. Dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings. Include the following:

- a. Enclosure types and details for types other than NEMA 250, Type 1.
  - b. Bus configuration, current, and voltage ratings.
  - c. Short-circuit current rating of panelboards and overcurrent protective devices.
  - d. UL listing for series rating of installed devices.
  - e. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
2. Wiring Diagrams: Diagram power, signal, and control wiring and differentiate between manufacturer-installed and field-installed wiring.
- C. Manufacturer Seismic Qualification Certification: Submit certification that panelboards, overcurrent protective devices, accessories, and components will withstand seismic forces defined in Division 16 Section "Seismic Controls for Electrical Work." Include the following:
1. Basis of Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
  2. The term "withstand" means "the unit will remain in place without separation of internal and external parts during a seismic event."
  3. The term "withstand" means "the unit will remain in place without separation of internal and external parts during a seismic event and the unit will be fully operational after the event."
  4. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
  5. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- D. Qualification Data: Submit data for testing agencies indicating that they comply with qualifications specified in "Quality Assurance" Article.
- E. Field Test Reports: Submit written test reports and include the following:
1. Test procedures used.
  2. Test results that comply with requirements.
  3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
- F. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.
- G. Maintenance Data: For panelboards and components to include in maintenance manuals specified in Division 1. In addition to requirements specified in Division 1 Section "Contract Closeout," include the following:
1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
  2. Time-current curves, including selectable ranges for each type of overcurrent protective device.
- 1.5 QUALITY ASSURANCE
- A. Testing Agency Qualifications: Testing agency that is a member company of the InterNational Electrical Testing Association and that is acceptable to authorities having jurisdiction.
1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

- 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 NEMA PB 1.
- D. Comply with NFPA 70.

#### 1.6 COORDINATION

- A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, and encumbrances to workspace clearance requirements.

#### 1.7 EXTRA MATERIALS

- A. Keys: (4) Four spares of each type of panelboard cabinet lock.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Panelboards, Overcurrent Protective Devices, Controllers, Contactors, and Accessories:
    - a. Cutler-Hammer Products.
    - b. General Electric Co.; Electrical Distribution & Control Div.
    - c. Siemens Energy & Automation, Inc.
    - d. Square D Co.
  - 2. TVSS Panelboards:
    - a. Current Technology, Inc.
    - b. Liebert Corporation.

#### 2.2 FABRICATION AND FEATURES

- A. Enclosures: Flush Surface (as noted) Flush- and surface-mounted cabinets. NEMA PB 1, Type 1, to meet environmental conditions at installed location.
  - 1. Outdoor Locations: NEMA 250, Type 4X Stainless Steel.
  - 2. Kitchen Areas: NEMA 250, Type 4X, stainless steel.
  - 3. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
  - 4. Hazardous Areas Indicated on Drawings: NEMA 250, Type 7C.

- B. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
- C. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
- D. Finish: Manufacturer's standard enamel finish over corrosion-resistant treatment or primer coat.
- E. Directory Card: With transparent protective cover, mounted inside metal frame, inside panelboard door.
- F. Bus: Hard-drawn copper, 98 percent conductivity.
- G. Main and Neutral Lugs: Mechanical type suitable for use with conductor material.
- H. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment ground conductors; bonded to box.
- I. Service Equipment Label: UL labeled for use as service equipment for panelboards with main service disconnect switches.
- J. Future Devices: Mounting brackets, bus connections, and necessary appurtenances required for future installation of devices.
- K. Isolated Equipment Ground Bus: Adequate for branch-circuit equipment ground conductors; insulated from box.
- L. Extra-Capacity Neutral Bus: Neutral bus rated 200 percent of phase bus and UL listed as suitable for nonlinear loads.
- M. Split Bus: Vertical buses divided into individual vertical sections.
- N. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.
- O. Gutter Barrier: Arrange to isolate individual panel sections.
- P. Column-Type Panelboards: Narrow gutter extension, with cover, to overhead junction box equipped with ground and neutral terminal buses.
- Q. Feed-through Lugs: [Compression] [Mechanical] type suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.

### 2.3 PANELBOARD SHORT-CIRCUIT RATING

- A. UL label indicating series-connected rating with integral or remote upstream devices. Include size and type of upstream device allowable, branch devices allowable, and UL series-connected short-circuit rating.
- B. Fully rated to interrupt symmetrical short-circuit current available at terminals.

### 2.4 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

- B. Doors: Front mounted with concealed hinges; secured with flush latch with tumbler lock; keyed alike.

## 2.5 DISTRIBUTION PANELBOARDS

- A. Doors: Front mounted, except omit in fused-switch panelboards; secured with vault-type latch with tumbler lock; keyed alike.
- B. Main Overcurrent Protective Devices: Circuit breaker.
- C. Branch overcurrent protective devices shall be one of the following:
  - 1. For Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.
  - 2. For Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.
  - 3. Fused switches.

## 2.6 OVERCURRENT PROTECTIVE DEVICES

- A. Molded-Case Circuit Breaker: NEMA AB 1, with interrupting capacity to meet available fault currents.
  - 1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
  - 2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
  - 3. Electronic Trip Unit Circuit Breakers: RMS sensing; field-replaceable rating plug; with the following field-adjustable settings:
    - a. Instantaneous trip.
    - b. Long- and short-time pickup levels.
    - c. Long- and short-time time adjustments.
    - d. Ground-fault pickup level, time delay, and  $I^2t$  response.
  - 4. GFCI Circuit Breakers: Single- and two-pole configurations with 5 30-mA trip sensitivity, adjustable to coordinate w/down stream unit..
- B. Molded-Case Circuit-Breaker Features and Accessories. Standard frame sizes, trip ratings, and number of poles.
  - 1. Lugs: Mechanical style, suitable for number, size, trip ratings, and material of conductors.
  - 2. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HACR, air-conditioning, and refrigerating equipment.
  - 3. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
  - 4. Communication Capability: Circuit-breaker-mounted communication module with functions and features compatible with power monitoring and control system.
  - 5. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 75 percent of rated voltage.
  - 6. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage with field-adjustable 0.1- to 0.6-second time delay.
  - 7. Auxiliary Switch: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
  - 8. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.



9. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.

C. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.

## 2.7 CONTROLLERS

A. Motor Controllers: NEMA ICS 2, Class A combination controller equipped for panelboard mounting and including the following accessories:

1. Individual control-power transformers.
2. Fuses for control-power transformers.
3. Bimetallic-element overload relay.
4. Melting-alloy overload relay.
5. Indicating lights.
6. Seal-in contact.
7. Two (2) convertible auxiliary contacts.
8. Push buttons.
9. Selector switches.

B. Contactors: NEMA ICS 2, Class A combination controller equipped for panelboard mounting and including the following accessories:

1. Individual control-power transformers.
2. Fuses for control-power transformers.
3. Indicating lights.
4. Seal-in contact.
5. Two (2) convertible auxiliary contacts.
6. Push buttons.
7. Selector switches.

C. Controller Disconnect Switches: Type as shown on drawings interlocked with controller.

1. Auxiliary Contacts: Integral with disconnect switches to de-energize external control-power source.

D. Contactors in Main Bus: NEMA ICS 2, Class A, mechanically held general-purpose controller.

1. Control-Power Source: Control-power transformer, with fused primary and secondary terminals, connected to main bus ahead of contactor connection.

## 2.8 ACCESSORY COMPONENTS AND FEATURES

A. Accessory Set: Tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

B. Portable Test Set: To test functions of solid-state trip devices without removal from panelboard.

C. Fungus Proofing: Permanent fungicidal treatment for panelboard interior, including overcurrent protective devices and other components.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install panelboards and accessories according to NEMA PB 1.1.
- B. Comply with mounting and anchoring requirements specified in Division 16 Section "Seismic Controls for Electrical Work."
- C. Mounting Heights: Top of trim **74 inches (1880 mm)** above finished floor, unless otherwise indicated.
- D. Mounting: Plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish.
- E. Circuit Directory: Create a directory to indicate installed circuit loads after balancing panelboard loads. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.
- F. Install filler plates in unused spaces.
- G. Provision for Future Circuits at Flush Panelboards: Stub four **1-inch (27-GRC)** empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four **1-inch (27-GRC)** empty conduits into raised floor space or below slab not on grade.
- H. Wiring in Panelboard Gutters: Arrange conductors into groups and bundle and wrap with wire ties after completing load balancing.

### 3.2 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 16 Section "Basic Electrical Materials and Methods."
- B. Panelboard Nameplates: Label each panelboard with engraved metal or laminated-plastic nameplate mounted with corrosion-resistant screws.

### 3.3 CONNECTIONS

- A. Install equipment grounding connections for panelboards with ground continuity to main electrical ground bus.
- B. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

### 3.4 FIELD QUALITY CONTROL

- A. Prepare for acceptance tests as follows:
  - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
  - 2. Test continuity of each circuit.

- B. Testing: After installing panelboards and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.
  - 1. Procedures: Perform each visual and mechanical inspection and electrical test indicated in NETA ATS, Section 7.5 for switches and Section 7.6 for molded-case circuit breakers. Certify compliance with test parameters.
  - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
  
- C. Balancing Loads: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes as follows:
  - 1. Measure as directed during period of normal system loading.
  - 2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data-processing, computing, transmitting, and receiving equipment.
  - 3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
  - 4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.
  
- D. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each panelboard. Remove panel fronts so joints and connections are accessible to portable scanner.
  - 1. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
  - 2. Record of Infrared Scanning: Prepare a certified report that identifies panelboards checked and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

### 3.5 ADJUSTING

- A. Set field-adjustable switches and circuit-breaker trip ranges.

### 3.6 CLEANING

- A. On completion of installation, inspect interior and exterior of panelboards. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

END OF SECTION 16442

## SECTION 16461 - DRY-TYPE TRANSFORMERS (1000 V AND LESS)

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes dry-type distribution and specialty transformers rated 1000 V and less.

#### 1.3 SUBMITTALS

- A. Product Data: Include data on features, components, ratings, and performance for each type of transformer specified. Include dimensioned plans, sections, and elevation views. Show minimum clearances and installed devices and features.
- B. Wiring Diagrams: Detail wiring and identify terminals for tap changing and connecting field-installed wiring.
- C. Product Certificates: Signed by manufacturers of transformers certifying that the products furnished comply with requirements.
- D. Qualification Data: For firms and persons specified in "Quality Assurance" Article.
- E. Factory Test Reports: Certified copies of manufacturer's design and routine factory tests required by referenced standards.
- F. Sound-Level Test Reports: Certified copies of manufacturer's sound-level tests applicable to equipment for this Project.
- G. Field Test Reports: Indicate and interpret test results for tests specified in Part 3.
- H. Maintenance Data: For transformers to include in the maintenance manuals specified in Division 1.

#### 1.4 QUALITY ASSURANCE

- A. Testing Agency Qualifications: In addition to requirements specified in Division 1 Section "Quality Control," an independent testing agency shall meet OSHA criteria for accreditation of testing laboratories, Title 29, Part 1907; or shall be a full-member company of the InterNational Electrical Testing Association.
  - 1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies, to supervise on-site testing specified in Part 3.
- B. Listing and Labeling: Provide transformers specified in this Section that are listed and labeled.

1. The Terms "Listed" and "Labeled": As defined in NFPA 70, Article 100.
2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" as defined in OSHA Regulation 1910.7.

C. Comply with IEEE C2.

D. Comply with NFPA 70.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Temporary Heating: Apply temporary heat according to manufacturer's written instructions within the enclosure of each ventilated-type unit throughout periods during which equipment is not energized and is not in a space that is continuously under normal control of temperature and humidity.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering transformers that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide transformers by one the following:

1. Acme Electric Corp.; Transformer Division.
2. Bryant Electric.
3. Challenger Electrical Equipment Corp.
4. Computer Power Inc.
5. Controlled Power Co.
6. Cutler-Hammer/Eaton Corp.
7. Federal Pacific Co.; Line Power Mfg. Corp. Subsidiary.
8. GE Electrical Distribution & Control.
9. Hammond Co.; Matra Electric, Inc.
10. MagneTek Inc.
11. Micron Industries Corp.
12. Siemens Energy & Automation, Inc.
13. Sola/Hevi-Duty Electric.
14. Square D; Groupe Schneider.
15. Uptegraff: R.E. Uptegraff Mfg. Co.
16. Virginia Transformer Corp.

#### 2.2 TRANSFORMERS, GENERAL

A. Description: Factory-assembled and -tested, air-cooled units of types specified, designed for 60-Hz service.

B. Cores: Grain-oriented, nonaging silicon steel.

C. Coils: Continuous windings without splices, except for taps.

D. Internal Coil Connections: Brazed or pressure type.

- E. Enclosure: Class complies with NEMA 250 for the environment in which installed.
- F. Low-Sound-Level Units: Minimum of 3 dBA less than NEMA ST 20 standard sound levels when factory tested according to IEEE C57.12.91.

### 2.3 GENERAL-PURPOSE DISTRIBUTION AND POWER TRANSFORMERS

- A. Comply with NEMA ST 20 and list and label as complying with UL 1561.
- B. Cores: One leg per phase.
- C. Windings: One coil per phase in primary and secondary.
- D. Enclosure: Indoor, ventilated.
- E. Enclosure: Indoor, ventilated, dripproof.
- F. Enclosure: Outdoor, ventilated, raintight, NEMA 250, Type 3R.
- G. Enclosure: Totally enclosed, nonventilated.
- H. Enclosure: Totally enclosed, nonventilated, suitable for outdoor use.
- I. Insulation Class: 185 or 220 deg C class for transformers 15 kVA or smaller; 220 deg C class for transformers larger than 15 kVA.
  - 1. Rated Temperature Rise: 80 deg C maximum rise above 40 deg C.
  - 2. Rated Temperature Rise: 115 deg C maximum rise above 40 deg C.
  - 3. Rated Temperature Rise: 150 deg C maximum rise above 40 deg C, for 220 deg C class insulation; 115 deg C maximum rise for 185 deg C class insulation.
- J. Taps: For transformers 3 kVA and larger, full-capacity taps in high-voltage windings are as follows:
  - 1. Taps, 3 through 25 kVA: Two 5-percent taps below rated high voltage.
  - 2. Taps, 3 through 10 kVA: Two 5-percent taps below rated high voltage.
  - 3. Taps, 15 through 500 kVA: Six 2.5-percent taps, 2 above and 4 below rated high voltage.
  - 4. Taps, 750 kVA and Above: Four 2.5-percent taps, 2 above and 2 below rated high voltage.
- K. K-Factor Rating: Transformers indicated to be K-factor rated are listed to comply with UL 1561 requirements for nonsinusoidal load current handling capability to the degree defined by the designated K-factor.
  - 1. Transformer design prevents overheating when carrying full load with harmonic content corresponding to the designated K-factor.
  - 2. Nameplate states the designated K-factor of the transformer.
- L. Electrostatic Shielding: Each winding is independently single shielded with a full-width copper electrostatic shield arranged to minimize interwinding capacitance.
  - 1. Coil leads and terminal strips are arranged to minimize capacitive coupling between input and output connections.
  - 2. Shield Terminal: Separate; marked "Shield" for grounding connection.
  - 3. Capacitance: Shield limits capacitance between primary and secondary to a maximum of 33 picofarads over a frequency range of 20 Hz to 1 MHz.

4. Common-Mode Noise Attenuation: Minus 120 dB minimum, 0.5 to 1.5 kHz; minus 65 dB minimum, 1.5 to 100 kHz.
5. Normal-Mode Noise Attenuation: Minus 52 dB minimum, 1.5 to 10 kHz.

M. Wall-Mounting Brackets: Manufacturer's standard brackets for transformers up to 75 kVA.

N. Fungus Proofing: Permanent fungicidal treatment for coil and core.

#### 2.4 BUCK-BOOST TRANSFORMERS

A. Units comply with NEMA ST 1 and are listed and labeled as complying with UL 506 or UL 1561.

B. Description: Self-cooled dry type, rated for continuous duty, and connected as autotransformers to provide the percentage of buck or boost indicated.

#### 2.5 CONTROL AND SIGNAL TRANSFORMERS

A. Units comply with NEMA ST 1 and are listed and labeled as complying with UL 506.

B. Ratings: Continuous duty. If rating is not indicated, provide capacity exceeding peak load by 50 percent minimum.

C. Description: Self-cooled, 2 windings.

#### 2.6 FINISHES

A. Indoor Units: Manufacturer's standard paint over corrosion-resistant pretreatment and primer.

B. Outdoor Units: Comply with ANSI C57.12.28.

#### 2.7 SOURCE QUALITY CONTROL

A. Factory Tests: Design and routine tests comply with referenced standards.

B. Factory Sound-Level Tests: Conduct sound-level tests on equipment for this Project if specified sound levels are below standard ratings.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

A. Comply with safety requirements of IEEE C2.

B. Arrange equipment to provide adequate spacing for access and for circulation of cooling air.

C. Identify transformers and install warning signs according to Division 16 Section "Electrical Identification."

- D. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

### 3.2 GROUNDING

- A. Separately Derived Systems: Comply with NFPA 70 requirements for connecting to grounding electrodes and for bonding to metallic piping near the transformer.
- B. Separately Derived Systems: Make grounding connections to grounding electrodes and bonding connections to metallic piping as indicated and to comply with NFPA 70.
- C. Comply with Division 16 Section "Grounding" for materials and installation requirements.

### 3.3 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to supervise the field assembly and connection of components, and the testing and adjusting of transformer components and accessories.
- B. Testing Agency: Owner will engage a qualified independent testing agency to perform field quality-control testing.
- C. Testing Agency: Engage a qualified independent testing agency to perform field quality-control testing.
- D. Test Objectives: To ensure transformer is operational within industry and manufacturer's tolerances, is installed according to the Contract Documents, and is suitable for energizing.
- E. Test Labeling: On satisfactory completion of tests for each transformer, attach a dated and signed "Satisfactory Test" label to tested component.
- F. Schedule tests and provide notification at least 7 days in advance of test commencement.
- G. Report: Submit a written report of observations and tests. Report defective materials and installation.
- H. Tests: Include the following minimum inspections and tests according to manufacturer's written instructions. Comply with IEEE C57.12.91 for test methods and data correction factors.
  - 1. Inspect accessible components for cleanliness, mechanical and electrical integrity, and damage or deterioration. Verify that temporary shipping bracing has been removed. Include internal inspection through access panels and covers.
  - 2. Inspect bolted electrical connections for tightness according to manufacturer's published torque values or, if not available, those specified in UL 486A and UL 486B.
  - 3. Insulation Resistance: Perform megohmmeter tests of primary and secondary winding to winding and winding to ground.
    - a. Minimum Test Voltage: 1000 V, dc.
    - b. Minimum Insulation Resistance: 500 megohms.
    - c. Duration of Each Test: 10 minutes.
    - d. Temperature Correction: Correct results for test temperature deviation from 20 deg C standard.
- I. Test Failures: Compare test results with specified performance or manufacturer's data. Correct deficiencies identified by tests and retest. Verify that transformers meet specified requirements.



### 3.4 CLEANING

- A. On completion of installation, inspect components. Remove paint splatters and other spots, dirt, and debris. Repair scratches and mars on finish to match original finish. Clean components internally using methods and materials recommended by manufacturer.

### 3.5 ADJUSTING

- A. After installing and cleaning, touch up scratches and mars on finish to match original finish.
- B. Adjust transformer taps to provide optimum voltage conditions at utilization equipment throughout normal operating cycle of facility. Record primary and secondary voltages and tap settings and submit with test results.
- C. Adjust buck-boost transformer connections to provide optimum voltage conditions at utilization equipment throughout normal operating cycle of facility.
- D. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in readjusting transformer tap settings to suit actual occupied conditions. Provide up to 2 visits to Project site for this purpose without additional cost.
  - 1. Voltage Recordings: Contractor performed. Provide up to 48 hours of recording on the low-voltage system of each medium-voltage transformer.
  - 2. Point of Measurement: Make voltage recordings at load outlets selected by Owner.

END OF SECTION 16461

## SECTION 16511 - INTERIOR LIGHTING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes interior lighting fixtures, lighting fixtures mounted on exterior building surfaces, lamps, ballasts, emergency lighting units, and accessories.
- B. Related Sections include the following:
  - 1. Division 16 Section "Lighting Control Equipment" for programmable lighting control systems, time switches, additional photoelectric relays, power relays, and contactors.

#### 1.3 SUBMITTALS

- A. Product Data: For each type of lighting fixture indicated, arranged in order of fixture designation. Include data on features, accessories, and the following:
  - 1. Dimensions of fixtures.
  - 2. Certified results of independent laboratory tests for fixtures and lamps for electrical ratings and photometric data.
  - 3. Certified results of laboratory tests for fixtures and lamps for photometric performance.
  - 4. Emergency lighting unit battery and charger.
  - 5. Fluorescent and high-intensity-discharge ballasts.
  - 6. Air and Thermal Performance Data: For air-handling fixtures. Furnish data required in "Submittals" Article in Division 15 Section "Diffusers, Registers, and Grilles."
  - 7. Sound Performance Data: For air-handling fixtures. Indicate sound power level and sound transmission class in test reports certified according to ADC.
  - 8. Types of lamps.
- B. Shop Drawings: Show details of nonstandard or custom fixtures. Indicate dimensions, weights, method of field assembly, components, features, and accessories.
  - 1. Wiring Diagrams: Detail wiring for fixtures and differentiate between manufacturer-installed and field-installed wiring.
- C. Coordination Drawings: Reflected ceiling plans and sections drawn to scale and coordinating fixture installation with ceiling grid, ceiling-mounted items, and other components in the vicinity. Include work of all trades that is to be installed near lighting equipment.
- D. Samples for Verification: For lighting fixtures designated for sample submission in the Interior Lighting Fixture Schedule.
  - 1. Lamps: Specified units installed.

2. Ballast: 120-V model of specified ballast type.
  3. Accessories: Cord and plug.
- E. Product Certificates: Signed by manufacturers of lighting fixtures certifying that products comply with requirements.
- F. Dimming Ballast Compatibility Certificates: Signed by manufacturer of ballast certifying that ballasts are compatible with dimming systems and equipment with which they are used.
- G. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.
- H. Maintenance Data: For lighting fixtures to include in maintenance manuals specified in Division 1.

#### 1.4 QUALITY ASSURANCE

- A. Fixtures, Emergency Lighting Units, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.
- B. Comply with NFPA 70.
- C. FM Compliance: Fixtures for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM.
- D. NFPA 101 Compliance: Comply with visibility and luminance requirements for exit signs.
- E. Mockups: Provide lighting fixtures for room or module mockups. Install fixtures for mockups with power and control connections.
1. Obtain Architect's approval of fixtures for mockups before starting installations.
  2. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
  3. Remove mockups when directed. Fixtures may be reinstalled in the Work with approval of Architect.
  4. Approved fixtures in mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

#### 1.5 COORDINATION

- A. Fixtures, Mounting Hardware, and Trim: Coordinate layout and installation of lighting fixtures with ceiling system and other construction.

#### 1.6 WARRANTY

- A. General Warranty: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Special Warranty for Batteries: Written warranty, executed by manufacturer agreeing to replace rechargeable batteries that fail in materials or workmanship within specified warranty period.

1. Special Warranty Period for Batteries: Manufacturer's standard, but not less than 10 years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for last nine years.
- C. Special Warranties for Fluorescent Ballasts: Written warranty, executed by manufacturer agreeing to replace fluorescent ballasts that fail in materials or workmanship within specified warranty period.
1. Special Warranty Period for Electronic Ballasts: Five years from date of manufacture, but not less than four years from date of Substantial Completion.
  2. Special Warranty Period for Electromagnetic Ballasts: Manufacturers' standard warranty, but not less than two years from date of manufacture.

## 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.
1. Lamps: 10 for every 100 of each type and rating installed. Furnish at least one of each type.
  2. Plastic Diffusers and Lenses: 1 for every 100 of each type and rating installed. Furnish at least one of each type.
  3. Battery and Charger Data: For emergency lighting units.
  4. Ballasts: 1 for every 100 of each type and rating installed. Furnish at least one of each type.
  5. Globes and Guards: 1 for every 20 of each type and rating installed. Furnish at least one of each type.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the products indicated in the Interior Lighting Fixture Schedule at the end of Part 3.
- B. Products: Subject to compliance with requirements, provide one of the products indicated for each designation in the Interior Lighting Fixture Schedule at the end of Part 3.

### 2.2 FIXTURES AND FIXTURE COMPONENTS, GENERAL

- A. Metal Parts: Free from burrs, sharp corners, and edges.
- B. Sheet Metal Components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging.
- C. Doors, Frames, and Other Internal Access: Smooth operating, free from light leakage under operating conditions, and arranged to permit relamping without use of tools. Arrange doors, frames, lenses, diffusers, and other pieces to prevent accidental falling during relamping and when secured in operating position.
- D. Reflecting Surfaces: Minimum reflectance as follows, unless otherwise indicated:
1. White Surfaces: 85 percent.

2. Specular Surfaces: 83 percent.
  3. Diffusing Specular Surfaces: 75 percent.
  4. Laminated Silver Metallized Film: 90 percent.
- E. Lenses, Diffusers, Covers, and Globes: 100 percent virgin acrylic plastic or annealed crystal glass, unless otherwise indicated.
1. Plastic: High resistance to yellowing and other changes due to aging, exposure to heat, and ultraviolet radiation.
  2. Lens Thickness: 0.125 inch (3 mm) minimum, unless greater thickness is indicated.
- F. Electromagnetic Interference Filters: Integral to fixture assembly. Provide one filter for each ballast. Suppress conducted electromagnetic interference filters as required by MIL-STD-461.
- G. Air-Handling Fixtures: For use with plenum ceiling for air return and heat extraction and for attaching an air-diffuser boot assembly specified in Division 15 Section "Diffusers, Registers, and Grilles."
1. Sound-Pressure Levels: Certified according to ADC.
  2. Air-Movement Performance Requirements: Certified according to ADC.
  3. Supply Units: Equip with slots in one or both side trims and join with air-diffuser boot assemblies.
  4. Heat Removal Units: An air path through lamp cavity.
  5. Dampers: Operable from outside fixture for control of return-air volume.
  6. Static Fixtures: Supply slots are blanked off, and fixture appearance matches active units.

## 2.3 FLUORESCENT LAMP BALLASTS

- A. General Requirements: Unless otherwise indicated, features include the following:
1. Designed for type and quantity of lamps indicated at full light output.
  2. Total Harmonic Distortion Rating: Less than 20 percent.
  3. Total Harmonic Distortion Rating: Less than 10 percent.
  4. Sound Rating: A.
- B. Electronic Ballasts for Linear Lamps: Unless otherwise indicated, features include the following, besides those in "General Requirements" Paragraph above:
1. Certified Ballast Manufacturer Certification: Indicated by label.
  2. Encapsulation: Without voids in potting compound.
  3. Parallel Lamp Circuits: Multiple lamp ballasts connected to maintain full light output on surviving lamps if one or more lamps fail.
- C. Ballasts for Compact Lamps : Unless otherwise indicated, additional features include the following:
1. Type: Electronic fully encapsulated in potting compound.
  2. Power Factor: 90 percent, minimum.
  3. Operating Frequency: 20 kHz or higher.
  4. Flicker: Less than 5 percent.
  5. Lamp Current Crest Factor: Less than 1.7.
  6. Transient Protection: Comply with IEEE C62.41 for Category A1 locations.
  7. Interference: Comply with 47 CFR, Chapter 1, Part 18, Subpart C for limitations on electromagnetic and radio-frequency interference for nonconsumer equipment.

- D. Ballasts for Dimmer-Controlled Fixtures: Comply with general and fixture-related requirements above for electronic ballasts.
  - 1. Compatibility: Certified by manufacturer for use with specific dimming system indicated for use with each dimming ballast.
- E. Ballasts for Low Electromagnetic Interference Environments: Comply with 47 CFR, Chapter 1, Part 18, Subpart C for limitations on electromagnetic and radio-frequency interference for consumer equipment.

## 2.4 HIGH-INTENSITY-DISCHARGE LAMP BALLASTS

- A. General: Comply with ANSI C82.4. Unless otherwise indicated, features include the following:
  - 1. Type: Constant wattage autotransformer or regulating high-power-factor type, unless otherwise indicated.
  - 2. Operating Voltage: Match system voltage.
  - 3. Minimum Starting Temperature: Minus 22 deg F (Minus 30 deg C) for single lamp ballasts.
  - 4. Normal Ambient Operating Temperature: 104 deg F (40 deg C).
  - 5. Open-circuit operation that will not reduce average life.
  - 6. Auxiliary, Instant-on, Quartz System: Automatically switches quartz lamp on when fixture is initially energized and when momentary power outages occur. Automatically turns quartz lamp off when high-intensity-discharge lamp reaches approximately 60 percent light output.
- B. Encapsulation: Manufacturer's standard epoxy-encapsulated model designed to minimize audible fixture noise.
- C. High-Pressure Sodium Ballasts: Equip with a solid-state igniter/starter having an average life in pulsing mode of 10,000 hours at an igniter/starter case temperature of 90 deg C.
  - 1. Instant Restrike Device: Solid-state, potted module, mounted inside high-pressure sodium fixture and compatible with high-pressure sodium lamps, ballasts, and sockets up to 150 W.
    - a. Restrike Range: 105- to 130-V ac.
    - b. Maximum Voltage: 250-V peak or 150-V ac RMS.

## 2.5 EXIT SIGNS

- A. General Requirements: Comply with UL 924 and the following:
  - 1. Sign Colors and Lettering Size: Comply with authorities having jurisdiction.
- B. Internally Lighted Signs: As follows:
  - 1. Lamps for AC Operation: Light-emitting diodes, 70,000 hours minimum rated lamp life.
  - 2. Additional Lamps for DC Operation: Two minimum, bayonet-base type, for connection to external dc source.
- C. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.
  - 1. Battery: Sealed, maintenance-free, nickel-cadmium type with special warranty.
  - 2. Charger: Fully automatic, solid-state type with sealed transfer relay.
  - 3. Operation: Relay automatically energizes lamp from unit when circuit voltage drops to 80 percent of nominal or below. When normal voltage is restored, relay disconnects lamps, and battery is automatically recharged and floated on charger.

## 2.6 EMERGENCY LIGHTING UNITS

- A. General Requirements: Self-contained units. Comply with UL 924. Units include the following features:
1. Battery: Sealed, maintenance-free, lead-acid type with minimum 10-year nominal life and special warranty.
  2. Charger: Fully automatic, solid-state type with sealed transfer relay.
  3. Operation: Relay automatically turns lamp on when supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps, and battery is automatically recharged and floated on charger.
  4. Wire Guard: Where indicated, heavy-chrome-plated wire guard arranged to protect lamp heads or fixtures.
  5. Integral Time-Delay Relay: Arranged to hold unit on for fixed interval after restoring power after an outage. Provides adequate time delay to permit high-intensity-discharge lamps to restrike and develop adequate output.

## 2.7 LAMPS

- A. Fluorescent Color Temperature and Minimum Color-Rendering Index: 3500 K and 85 CRI, unless otherwise indicated.
- B. Noncompact Fluorescent Lamp Life: Rated average is 20,000 hours at 3 hours per start when used on rapid-start circuits.
- C. Metal-Halide Color Temperature and Minimum Color-Rendering Index: 3600 K and 70 CRI, unless otherwise indicated.

## 2.8 FIXTURE SUPPORT COMPONENTS

- A. Comply with Division 16 Section "Basic Electrical Materials and Methods," for channel- and angle-iron supports and nonmetallic channel and angle supports.
- B. Single-Stem Hangers: **1/2-inch (12-mm)** steel tubing with swivel ball fitting and ceiling canopy. Finish same as fixture.
- C. Twin-Stem Hangers: Two, **1/2-inch (12-mm)** steel tubes with single canopy arranged to mount a single fixture. Finish same as fixture.
- D. Rod Hangers: **3/16-inch- (5-mm-)** minimum diameter, cadmium-plated, threaded steel rod.
- E. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.
- F. Aircraft Cable Support: Use cable, anchorages, and intermediate supports recommended by fixture manufacturer.

## 2.9 FINISHES

- A. Fixtures: Manufacturer's standard, unless otherwise indicated.

1. Paint Finish: Applied over corrosion-resistant treatment or primer, free of defects.
2. Metallic Finish: Corrosion resistant.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Fixtures: Set level, plumb, and square with ceiling and walls, and secure according to manufacturer's written instructions and approved submittal materials. Install lamps in each fixture.
- B. Support for Fixtures in or on Grid-Type Suspended Ceilings: Use grid for support.
  1. Install a minimum of four ceiling support system rods or wires for each fixture. Locate not more than **6 inches (150 mm)** from fixture corners.
  2. Fixtures of Sizes Less Than Ceiling Grid: Arrange as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two **3/4-inch (20-mm)** metal channels spanning and secured to ceiling tees.
- C. Suspended Fixture Support: As follows:
  1. Pendants and Rods: Where longer than **48 inches (1200 mm)**, brace to limit swinging.
  2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
  3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.
  4. Continuous Rows: Suspend from cable installed according to fixture manufacturer's written instructions and details on Drawings.
- D. Air-Handling Fixtures: Install with dampers closed.

### 3.2 CONNECTIONS

- A. Ground equipment.
  1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

### 3.3 FIELD QUALITY CONTROL

- A. Inspect each installed fixture for damage. Replace damaged fixtures and components.
- B. Advance Notice: Give dates and times for field tests.
- C. Provide instruments to make and record test results.
- D. Tests: As follows:
  1. Verify normal operation of each fixture after installation.
  2. Emergency Lighting: Interrupt electrical supply to demonstrate proper operation.
  3. Verify normal transfer to battery source and retransfer to normal.
  4. Report results in writing.



- E. Malfunctioning Fixtures and Components: Replace or repair, then retest. Repeat procedure until units operate properly.
- F. Corrosive Fixtures: Replace during warranty period.

#### 3.4 CLEANING AND ADJUSTING

- A. Clean fixtures internally and externally after installation. Use methods and materials recommended by manufacturer.
- B. Adjust aimable fixtures to provide required light intensities.

END OF SECTION 16511

## SECTION 16721 – FIRE ALARM SYSTEM

### Part 1 - General

#### 1.1 Scope

- A. Work covered by this specification section includes the furnishing of labor, equipment, materials, and complete operational performance required for installation of the Fire Alarm System Network as shown on the drawings, as here specified, and as directed by the Architect/Engineer.
- B. The Fire Alarm System shall consist of all necessary hardware and software equipment to perform the following functions:
  - 1. Fire Alarm and Detection Operations
  - 2. Remote Manual and Automatic Control of Elevators, remote monitoring of sprinkler, fire pump and emergency power systems.
  - 3. “Tripping” of main disconnect enclosed circuit breaker at elevator machine rooms.
- C. Each item of the Fire Alarm System shall be listed as a product of a single fire alarm system manufacturer under the appropriate category by Underwriters' Laboratories, Inc. (UL), and shall bear the UL label. All Control Equipment shall be listed under UL category UOJZ.

The complete installation shall conform to the applicable sections of NFPA-72D, NEC 760, Life Safety Code 101, and Local Code Requirements.

- D. In addition to the UL-UOJZ requirement mentioned above, the system controls shall be UL listed for Power Limited Applications per NEC 760. All circuits must be marked in accordance with NEC article 760-23.
- E. Nodes as defined for this specification shall be intelligent, microprocessor based devices that connect to, and handle network communications in a peer-to-peer manner. In order to maintain network integrity, systems using a single master with remote slave units will not be acceptable. Decisions pertinent to the network shall be distributed among the nodes such that there is no need for a central controller.
- F. By programmable selection at each node:
  - 1. The specific detail information of any point connected to any node in the network may be made accessible (declared public) to the network.
  - 2. Any public point information may be incorporated into the custom control program of any node and operated upon as though that point was physically connected to that node.
  - 3. Points within each node shall be able to be grouped by area, type of device, type of function, or any other user selectable category, and custom labeled as a point list. A point list shall be acted upon as though it was a point for purposes of interaction with the node custom control program. Detail information shall not burden the point list messages, only the quantity and type of status shall be broadcast into the network.

#### 1.2 General

- A. Furnish and install all networked fire alarm system equipment as defined by these specifications, to be wired, connected, and left in first class operating condition.

- B. Network operations shall be via communication links that connect all network nodes and include data transfer, an audio signalling bus serving all remote primary and backup amplifiers and a two-way phone communications bus serving all individually controlled fire phone circuits. All communications trunk wiring shall be electrically supervised.
- C. The network shall operate using half-duplex, digital RS485 communication techniques at a data rate of 57.6 Kbaud. Communications shall be via twisted and shielded #18 AWG wire in combination with fiber optic communications.

### 1.3 Submittals

- A. Complete description data indicating UL listing for all network components.
- B. Complete sequence of operation of all functions of the network.
- C. A list of every network node address.
- D. A list of every address of every device connected to a network node that is provided for purposes of alarm initiation, status monitoring, supervised notification appliance circuits, and auxiliary control.
- E. Complete network wiring diagrams for all components and interfaces to equipment supplied by others.
- F. A listing of the manufacturer's representatives responsible for installation coordination and service.
- G. Location of all controls, alarm actuating devices and notification appliance devices as shown on drawings.
- H. Systems not capable of complete network interface operations as described in this specification shall supply a complete local area or wide area network with CRT/terminals at each location and shall obtain UL site certification and approval prior to the completion date. Certification shall not delay final system acceptance.

### 1.4 Network Operation

- A. Network communication details shall be per the following:
  - 1. Each node shall communicate to the next in a token ring configuration at 57.6 Kbaud.
  - 2. In the event that the path to the next node on the ring has experienced a communications failure, the node with possession of the token shall transmit it back in the direction from which it came to attempt to reach the next node by going around the ring in the opposite direction. At the same time, the status of the noncommunicating node shall be added into the token content.
  - 3. The fiber optic communication method shall be NFPA 72 style 7.
  - 4. If a group of nodes becomes isolated from the rest of the network ring, that group shall form a sub-network with all common interaction of monitoring and control remaining intact. The network shall be notified with the exact details of the lost communications.
  - 5. In the event that a single node becomes unable to handle the network token, the network interface card shall continue communications to the rest of the network. The off-line node is reported as such to the network and is periodically interrogated to determine if it is ready to be brought back on-line with the rest of the network.
- B. Network operation for any manual or automatic fire alarm initiating device activation shall be as follows:

1. The node connected to the alarmed device shall operate in accordance with its programmed response.
2. When the network token message reaches that node, it shall be updated with the alarm condition to include:
  - a. Public point node identification and point location.
  - b. Non-public point node identification.
  - c. The red ALARM LED shall flash on the monitoring node, and on all connected network nodes programmed to recognize that alarm, until the alarm has been manually acknowledged. When the alarm has been acknowledged, this same LED shall latch on. A subsequent alarm received after any acknowledgment shall again flash the same LEDs.
  - d. The source of alarm shall be annunciated via English language description on the alphanumeric display at the monitoring node and all other nodes programmed to respond to that alarm.
  - e. All nodes shall respond to the alarm information in accordance with their individually programmed response which may include operation of control functions both connected to that node and on other nodes if public.
  - f. All alarm conditions shall be visually indicated at the owner node and at all remote annunciators as programmed.
  - g. All alarms shall be recorded with the time and date on the designated network printer.
  - h. Any smoke detection Alarm Verification timing shall be performed by the owner node in accordance with that node's pre-programmed operation.
  - i. The network operation shall be such that the alarm operation of any alarm initiating device shall not prevent the subsequent alarm operation of any other initiating device due to wiring or power limitations.

C. Time Keeping.

Network time synchronization with seconds resolution accuracy shall be provided by designating one node as the network timekeeper. This node shall notify the network of authorized time and date changes. During periods without any time or date changes, the network timekeeper shall maintain network time synchronization by network communication once every 24 hours. In the event that the network timekeeper is unable to communicate the correct time, each node shall maintain its own local time and date reference using an internal, crystal controlled oscillator.

D. Smoke Control

Network communications shall activate any and all nodes programmed for control and/or signalling of dedicated supply and exhaust fans and/or HVAC network panel in an alarm situation.

E. Elevator Recall

Network communications shall activate any and all nodes programmed for control of all required elevator recall operations. When alarms are reported, either manually or automatically, control

relays at the designated nodes and connected to the elevator control circuitry shall energize and the elevators shall be recalled to the ground floor for fire fighters use. Should the fire be on the ground floor the elevators shall be sent to the alternate safe floor all per programming at the applicable nodes.

F. Elevator Machine Rooms

Heat detectors at elevator machine rooms shall be combination fixed temp/rate of rise type with a base mounted relay module. Fixed temp rating shall be lower than the rating of the sprinkler heads inside the machine room. Upon activation of any heat detector the relay base shall be activated in order to send a "trip" signal to the main disconnect enclosed circuit breaker and an alarm signal shall be send to the main control panel.

## 1.5 Network Equipment

A. Network Display Unit, 2500 NDU, shall contain the following features:

1. 80 column by 2 line back-lighted LCD readout of point status.
2. Capacity to annunciate 2500 network point and/or point lists.
3. Multiple NDUs shall be capable of being installed as needed to vector point information by type, location, or other qualifier.
4. Programming and interface flexibility shall be similar to the 4120 control panel.
5. Historical event logs shall maintain 1200 events.
6. RS232 ports shall be provided to:
  - a. Interface to CRT/keyboards to access network information and perform control as programmed at the NDU.
  - b. Interface to serial printer to record network information as programmed at the NDU.

C. Network Nodes, 4120 Fire Alarm Control Panels

1. 4120 Control panels shall be microprocessor based, housed in an all metal cabinet suitable for wall mounting, either semi-flush or surface. Each control panel shall be an NFPA 72, stand-alone, complete fire alarm control panel with communications into the network.
2. Each 4120 Control Panel shall be a specially configured Simplex 4100 series Control Panel with a network interface card and custom network programming capabilities.
3. Selected network nodes, in addition to being stand-alone NFPA 72 fire alarm control panels, shall be approved by Factory Mutual Research Corp. (FM) for Fixed Extinguishing (Agent) System Release.
4. All points monitored and controlled by the 4120 Control panel shall be capable of being made available to the network by being programmed as "Public". Such points shall include: initiating circuit devices such as TrueAlarm™ analog sensors, including sensor type and sensor values; conventional addressable or zone connected smoke and heat detectors; addressable manual fire alarm pull stations; supervisory operation, such as for

sprinkler flow and tamper monitoring; control circuits, such as for notification appliances, fan control, elevator control, and other similar operations.

5. Each point made public to the network may be programmed to be operated by any other 4120 Control panel connected to the network. When point information is programmed into a node other than the "owner", a "replica" of that point is programmed into the other node. When a replica is so programmed, the node with the replica can operate on those points as though they were directly connected to that node.
6. Network communications shall be capable of supporting "point lists" that can be handled as though they were a single point.
  - a. When any point in the list enters into an off-normal condition, the list is annunciated as in that condition.
  - b. The network message shall include the point list name, the point list status, and the number of devices in that status.
  - c. The network message shall not be burdened with detail information on each point in the point list. If such information is needed by the network, the points required shall be declared public and programmed accordingly.
  - d. Individual point information is available either by inquiry at the owner node, or by accessing the point if it is public and programmed as external at the inquiring node.

D. 4120 Universal Transponders

1. The network shall be capable of interfacing to 4120 series Universal Transponders (UT). This transponder shall operate in a conventional multiplex master/slave fashion in that it shall not contain sufficient feature for performing as a stand-alone NFPA 72 control panel.
2. Network communications shall connect the UT to the node(s) necessary to provide the annunciation, user interface, or control required to incorporate the UT into the network fire alarm system operation.
3. The UT shall be equipped with a subset of features as found in the 4120 control panel section.

**END OF SECTION 16721**

